An tairseach (threshold) : an exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education

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An Tairseach (Threshold):
An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education

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ABSTRACT

This thesis explores ways of connecting the emerging scientific story of the universe to authentic primary school environmental education, in Catholic education. More specifically, the study sought to understand the extent to which students’ environmental values could be informed and extended through the impacts of a pedagogical intervention around the scientific origin story.

There is clear evidence that international, national and whole-systems policy documents address the need for holistic, interdisciplinary and values-based environmental education. Existing literature also identifies a clear mandate from Catholic Church official teachings and documents for Catholic schools to foster ecological consciousness and conversion. Values are embedded as foundational to the development of the Australian Curriculum, with sustainability named as a cross-curriculum priority for Australian education. However, there is evidence in research literature, if a wider worldview is not introduced, that students’ environmental values are permeated by their own culture’s historical metaphors and story. In particular, evidence suggests that anthropocentric thinking can be addressed through the transdisciplinary nature and socioecological impacts of an understanding of the place of the anthropocene within the deep time of the emerging scientific story of the universe.

The theoretical framework of this study is grounded in socioecological education, linking environmental values to whole systems thinking and curriculum theory. In underpinning the study to transdisciplinary learning, students could incorporate an understanding of the deep time of the history of the universe, around the interconnected interrelationships of ecological, social, economic and holistic perspectives of socioecological education.

The research methodology of this study was qualitative, applying an action-based methodology. The methods consisted of semi-structured interviews, conducted before, during and after the implementation of a Big History pedagogical program with 8- to 9-year-old students and their teacher. Data were gathered from student writing, recorded research journal observations, semi-
structured interviews and child-framed deep learning opportunities on the shared understanding with children that both the classroom teacher, and myself as researcher, were lead learners in the classroom.

Analysis of data centred on a cyclical model, based on the developing complexity of the unfolding universe story. Student values were interpreted in the context of the local school setting. Qualitative analysis of these interviews indicated that primary students could successfully access Big History, which provided them with a shared, evidence-based and flexible narrative for future learning. They were then able to apply this narrative as a framework for whole-systems based, socioecological learning. Five interdependent themes were identified as significant to the conclusions for the study: students’ growth in critical knowledge, local school values, Catholic cultural setting, transdisciplinary learning and socioecological learning.

The power of transdisciplinary Big History learning was foundational to the research conclusions in that it allowed students to engage in meaningful discussions, integrating shared knowledge of their own origin stories alongside knowledge from both their Catholic teaching and their local school values. As the pedagogical intervention progressed, the research findings showed that children realised their new Big History learning needed a holistic, rather than a siloed approach that informed environmental values and in turn embraced socioecological learning.

The study affirms that the impacts of employing Big History as a teaching vehicle for the scientific universe story achieved a cohesive, wider worldview for primary-aged learners, empowering them to engage in transformative, socioecological thinking for the future. These findings have wider implications for systems-wide education and curricula development, providing evidence that Big History is accessible and relevant to primary-aged students where environmental education is not taught as a silo discipline, but as a transdisciplinary based and socioecological learning structure.
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DEDICATION

For every primary school child.

Every child needs to hear:

You came out of the energy

that gave birth to the Universe.

It is your beginning that fashioned the galaxies:

It is alive within you.

- Swimme, 1990, np
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I thank my extended family, work colleagues and my friends for their friendship, support and encouragement. At times, when I felt I had lost the path, your unstinting faith that I would complete my thesis signposted the completion of the journey for me.

Professional editor, John McAndrew, provided copyediting and proofreading services, according to the guidelines laid out in the university-endorsed national ‘Guidelines for editing research theses’.
DECLARATION

I certify that the work presented in this thesis is, to the best of my knowledge and belief, original, except as acknowledged in the text, and that the material has not been submitted, either in whole or in part, for a degree at this or any other university.

I acknowledge that I have read and understood the University's rules, requirements, procedures and policy relating to my higher degree research award and to my thesis. I certify that I have complied with the rules, requirements, procedures and policy of the University (as they may be from time to time).

Marilyn Therese Ahearn
Prologue: The Emerging Story Of Our Universe

My dearest Earthlings,

You may not know me. We haven't talked before. I am the Universe and it's time for us to get to know each other. After all I'm 13 billion years old now, give or take a few billion years ...

Now, my dear Earthlings, make yourselves comfortable and let's begin at the very beginning... (Morgan, 2002, Prologue, np).

... back 13.7 billion years to the beginning of time. Around us there's nothing. There's not even time or space. Imagine the darkest, emptiest thing you can and cube it a gazillion times and that's where we are. And then suddenly, bang! A universe appears, an entire universe. And we've crossed our first threshold. The universe is tiny; it's smaller than an atom. It's incredibly hot. It contains everything that's in today's universe, so you can imagine, it's busting, and it's expanding at incredible speed. And at first it's just a blur, but very quickly distinct things begin to appear in that blur. Within the first second, energy itself shatters into distinct forces including electromagnetism and gravity. And energy does something else quite magical, it congeals to form matter -- quarks that will create protons and leptons that include electrons. And all of that happens in the first second.

Now we move forward 380,000 years. That's twice as long as humans have been on this planet. And now simple atoms of hydrogen and helium appear. Now I want to pause for a moment because we actually know quite a lot about the universe at this stage. We know above all that it was extremely simple. It consisted of huge clouds of hydrogen and helium atoms, and they have no structure ... but that's not completely true. Recent studies by satellites ... have shown that, in fact, there are just tiny differences in that background ... enough for the universe to move on to the next stage of building complexity.

And this is how it works. Gravity is more powerful where there's more stuff. So where you get slightly denser areas, gravity starts compacting clouds of hydrogen and helium atoms. So we can imagine the early universe breaking up into a billion clouds. And each cloud is compacted, gravity gets more powerful as density increases, the temperature begins to rise at the center of each cloud ... and crosses the threshold temperature of 10 million degrees, protons start to fuse, there's a huge release of energy, and, bang! We have our first stars. From about 200 million years after the Big Bang, stars begin to appear all through the universe, billions of them. And the universe is now significantly more interesting and more complex.

Stars will create the Goldilocks conditions for crossing two new thresholds. When very large stars die, they create temperatures so high that protons begin to fuse in all sorts of exotic combinations, to form all the elements of the periodic table. So now the universe is chemically more complex ... and it's possible to make more things. And what starts happening is that, around young suns, young stars, all these elements combine, they swirl around, the energy of the star stirs them around, they form particles, they form snowflakes, they form little dust motes, they form rocks, they form asteroids, and eventually they form planets and moons. And that is how our solar system was formed, four and a half billion years ago. Rocky planets like our Earth are significantly more
complex than stars because they contain a much greater diversity of materials. So we've crossed a fourth threshold of complexity.

Now, the going gets tougher. The next stage introduces entities that are significantly more fragile ... but they're also much more creative and much more capable of generating further complexity. I'm talking, of course, about living organisms ... created by chemistry. We are huge packages of chemicals. So chemistry is dominated by the electromagnetic force that operates over smaller scales than gravity, which explains why you and I are smaller than the stars or planets. Now what are the ideal conditions for chemistry? What are the Goldilocks conditions? Well, first you need energy, but not too much. In the centre of a star, there's so much energy, that any atoms that combine will just get busted apart again. But not too little ... in intergalactic space, there's so little energy that atoms can't combine. What you want is just the right amount, and planets, it turns out, are just right, because they're close to stars, but not too close.

You also need a great diversity of chemical elements, and you need liquid such as water. Why? Well in gases, atoms move past each other so fast that they can't hitch up. In solids, atoms are stuck together, they can't move. In liquids, they can cruise and cuddle and link up to form molecules. Now where do you find such Goldilocks conditions? Well planets are great, and our early Earth was almost perfect. It was just the right distance from its star to contain huge oceans of open water. And deep beneath those oceans at cracks in the Earth's crust, you've got heat seeping up from inside the Earth, and you've got a great diversity of elements. So at those deep oceanic vents, fantastic chemistry began to happen, and atoms combined in all sorts of exotic combinations.

But of course, life is more than just exotic chemistry. How do you stabilize those huge molecules that seem to be viable? Well it's here that life introduces an entirely new trick. You don't stabilize the individual; you stabilize the template, the thing that carries information, and you allow the template to copy itself. And DNA, of course, is the beautiful molecule that contains that information ... about how to make living organisms. And DNA also copies itself ... and scatters the templates through the ocean. So the information spreads.... The real beauty of DNA though is in its imperfections. As it copies itself, once in every billion rungs, there tends to be an error. And what that means is that DNA is, in effect, learning. It's accumulating new ways of making living organisms because some of those errors work. So DNA's learning and it's building greater diversity and greater complexity. And we can see this happening over the last four billion years.

For most of that time of life on Earth, living organisms have been relatively simple - single cells. But they had great diversity, and, inside, great complexity. Then from about 600 to 800 million years ago, multi-celled organisms appear ... fungi, fish, plants, amphibians, reptiles and then of course ... the dinosaurs. And occasionally, there are disasters. 65 million years ago, an asteroid landed on Earth near the Yucatan Peninsula, creating conditions equivalent to those of a nuclear war, and the dinosaurs were wiped out - terrible news for the dinosaurs. But great news for our mammalian ancestors who flourished in the niches left empty by the dinosaurs. And we human beings are part of that creative evolutionary pulse that began 65 million years ago with the landing of an asteroid.

Humans appear about 200,000 years ago. And I believe we count as a threshold in this great story. Let me explain why. We've seen that DNA learns in a sense, it accumulates information ... (slowly) through random errors, some of which just happen to work. But
DNA had actually generated a faster way of learning; it had produced organisms with brains. They accumulate information, they learn. The sad thing is, when they die, the information dies with them. Now what makes humans different is human language. We can share what we've learned with such precision that it can accumulate in the collective memory ... from generation to generation. And that's why, as a species, we're so creative and so powerful, and that's why we have a history. We seem to be the only species in four billion years to have this gift.

I call this ability collective learning. It's what makes us different. We can see it at work in the earliest stages of human history. We evolved as a species in the savanna lands of Africa, but then you see humans migrating into new environments -- into desert lands, ... jungles ... ice age tundra of Siberia ... into the Americas, into Australasia. Each migration involved learning ...

Then 10,000 years ago, exploiting a sudden change in global climate with the end of the last ice age, human's learned to farm. Farming was an energy bonanza. And exploiting that energy, human populations multiplied. Human societies got larger, denser, more interconnected. And then from about 500 years ago, humans began to link up globally through shipping, through trains, through telegraph, through the Internet, until now we seem to form a single global brain of almost seven billion individuals. And that brain is learning at warp speed. And in the last 200 years, something else has happened: we've stumbled on another energy bonanza in fossil fuels. So fossil fuels and collective learning together explain the staggering complexity we see around us.

So, here we are ... We've been on a journey, a return journey, of 13.7 billion years ... it's a story in which humans play an astonishing and creative role. But it also contains warnings. Collective learning is a very, very powerful force, and it's not clear that we humans are in charge of it. ... We're burning fossil fuels at such a rate that we seem to be undermining the Goldilocks conditions that made it possible for human civilizations to flourish over the last 10,000 years. So what big history can do is show us the nature of our complexity and fragility and the dangers that face us, but it can also show us our power with collective learning.

And now, finally, this is what I want. I want my grandson Daniel ... and his generation ... to know the story of big history ... that they understand both the challenges ... and the opportunities that face us ... at this threshold moment in the history of our beautiful planet.

(adapted from "The history of our world in 18 minutes", TED talk, Christian, 2011)\(^1\)

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\(^1\) The term ‘Big History’ is important to this research. It can be summarised as: “Students investigate differing scales of space and time, and read origin stories that have emerged throughout human history. The process of critical inquiry is introduced as students probe how scientific and historical discoveries have merged to become a modern, scientific origin story” (IBHA, 2012, np).
CHAPTER ONE

AT THE THRESHOLD OF THE STORY - BACKGROUND TO THE STUDY

Introduction

This study is about exploring values in relation to environmental education, particularly in the context of primary Catholic education. More specifically, the thesis investigates the extent to which environmental and scientific values, as told in the scientific story of the universe, can be integrated into the primary Catholic curriculum. This research is significant in explaining how environmental education practice is permeated by a particular culture’s historical metaphors and story. In particular, this study is important in that it correlates and reviews the many theoretical recommendations in international and national environmental education reports alongside the actual implementation of authentic knowledge and values-based interdisciplinary teaching practices in Catholic primary education.

My thesis incorporates the major theme of ‘Story’ throughout the thesis chapters:

• Chapter One. At the threshold of the story: Background to the study, including my personal orientation, justification, significance of the study and research questions;
• Chapter Two. Reviewing the storyline: Literature review that informs my study directions, followed by research questions which emerge from the current literature, and which I believe are significant to this study;
• Chapter Three. Framing the story: Theoretical Framework;
• Chapter Four. Designing the story: Methodology and research design;
• Chapter Five. Extending the storyline: Data representation and analysis;
  and
• Chapter Six. The future story: Synthesis of themes, limitations and
  implications for future research.

I now explain my research orientation and the motivation that directed me to form
my research focus. I then outline the justification of the study, followed by
significant literature and research that informs this PhD. I conclude by summarising
the underpinning objectives that emerged within this framework in the form of an
overarching research question alongside two subsidiary questions, which established
the trajectory of the research.

1.1 Personal orientation to the research

The Earth is not part of the Human Story,
the human story is part of the Earth Story. (Berry, 1996, p. 6)

Every child needs to hear: you came out of the energy that gave birth to
the Universe. It is your beginning that fashioned the galaxies: it is alive
within you. (Swimme, 1990, np)

As a teacher I have learnt to value story as a primary educational resource that
contains the power to create, guide and affirm knowledge, understanding and values
within particular cultural contexts. In 2007, I spent ten weeks on a sabbatical program at An Tairseach, a Dominican Ecological farm and spirituality centre in Wicklow, Ireland. “An Tairseach, is the Irish word for threshold and it suggests a new beginning, a more sustainable way of working with the land, as well as a renewed relationship with the whole community of life, human and non-human” (Dominican Sisters, 2018, np). These words have become a powerful symbol for me, of the way that the scientific history of the universe calls us to walk through the threshold to a greater understanding of the power of environmental education. I was provided with a wonderful opportunity at An Tairseach to reflect on my own cultural origin story within a Catholic tradition and also from within my Australian culture, where so much has originated from Christian tradition and customs. I was challenged to explore and question my identity within the radically amazing context of new scientific discoveries about the 13.8-billion-year history of our universe – and so, my paradigm shift happened!

My learning has inspired me to encourage students to marvel and be mesmerised by the universe. On return to my Catholic school, where I taught Year 5, my An Tairseach experience provided me with the ongoing opportunity to reflect on students’ disconnectedness with the environment and the lack of a relevant, scientific ecocentric origin story, incorporating current scientific knowledge. I have observed that the education community continues to implement the wonderful environmental changes and programs in primary schools (Catholic Earthcare Australia, 2008, 2010, 2013; Victorian Department of Education, 2017), but those benefits can be limited when offered within traditional western cultural anthropocentric values.
From my own experience, my decision to teach the scientific origin of the universe to my students then integrate it into class programs and underlying thinking was fruitful. I was impressed that the framework enabled students to understand the interconnectedness of the evolution of human life within the history of the universe. This knowledge allowed them to critique the environmental actions being implemented within an underlying, joint responsibility to take care of the earth and to understand that everything is interconnected from that perspective. As a teacher in Catholic education, I believe that the ongoing scientific discoveries about our universe would naturally enhance the Religious Education program, where awe and wonder of creation is already a component.

Further, in both my teaching roles and as an environmental education coordinator for over twenty years, I was part of many environmental initiatives, yet it concerned me deeply that the school communities focused on “doing” but not “internalising” environmental education. Environmental programs were actively promoted and embraced within the philosophy of the school, yet there appeared to be a dependence on the “enthusiastic, expert” environmental educator driving any environmental initiatives; otherwise the vegetable gardens remained un-watered and lights remained on. This drove me to investigate what knowledge of the history of the universe could underpin teachers’ and students’ meaning and connection with the environment, and therefore transform their learning and leadership skills in the areas of environmental education and the interrelationship that entails. I now outline the justification for this study.
1.2 Justification

There is a dearth of research concerning what measurable effects would be evident when student learning is directly linked to values embedded in environmental education (Department of Education, 2009; Department of Education Employment and Workplace Relations, 2011; Department of Education: Science and Training, 2005; UNESCO, 2010, 2012). Whilst there has been substantial policy development with respect to the development, identification and dissemination of broad values in environmental education (Earth Charter Commission, 2000), principally UNESCO publications (Department of the Environment and Heritage, 2005; UNESCO, 1976, 1977, 1980, 1997, 2004; UNESCO Education sector, 2012), there are currently few studies which have researched such values in curriculum and directions in Australian education (see Department of Education, 2009; Johnston, 2009; Leviston, Leitch, Greenhill, Leonard, & Walker, 2011; Mitchell, 2012; Pearson, Honeywood, & O'Toole, 2005; UNESCO, 2010).

A further debate in current environmental education research is the need to change from anthropocentric to ecocentric, systems thinking and value-based education. Cutter-Mackenzie (2011), in citing the United Nations 2009 statement (2009), highlights that some progress has been made, but, to a large extent, the anthropocentric focus remains. This sentiment is echoed in much of the historical and

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1 The definition of anthropocentrism for the purpose of my research, and to be discussed further in this literature review, is placing “human interests and concerns at the centre of the relationship between people and the environment” (Ashley, 2006, p. 89). This definition is particularly relevant to this study in the light of the anthropocentric nature of traditional Catholic Church documents.

2 Ecocentrism: “transfers the reality spotlight from humanity to the Ecosphere, from the part to the whole” and is the polarisation of the term ‘anthropocentric’ (Kopnina, 2013, p. 611).

3 Systems thinking and value-based education in the context of this research is “to understand phenomena observed in local or macro environments requires an holistic educational approach, involving networks and relationships across a variety of disciplines” (Laszlo & Krippner, 1998, p.8). This approach is guided by values inherent in environmental education to enable decision-making and the ability to act on that understanding (Catholic Education Office: Sydney, 2006; Laszlo & Krippner, 1998; Sterling, 2010; Stone, 2010).

Further justification for this aspect of the research lies in the reality that Catholic Church environmental documents and statements are particularly focused on an anthropocentric viewpoint because of historical Christian foundations (Catholic Earthcare Australia, 2012; Migliore, 2009a; UNESCO, 2012). In writing of the traditional convictions of the Church, Edwards (2012, p. 7), identifies one of these dichotomies in that, while there have been many damaging mistakes on the part of theologians and the church authorities, Christian theology has also embraced the theology of St Augustine of Hippo, which encompasses both natural sciences and traditional, anthropocentric bible depictions. In 1967, White attributed the historical roots of “orthodox Christian view of nature and man’s (sic) relation to it” as pervading the view of present day science and technology (1967, p. 1207). There has been much debate around the issue with Arnoud (2009, pp. 1-7) repeatedly asking the question, “Choosing between God and Darwin?” to extrapolate his thinking on the subject, and there are many likewise similar written perspectives examining the historical science/Catholic Church divide (see Berry & Swimme, 1992; Brooke, 1991; Cannato, 2006; Edwards, 2006, 2012; Salomone, 2006; Vatican Radio, 2009; White, 1967).

This division has not only historically ostracised the scientific discoveries of such luminaries as Copernicus, Galileo and Darwin (Arnoud, 2009; Feehan, 2010;
Ferngren, 2002; Vatican, 2005) in the history of the Catholic Church but has also led to a strong leaning towards written, anthropocentric statements in Church encyclicals and documents since the 1891 Rerum Novarum Encyclical on capital and labor (Leo XIII). Its homocentric tone is obvious when addressing the importance of the ‘earth’ to ‘man’ (sic) as “the fact that God has given the earth for the use and enjoyment of the whole human race” (Leo XIII, 1891, no.8), extending to 20th Century statements, including Pope John XXIII’s statement that “God created man in His own image and likeness, endowed him with intelligence and freedom, and made him lord of creation” (1963, no. 3). The use of the term “man” as “lord of all creation” is indicative of the Catholic Church’s traditional anthropocentric language used in the 1960s. Even as recently as 2014, Pope Francis, during an audience address (Radio Vaticana, 2014) used contradicting terms in that he proclaimed, “Custodians (of) Creation, not Masters of Creation is a gift that the Lord has given us!”, then a few brief sentences later states, “Creation is a gift from God, a gift for the best thing he created which is the human person” (Radio Vaticana, 2014, np). Much of the information contained in Catholic environmental matters refers to the supporting of the anthropocentric view of human life and dignity, rather than emphasising the ecocentric values so desperately needed in addressing environmental education (Catholic Climate Covenant, 2011; United States Conference of Catholic Bishops, 2012a, 2012b). In his 2015 encyclical⁴, Pope Francis I paved the way towards addressing the Church’s traditional anthropocentric interpretation in favour of describing an ‘ecological crisis’, stressing that “Nature cannot be regarded as something separate from ourselves or as a mere setting in which we live. We are part

⁴ In the Catholic Church an encyclical is a letter written by a Pope and “addressed to the Church, to his fellow bishops, or to all men and women of good will … where Catholics are required to consider the content and context of each document, especially the intentions of the Pope in issuing the document and the way in which the bishops and the whole Church receive the teaching” (Catholic Australia, 2018, np).
of nature, included in it and thus in constant interaction with it” (Francis I, 2015, no. 139).

Further justification for this research lies in addressing the significance that values can play to address the lack of systemic thinking (Arnoud, 2009; Bonnett, 2007, 2017) and environment/society disconnect (Barry, 2006, 2010) in environmental education. Adding to the above concerns involving the lack of systemic thinking and environment society disconnect, I have also found limited research that has focused on the extent that environmental education is permeated by a society’s historical metaphor; this, in turn, could affect values that are embedded in that culture’s story (Beringer, 2007; Bowers, 2010, 2012). This line of research will necessarily address the place of narrative⁵ and metanarrative⁶ in environmental education (Berry & Swimme, 1992; Bowers, 1994; Henderson & Danaher, 2011; Leiserowitz & Fernandez, 2008; Pleasants, 2006; Wallette & Edgren, 2013). Having justified the need for this research I now turn to discussing the significance of this study for the research field.

1.3 Significance of the research

Having justified the need for research into Catholic primary environmental education, I identify the significance of the research, particularly through outlining the value of

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⁵ Rodrigues offers the following description of ‘narrative’ as seen from an environmental education perspective: “It fundamentally alters our relation to the world, our relation to others and our relation to our humanity. It also gives us a compelling ethical foundation. Most of all, it commits us to look critically and urgently at the implications and consequences of our actions on the condition of the world. It intertwines the condition of the world with the condition of our humanity” (Rodriguez, 2002, p. 6).

⁶ The deepest ‘metanarratives’ of a social group, as described by Bowers, strongly influence the education of children (1994, p. 71). For the purpose of this research I extrapolate on Bower’s thinking to Christian’s contemporary understanding of metanarrative as universal history, “that history and literature and biology and cosmology are not separate intellectual islands, but parts of a single, global, and interdisciplinary attempt to explain our world” (Christian, 2010, p. 25).
the new emerging scientific story in primary education, within the cultural context of Catholic education, alongside the need to investigate the importance of teaching and researching values in Catholic primary environmental education.

**The value of the new emerging scientific story**

The story of the universe expresses a functional cosmology that needs to be taught at every level of education … This is why the story of the universe, and especially of the planet Earth, is so important. Through our understanding of this story, our own role in the story is revealed. In this revelation lies our way into the future. (Berry, 2006, pp. 22-23)

Berry’s statement emphasises the fundamental importance of ‘story’ to environmental education. For the purpose of this research particular emphasis needs to be placed around significant findings of the emerging new scientific ‘story’ of the history of the universe and values that story encapsulates (see Agelidou, 2010; Andresen, 1999; Barry, 2010; Benjamin, 2009; Berry & Swimme, 1992; Bonnett, 2012; Bowers, 1993; Brown, 2012; Brown, 2004; Bryson, 2006; Cannato, 2006; Christian, 2010, 2011a, 2012; Christian & Gates, 2011; Duffy, 2011; Engelman, 2013).

Since Berry’s initial call for the history of the universe to be the new unifying story for humanity (1978), there have been continuing calls from Catholic theologians and scholars to heed his message (see Brown, 2004; Cannato, 2006; Edwards, 2006, 2012; Fox, 1983; Mcdonagh, 2013; Migliore, 2003; O'Murchu, 1998; Salomone, 2006;...
Tucker, 2012). Recent doctoral theses (see Bannan-Watts, 2009; Hindmarsh, 2008) have also addressed the issue of the need for a unifying, universal story that informs and embraces the rich culture of Catholic education. Various Catholic education systems in Australia are addressing the problem with stronger policy statements and recommendations on environmental education (Brisbane Catholic Education, 2014; Catholic Education Office: Sydney, 2006; Catholic Education: Sandhurst Diocese, 2014a, 2014b, 2014c; Sydney Catholic Education Office, 2005), particularly from the point of view of action plans (Catholic Earthcare Australia, 2005, 2010, 2012, 2013; Catholic Education Office: Sydney, 2006).

Some secular university and secondary education institutions, both overseas and in Australia, have trialled and implemented the teaching of the scientific story of the universe through a systematic online course called Big History Project (see Big History Project, 2015, 2017; Dominican University, 2013; Macquarie University, 2012; Spier, 2011, p. 2). The number of participating Australian high schools increased from two in 2011 to twenty-three in 2014 (see Big History Project, 2018; Lane, 2011). Such progress is to be commended as essential parts of the diverse paths in teaching environmental education, but research into the tenets of Big History presents a new direction in rethinking this emerging new story by embracing evidence-based concepts and skills alongside multi-disciplinary learning. Christian, a prominent exponent of Big History (2011, np), advocates “we need to move beyond the fragmented account of reality that has dominated scholarship (and served it well) for a century … to a grand unified story”. For the purpose of this study the ‘grand unified story’ is viewed in the context of the Catholic primary school curriculum which, being the first study to do so, signifies its significance to the environmental education research field.
The incorporation of an interdisciplinary approach to the emerging scientific universe story is a critical component of this research for the following three reasons.

Firstly, a significant component of this study is based on the fact that the wide and varied research in environmental education presents no developed, definitive terms that contributes to the current understanding of the emerging, cohesive universe story, within both the general population and, in particular, primary education. From the time of its inception in the 1960s, Agyeman (2006) and Kollmuss and Agyeman (2002) acknowledge that the knowledge-action gap in environmental education is a complex problem, in that awareness does not always necessarily lead to action. This dialectic demonstrates a significant need for Catholic Church teaching and Catholic values education to inform and address the knowledge-action gap in environmental education within Catholic primary schools.

Secondly, the current environmental education ‘story’ needs to be addressed from a curriculum-based perspective as exemplified by the United Nations call in 1987 for an interdisciplinary approach where “environmental education should be included in and should run throughout the other disciplines of the formal education curriculum at all levels” (p. 96). Such addresses were aimed at encouraging students to develop understanding, values and actions in the environmental education field. In 2013, when a new Australian Curriculum (ACARA, 2014) was being implemented, there emerged a definitive need to investigate the practical interdisciplinary approach of that Curriculum in terms of the call of the United Nations (UNESCO, 1998; UNESCO Education sector, 2012; United Nations, 1992) and interdisciplinary environmental education curriculum research (Golding, 2009; Spier, 2008; Stein, Connell, & Gardner, 2008; Stone, 2010).
Lastly, looking to the future of the environmental education ‘story’, it is envisaged that the action research undertaken will lead to future directions for an interdisciplinary curriculum that embraces the emerging scientific origin story. It will particularly have significance in illuminating the dearth of current research on the extent that values are inherent in teaching authentic environmental education (Huckle, 1991; Selby, 2006; Thomson, Hoffman, & Staniforth, 2003; UNESCO-UNEP, 1978) and Catholic Religious education (Catholic Education Office: Sydney, 2006; Longbottom, 2015).

The value of Catholic education to this research

The significance of linking this study with the Catholic education system is deliberate for the following two reasons.

Firstly, the Catholic Church has a recent history of strong calls for action to save the destruction of the environment (see Francis I, 2015; John Paul II, 1985, 1989; John XXIII, 1963; Migliore, 2009b; Paul VI, 1971; Radio Vaticana, 2014), including Pope Benedict XVI’s statement: “How important it is then that the international community and individual governments send the right signals to their citizens to succeed in countering harmful ways of treating the environment!” (2009, p. 1). Such calls have also resulted in the formation of Catholic organisations to address the resulting inherent issues in education (Andresen, 1999; Australian Catholic Social Justice Council (ACSJC), 2002; Catholic Climate Covenant, 2011; Catholic Earthcare Australia, 2008, 2010, 2011; Catholic Education Office: Sydney, 2006; Catholic Education: Sandhurst Diocese, 2014a). Written statements pertaining to the destruction of the environment are evident in official Catholic documents, yet the
following words of Berry (1996), although written twenty-two years ago, are still significant for Catholic education today: “Most amazing is the inability of our religious or educational establishments to provide any effective religious or ethical judgment on what is happening” (1996, p. 7). This sentiment harks at the crux of the dilemma of the Catholic Church’s directions it needs to take in education, between merely expressing in words and policies the environmental crisis or to ensure the teaching of authentic, systematic, ecological awareness and transformation in environmental education in Catholic primary schools. Cole’s warning (2007) that the potential for effective education is challenged when educators are unwilling to reflect upon and restructure pedagogies to enhance learning, is necessarily a challenge for Catholic primary environmental education to remain authentic. She calls for environmental education to reimagine itself, “where rich theories, disciplines and programs offer tools, ideas and inspiration for environmental education … to become a more inclusive, interdisciplinary and progressive field” (2007, pp. 42-43). This study contributes to Catholic environmental education by critiquing its current educational pedagogy and future directions within wider environmental education research.

Secondly, Salomone (2006) points to the potential cultural and moral influence of the Catholic Church in environmental education, with over one billion Catholics and a powerful organisational strength, including health, education, religious orders, publishing and media outlets across all ages and social classes. Importantly for this research, common values, including social justice and calls for an end to consumerism, are core to both the traditional institution of the Church (Vatican, 2005, 2012) and the environmental education movement: “The ecological problem for Catholics, then, is essentially a moral one. It is a question of respecting the value
of life and the beauty of the cosmos, practicing meekness, and controlling one’s
desire for dominion” (Salomone, 2006, p. 80).

Environmental warnings are being used increasingly in Church documents and
statements, but, McDonagh (2013, 2016) contends, that until the recent encyclical,
Care of our Common Home (Francis I, 2015), these concerns generally did not equate
to accurate analysis of the science behind the vast environmental problem the world
faces. Both McDonagh and Gregg (2012; 2013) lament the lost opportunity of the
Church to address the magnitude of the need to safeguard the environment in The
Compendium of the Social Doctrine of the Church (2004), where “the rampant
destruction of biodiversity only merits one paragraph from a church that claims to be
pro life!” (McDonagh, 2013, p. 1).

The commonality in environmental concerns and values statements, in both
environmental education bodies and Catholic Church environmental education
documents is a key, common starting point in investigating the potential role of
Catholic education in those areas.

The importance of teaching and researching values in Catholic primary
environmental education
Diocesan Catholic education policies (Bishop's Commission for Catholic Schools,
1993; Brisbane Catholic Education, 2014; Catholic Earthcare Australia, 2010;
Catholic Education: Sandhurst Diocese, 2014c, 2014d; Sydney CEO, 2012) and
online resources (Catholic Climate Covenant, 2011; Catholic Earthcare Australia,
2008, 2011, 2013; Catholic Education Office: Sydney, 2006) are currently being
promoted in Catholic environmental education in Australia but, to date, there is no
evidence of any research into the systematic planning and implementation of a unified scientific history of the universe curriculum in primary schooling and the possible effects such a curriculum would have on informing the values of students in Catholic environmental education. This research is significant in that it addresses that void, researching the extent of any effects of teaching the emerging scientific story of the universe on the development of environmental education values in primary aged students. Any significant outcomes from embedding current scientific evidence of the history of the universe into environmental education, will need to be understood in light of indicators that transform student and teacher values, and hence their engagement in environmental understanding (Blake, 1999; Burford et al., 2013; Dahl, 2012; Podger, Piggot, et al., 2010). A further imperative for this research is to investigate the extent that values outlined in wider education research can be effectively transferred to, and understood, in Catholic environmental education (see Burford et al., 2013; Corrigan, Dillon, & Gunstone, 2007; Fien, 1997; Nolt, 2010; Palmer & Wagner, 2013; Podger, Mustakova-Possardt, & Reid, 2010; Ratner, 2004; UNESCO, 2012).

I now outline the research questions that guide this study.

### 1.4 Research questions

My central research question is:

- **To what extent can the emerging scientific story of the universe inform children’s environmental values through Catholic education?**

The subsidiary questions of this study are:
• To what extent can teaching children critical knowledge of the emerging scientific origin story support them to extend environmental education values within their knowledge of local school values and the Catholic education curriculum?

• To what extent can the transdisciplinary nature of the emerging scientific story of the universe inform children’s environmental values as socioecological learners?

1.5 Summary

Chapter One introduced my research topic, which is underpinned by ‘story’, particularly through the history of the emerging universe. It explored historical, current and future oriented environmental education thinking in International, National and Catholic environmental education. In my personal orientation story, I identified my paradigm shift upon learning the emerging scientific origin story. This shift in turn has flowed into my justification for undertaking the research, including the dearth of research in exploring interdisciplinary curriculum in Catholic primary environmental education from a values-based perspective. I now turn to Chapter Two to review the current literature relevant to my research.
CHAPTER TWO

REVIEWING THE STORYLINE - LITERATURE REVIEW

Introduction

For in the end, we will conserve only that which we love;
we will love only that which we understand;
and we will understand only that which we have been taught.
(Baba Dioum, cited in Vickers & Matthews, 2002, p. 16)

The various phenomena of environmental degradation and natural disasters …
remind us of the urgent need to respect nature as we should, recovering and
appreciating a correct relationship with the environment in everyday life.
(Benedict XVI, 2009, p. 1)

In Chapter Two, I continue the ‘story’ by reviewing the existing literature, including a
deeper insight into the major concepts discussed in Chapter One. The underpinning
concept of values in environmental education lies at the heart of my research. Therefore,
in this section, I review current literature on values in the environmental
education curriculum, in particular within Catholic schooling. The following four key
literature themes, discussed in detail below, form the framework of my research:

1. The beginnings of environmental education: defining and positioning;
2. Positioning of environmental education within the Catholic Church;
3. The emergence of environmental education in the primary school curriculum, with
   particular reference to the Catholic school context; and
4. The relevance of story, in particular, the emerging scientific origin story in environmental education.

Before presenting the review of the literature, the distinction among the terms ‘disciplinary’, ‘multidisciplinary’, ‘interdisciplinary’ and ‘transdisciplinary’ learning require clarification if ‘transdisciplinary’ is to be viewed as an essential direction for this research. In particular, the terminology of ‘interdisciplinary’ and ‘transdisciplinary’ learning are crucial components in the study of the history of the universe and environmental education where, the two terms are not consistently distinguished as having their own particular definition (see Christian, 2017, p. 15; Crumley, Laparidou, Ramsey, & Rosen, 2015; Moddejonge; Spier, 2009; UNESCO, 2005). Burford et al. contribute to the relevance of the understanding of transdisciplinary learning in research in that it “looks not only across and between disciplines but also beyond them (Burford et al., 2013). They proffer the suggestion that the emerging theoretical understandings of transdisciplinary has the potential to transform directions for environmental education (2013). In support of the interpretation of Burford et al., Table 2.1 compares and synthesises similar research perspectives (see Gillis et al., 2017; Klein, 2008; Savage & Drake, 2016; UNESCO, 1998). Although I will predominantly stress the need for transdisciplinary learning approaches because of the directions this study pursues, all terms will be utilised in varying degrees, to explain their transitioning and interrelationship.
Table 2.1 Comparing discipline definitions

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<tr>
<td>Disciplinary</td>
<td>Traditional subject areas of learning (“silos of learning”)</td>
<td>Importance of individual disciplines acknowledged (p.3).</td>
<td>Solve problems through the generation of knowledge, traditionally addressed from discipline-specific points of view; produces discipline knowledge experts (p.203). To address today’s complex problems requires the expertise of multi-disciplines (p.203). Breaking down disciplinary barriers; a common goal but not actively engaged in knowledge building among each discipline (p.205).</td>
<td>Well-established disciplines have a vital role to play while still maintaining their distinct identities (no.6).</td>
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<td>Multidisciplinary</td>
<td>Adds breadth to available knowledge, information, and methods, speaking as ‘separate voices’ (p.5).</td>
<td>No references</td>
<td>Collaboration of knowledge and methods’ building from two or more disciplines to gain a synthesis of results (p.205).</td>
<td>Traditional compartments and categories no longer remain in isolation from each other - work increasingly at the interface of disciplines in order to address the complex problems of today’s world (no.58).</td>
</tr>
<tr>
<td>Interdisciplinary</td>
<td>Subjects/disciplines become tools for studying a theme, a problem, question, or idea ... to address cross-curricular issues in the social, political and economical world (p. 14).</td>
<td>Integrative: Combining existing discipline approaches</td>
<td>Collaborative nature goes beyond institutions and into global communities – more holistic perspective. (p. 204)</td>
<td>Reorienting education from isolated disciplines in order to address the complex problems of today’s world. This is true within education, where interdisciplinarity is slowly and with difficulty gaining ground (no.58). Increasingly, important discoveries are being made not within disciplines, but on the borders between them (no.89).</td>
</tr>
<tr>
<td>Transdisciplinary</td>
<td>21st Century learning – new framework; Accounts for all dimensions of the human. It enacts the four pillars of learning articulated by Jacques Delors: learning to know, learning to do, learning to live together, and learning to be (p.14).</td>
<td>An iteration of – “what, why &amp; how” of learning; transcends discipline boundaries beyond an integrated framework for whole person: mind, body &amp; emotions; addresses the 21st Century learner to acquire and apply transdisciplinary skills and worldview (pp.-2).</td>
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Having used Table 2.1 to clarify and justify the relevance of utilising the terms, as appropriate, throughout my thesis, I now present a review of the literature relevant to this research.
2.1 The beginnings of environmental education:

Defining and positioning

In Section 2.1 I define and discuss the beginnings of environmental education, the sustainable development debate, the education for sustainability debate and the Australian perspective.

Significant historical events

In this section I address the significant historical events in environmental education, as represented in Table 2.2 below. In this review I highlight any pertinent references to values from these documents that inform a central component of my research.

Table 2.2 Significant historical events in environmental education

- 1970: IUCN Environmental Education in the School Curriculum, Nevada, USA
- 1972: UN Conference on the Human Environment, Stockholm, Sweden
- 1977: UNESCO Intergovernmental Conference on Environmental Education, Tbilisi, the former USSR
- 1997: The UN International Conference on Environment and Society, Thessaloniki, Greece
- 2000: Launch of the Earth Charter
- 2005-2014: UN Decade in Education for Sustainable Development
- 2014: World Conference on Education for sustainable developmentOkayama, Japan
- 2015: World Education Forum, South Korea a new fifteen year vision
- 2018: One Planet Summit, France. Creation of ‘One Planet Coalition’
awareness of the need for environmental education was raised in Rachel Carson’s seminal book *Silent Spring* (1962). Neal and Palmer cite it as promoting an environmental consciousness (2003, p. 12) and, according to Lytle (2007), it signalled the beginning of the modern environmentalist movement. Dewey (1966) later contributed the idea that nature-based educational experiences, that empower the agency of the child, are imperative for authentic education.

Historically, Palmer (1998) emphasised the necessity to trace the history of environmental education as fundamental to building on the foundations of the field, rather than viewing it as merely a product of recent educational initiatives. She cites 1948 as the first use of the term at the IUCN Paris Conference but quotes a definition, formulated at an International Meeting of Environmental Education in the School Curriculum at Nevada in 1970 and promoted by the IUCN, as influential and classic. As such, the IUCN validated values and attitudes as core components of environmental education in its following definition:

> The process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among man (sic), his culture and his biophysical surroundings [sic]. Environmental education also entails practice in decision-making and self-formulation of a code of behaviour about issues concerning the environmental quality (1970, p. 2).

The *Tbilisi Declaration* (UNESCO-UNEP, 1978) was a significant factor in the ongoing promotion of environmental education. It influenced future environmental education thinking and was cited in the United Nations Conference on Environment
and Development, *Agenda 21* report (1992, p. 36), which claimed the *Tbilisi Declaration* as the basis for the fundamental principles it proposed. One of its three goals was “to provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment”. It is also noteworthy that the 1978 declaration was already calling for an interdisciplinary\(^8\) approach in the teaching of environmental education, which it acknowledges as the “dovetailing” of different disciplines and experiences in education (UNESCO-UNEP, 1978, no. 2 and no. 7).

*The Belgrade Charter: A Global Framework for Environmental Education*, (UNESCO-UNEP, 1976) also set ground-breaking future directions for the consideration of values in environmental education in its insistence that there needed to be a “new global ethic, which espouses attitudes and behaviour for individuals and societies”. In fact, one environmental education objective in the charter stated that individuals and groups be helped to acquire “social values and strong feelings for the environment” (UNESCO-UNEP, p. 2). Its contribution to the developments in environmental education was sanctioned in the *Declaration of Thessaloniki* for the significance of the plans and recommendations of its Charter – although it was acknowledged that they had not been fully explored (UNESCO, 1997).

The new directions, encompassing attitudes and behaviour from the *Belgrade Charter* are echoed in the *Tbilisi Declaration* (UNESCO-UNEP, 1978) and *Agenda 21*, where the terms ‘knowledge, values, attitudes, and practical skills’ are cited in both documents as being indispensable to addressing environmental awareness in

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\(^8\) For the purpose of this research paper I refer to the following definition of interdisciplinary approach as being distinct from multidisciplinarity, which is defined as “a conglomeration of disciplinary components”, compared to “interdisciplinarity, a more synthetic attempt of mutual interaction” (Huuutoniemi, Klein, Bruun, & Hukkinen, 2010, p.80).
education (1978, p. I.3; United Nations, 1992, no. 36.33). This commonality of terms informs my research in that historically, environmental education has embraced the importance of a framework involving knowledge, values, attitudes and skills.

While the international conferences in the 1970s offered some consensus to the understanding of environmental education, it was particularly Tbilisi (UNESCO-UNEP, 1978, p. I.3) and Belgrade (IUCN) that provided, in Hart’s words, the principles for “the most commonly referenced characteristics of environmental education world wide” (2003b, p. 34). Of particular interest to this research is Hart’s reference that environmental education “encourages the clarification of values and the development of values sensitive to the environment” (2003b, p. 34), particularly in referring to the ‘development’ of values, thus inferring values are not merely to be recognised but can be taught; hence the need for environmental education. However, as evidenced in the following paragraphs, the term environmental education itself has become interchangeable in more recent research with the terms sustainability or sustainable development.

**Sustainable development**

It was the 1980s, including the *World Conservation Strategy* and the *Report of the World Commission on Environment and Development: Our Common Future* (IUCN & WWF, 1980) that saw the introduction of the concept of sustainable development⁹, which in turn infiltrated the field of environmental education (see Cutter-Mackenzie, 2017; Hart, 2003b; Tilbury, 1995, 2002). The *World Conservation Strategy* set the new direction of “exploring the links between economic growth and environmental

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⁹ *Our Common Future* defined sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987, no. 49).

Although *Agenda 21* (1992) had called for the development of an education for sustainability strategy (EFS)\(^\text{10}\) by 2002, little development occurred until the 57th Session of the UN General Assembly passed “Resolution 57/254 declaring the Decade of Education for Sustainable Development (UNDESD) from 2005 to 2014” (The Australian Research Institute for Environment and Sustainability, 2013; UNESCO, 2002, 2004).

The *Bonn Declaration* (UNESCO, 2009a), the result of the 2009 UNESCO World Conference on Education for Sustainable Development, acknowledged the first five years of development of the UNDESD but called for the strengthening of its outcomes in the next five years (2009a, para. 14). The report specifies that education for sustainable development (ESD) involves formal, non-formal, informal, vocational, and teacher education and is “a cross-cutting theme with relevance to all disciplines and sectors” (2009a, para. 15f). Gough (2013) expands on the *Bonn Declaration’s* call to action as a perceived broadening of the research field in current environmental education “to a position where all research methodologies can now be considered valuable and appropriate, depending on the questions, issues, and problems being researched” (p. 17).

The implementation scheme for the UNDECD 2005-2014 (UNESCO, 2004) included a goal “to create a locally relevant and culturally appropriate values component to

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\(^{10}\) EFS and Education for sustainable development (ESD) will be discussed further in Section 2.2.
ESD that is informed by the principles and values inherent in sustainable development” (UNESCO, 2004, p. 7). The final judgement on whether this has been achieved is yet to be decided; however, the 2012 second progress report on the UNDECD (UNESCO, 2012) contains twenty-nine instances of the word ‘value’. In fact, in the report, the IAC has noted ESD was initially seen as a separate educational entity but “is now more than ever seen as a set of learning skills, perspectives and values that are intrinsic to quality education” (UNESCO, 2012, p. 79).

One other global initiative pertinent to this study was the launch of the Earth Charter (Earth Charter Commission, 2000), which was developed to form a global partnership regarding sustainable development. One of its interdependent principles is an urgently needed “shared vision of basic values to provide an ethical foundation for the emerging world community” (Earth Charter preamble).

The 2012 UNESCO Rio+20 report, The Future We Want: United Nations Conference on Sustainable Development (UNESCO-UNEP, 2012) reiterated the call for sustainable development. The call was portrayed in the State of the World 2013: Is Sustainability Still Possible? publication and illustrated in Victor Ndula’s cartoon reproduced in Figure 2.1 and in the wording that “the consensus still persists that it (the conference) produced lots of gaseous talk and no significant action” (Engelman, 2013, p. 111).
The education for sustainability debate

Hart (2003b, p. 35) and Cutter-Mackenzie (2017, p. 351) cite the debate that ensued from the conflicting ideas of definitions on sustainable development as the catalyst for the Earth Summit, the United Nations Conference on Environment and Development (1992). A significant objective from Chapter 36 of *Agenda 21*, in relation to this study, is the call for “a global education effort to strengthen values, attitudes and actions which are compatible with sustainable development” (1992). This raises the issue, though, that the reality is the implementation of the *Agenda 21* action plan for sustainability has been slow and cites that the values needed to move towards sustainability are contradicted by materialistic values of economic systems and consumer societies. Dahl (2012, p. 18) adds emphasis by quoting the World Summit of Sustainable Development, Johannesburg which calls for “the need to consider ethics in the implementation of *Agenda 21*”. Dahl believes that the development of
values-based indicators will encourage debate around the ethical challenge of sustainability, and his viewpoint, along with those of Podger et al. (2010), have implications for this study, in that the historical call for values in environmental education action can be reviewed through a new lens of advocated action.

By the end of the 1990s, Jickling and Spork (1998) saw the defining of environmental education within the terminology of education for sustainable development as highly problematic. They specifically cited the Our Common Future report (United Nations, 1987), which advocates individuals can be persuaded to act in the common interest of sustainable development, partly through “education, institutional development and law reinforcement” (1987, p. 46). The dichotomy they raise is, should the use of persuasive language be linked to the process of education. Jickling and Spork (1998) had embraced the idea that environmental education definitions continue to evolve and emerge, and this is advantageous in encouraging a discussion that does not follow a narrow perspective but remains open to continuous re-interpretation. This viewpoint is supported by Knapp (2000) in his critique of the Thessaloniki Declaration (1997), where he is disparaging of the move away from the Tbilisi Declaration’s emphasis on the term ‘environmental education’ (1978) in favour of ‘education for sustainability’ (2000, p. 38). He argues that the term ‘sustainability’ was limiting and leads to the debate around who defines the limits ‘sustainability’ in relation to the wider scope of environmental education.

Counter to this stance, the work of Fien (1993, 1995, 2000; 2010) displays strong support for the concept of education for sustainability. Fien (2000) argues, to avoid indoctrination, the principles of impartiality called for by Jickling and Spork, are counteracted by recommendations of protocols as important safeguards …when
adopting a committed approach to teaching (Fien, 2000, p. 8). Likewise, Huckle (1991, p. 12) advocates that, when considering the contradictions within the term ‘education for sustainability’, that it be seen as a form of social education that “empower(s) pupils so that they can democratically transform society”.

Cutter-Mackenzie (2017) critically evaluates the term ‘sustainability’ and argues that within the many varied definitions put forward, there are two broad views of what she terms ‘technological’ (or anthropocentric) and ‘ecological’ sustainability. She contends the phrase ‘environmental education’ has been overtaken by ‘education for sustainable development’, as evidenced in The Decade for Education for Sustainable Development document (Cutter-Mackenzie, 2017, p. 354; UNESCO, 2004) and the Australian Government National Action Plan (Commonwealth of Australia, 2009). Cutter-Mackenzie (2017) further cautions against the potential for a leaning towards an anthropocentric focus in the National Action Plan where the concepts of social, economic and political sustainability sit alongside ecological sustainability.

Gough (2013, p. 13) acknowledges that most researchers “who researched environmental education now undertake research, which is often categorised as education for sustainable development, and many see Education for Sustainable Development as a contributor to an enhanced relevance of environmental education”.

This is an example of a timely caution for researchers to continue to critically evaluate the terms, ‘environmental education’ and ‘sustainability’, within the varying contexts that they may be presented. Bonnett (2007) raises the same concern when he claims that, by focusing on sustainability around the needs of humans in environmental education, there is too great an emphasis on the anthropocentric
approach. He, too, raises critical questions around this premise, for educators to address “our understanding of nature and our relationship to it” (2007, p. 709).

Current research continues to pronounce warnings around the anthropocene. One particular stance on anthropocentrism is taken from Crumley et al. (2015) who ask for more research around the anthropocene in deep time. This direction encourages a thorough study of the anthropocene that embraces a broader and more complex application of narrative, inclusive of old and new sciences of the environment, ethics, and reflexive practice. Crumley et al. believe such a flexible structure will allow researchers to assess how human thought and action has shaped the present world to inform the future (2015, p. 1723).

The 2000 publication, Environmental Education for a Sustainable Future: National Action Plan (Department of Environment and Heritage, 2000) was significant in that it called for a means to change people’s behaviour in order to improve environmental problems. It also identified new perspectives, values and knowledge and skills, which it claimed lead to changed behaviour in support of an ecologically sustainable environment. Environmental education currently places strong emphasis on perceived action in a sustainable school context, with the flourishing of vegetable gardens, installation of water tanks and auditing of electricity, to name a few of the activities. This is supported more recently in Cutter-Mackenzie’s conclusions regarding the Australian Waste Wise Schools Program (2010), where she summarises that “The data analysis of the Waste Wise Schools program reveals that it is becoming increasingly ingrained in the growing sustainability culture taking place in Australian schools” (2010, p. 176).

11 In the above context Crumley et al. refer to deep-time from an “interdisciplinary perspective on the Anthropocene and signals the importance of the Anthropocene concept in past, present, and future human–environmental relationships” (2015, p. 1721).

I acknowledge that the term ‘sustainability’ is a key theme running through the historical and current environmental education research and documents, and that debate is still prevalent. The debate on directions for environmental education has progressed since Jickling and Spork’s research (1998, pp. 13-14), where they cite Gough (1987) as arguing that environmental education should not be confined to ‘in and about’ the environment, but likewise, should not be limited to ‘for’ the environment¹². Jickling continues to caution against the term ‘for’ (2005) when he cites Fien’s “red-green” vision (Jickling, 2005, p. 252) as blurring personal commitment within the broader concept of education. He argues that there is a myriad of ‘education for …’ interest groups and questions which ones are to prevail and queries if critical meaning will be lost. In the current school system, within the myriad

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¹² “‘Education about the environment focuses on students’ understanding of important facts, education in the environment involves students in direct contact with (the environment… and) education for the environment aims to promote a willingness to adopt lifestyles compatible with the wise use of resources” (Department of the Environment and Heritage, 2005, p.6). However, Gough (2015, p.8) argues that ‘for’ the environment is an anthropocentric term as it alludes to humans knowing which environment as what is best for that particular environment.
of competing themes in education, environmental education needs to stand out as having, in Jickling’s words, the “potential to transcend the present, potential to disrupt the status quo … we should expect good education to reach outside and beyond sustainable development” (2005, p. 257). He cautions against hearing only the voices of anthropocentrism if “education for” limits the wider expectations of good education. The stance addressing the broader question of the worth of sustainability in ‘good’ education through critical, inquiry learning is also supported by Scott (2009) and the UNESCO education strategy 2014-2021 that sees its overall educational goal as “aiming to achieve just, inclusive, peaceful and sustainable societies (which will) ensure equitable and inclusive quality education and lifelong learning for all by 2030” (2014, p. 26).

Having reviewed the debate around ‘education for sustainability’ I now focus on the Australian perspective of the debate.

**Australian perspectives**

Jickling’s argument needs to be kept in mind when reviewing any pedagogical framework that promotes the organising of environmental education experiences through the lens of educating ‘about, in and for’ the environment (see Cutter-Mackenzie, 2003; Department of the Environment and Heritage, 2005; Hart, 2003a). In Australian Government documents the term is inconsistently used. The document, *Educating for a Sustainable Future: A National Environmental Educational Statement for Australian Schools* (2005) uses the term education ‘about, in and for the environment’ as an accepted framework in environmental education thinking, stating that it is “a popular way of organising the experiences within an environmental education program” (2005, p. 6). A similar recognition of the term is found in the
environmental education policy for schools (NSW Department of Education and Training, 2001) yet in the Australian Government document, *Sustainability Curriculum Framework: A Guide for Curriculum Developers and Policy Makers* (Department of Environment and Heritage, 2010) there is not one mention of the term. In spite of the fact that ‘Sustainability’ is one of the three cross-curriculum priorities in the *Foundation to Year 10 Australian Curriculum* (ACARA, 2014) there is a similar lack of the terms ‘sustainable’ and ‘sustainability’, appearing only seven times in the literacy curriculum document and ten in the mathematics document. The new *Australian Curriculum* will be highly significant to this research as to how the sustainability cross-curriculum link will be implemented into primary schools to effect a change into centring environmental education within the mainstream of English, mathematics, science and history. There is a definite need to investigate the impact of environmental education as an integral component of compulsory education in the new curriculum. Hart’s observation (2003b, p. 37) that a term is simply adopted in education when the majority of educators and policy makers have adopted it, may well be the true test in the instance discussed above.

The above discrepancy highlights the current inconsistent use of terms, both in research and in published frameworks for environmental education. It has implications for ongoing educational dialogue and the relevance of primary environmental education. As highlighted in statements of Jickling and Spork (2005, pp. 14-16; 1998, p. 11), the way forward for environmental education requires ongoing exploration of new possibilities. One such emerging exploration is the interpretation of environmental education through an emerging new cosmology, to be further outlined in Section 2.4 of my research.
Examples of the call for ongoing, professional discussions on terminology are further evidenced in Jickling’s later writing (2003, 2005; Jickling & Wals, 2008), along with Palmer (1998), Chawla (1999), Orr (2004), Meyers (2006) and Bowers (2010b). However, for the purpose of my research, I refer to the following definition: that the concept of sustainability “represents diverse local to global efforts to imagine and enact a positive vision of a world in which basic human needs are met without destroying or irrevocably degrading the natural systems on which we depend” (Kates, Parris, & Leiserowitz, 2005, p. 20).

Despite my review of inconsistent terminology used in environmental education, it is also important to acknowledge that current Australian education curricula is faithful, in many instances, to terminology used in historic environmental education documents, where the language continues to endorse historic documents. An instance of this is from the preface of the 1998 document, *Educating for a Sustainable Future* (UNESCO, 1998, p. 1) which laments that “Twenty years after Tbilisi and five years after Rio and ECO-ED, who would deny that too little has been achieved?” Table 2.3 demonstrates that key wording from the 1997 historic international *Tbilisi Declaration* (UNESCO-UNEP, 1978) is still evident in the current national *Australian Curriculum* (ACARA, 2014). The terminology from official documents can therefore influence the thinking behind current educational thought.
Table 2.3 Keywords from *Tbilisi Declaration* and the current *Australian Curriculum*

<table>
<thead>
<tr>
<th><strong>Tbilisi Declaration 1978</strong></th>
<th><strong>ACARA, Australian Curriculum 2014</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainability</td>
<td>Sustainability</td>
</tr>
<tr>
<td>Knowledge, values, attitude, commitment, skills</td>
<td>Knowledge, skills, attitudes, values</td>
</tr>
<tr>
<td>Lifelong learning for future sustainability</td>
<td>Futures-oriented,</td>
</tr>
<tr>
<td>Interdisciplinary education,</td>
<td>Interdisciplinary focus: cross-disciplinary</td>
</tr>
<tr>
<td></td>
<td>priorities, “general capabilities”</td>
</tr>
<tr>
<td>Local, national and international perspectives</td>
<td>Local, national and international perspectives</td>
</tr>
<tr>
<td>Empowerment</td>
<td>Contribute to more sustainable patterns of living</td>
</tr>
<tr>
<td>Interdependence – economic, political, social, ecological</td>
<td>Protect environments in an ecologically and socially just world through informed action</td>
</tr>
<tr>
<td>Holistic and balanced perspective</td>
<td>Reflect on ways of interpreting and engaging with the world.</td>
</tr>
<tr>
<td>First-hand experiences/problem solving cooperation</td>
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</table>

Common understanding and use of environmental education terms need to remain relevant in primary schooling. The ongoing diversity and controversy pertaining to the understanding of ‘sustainability’ require continued dissemination and shared understanding in all Australian curriculum documents if we are to heed the call of the UNESCO document, “transdisciplinary vision for concerted action” (UNESCO, 1998). If wider education systems are to remain attentive to UNESCO’s call (2005) to redesign existing current practices directed toward a sustainable future, there is also the imperative to work within a shared terminology which in turn promotes shared
understanding and dialogue.

Summary

This section has highlighted the unfolding story in the history of environmental education that has emerged over the past forty years; it is an environmental education story that began with scientific, factual roots and, through research and global conferences and reports, has opened to a wider understanding of a myriad of interdisciplinary ways to educate. This historical view of environmental education has been written with particular reference to the concept of values identified in major documents since the 1970s. One significant debate in the history of environmental education documented in this section was the introduction in the 1980s of the term ‘education for sustainability’ (specifically in global environmental education documents) as opposed to ‘environmental education’, and the polarising literature that has ensued. The historical understanding of both values and the current, popular term ‘sustainability’ has broad reaching significance for this study, particularly within the new Australian Curriculum sustainability priority. In the next section I further discuss these two terms within the context of environmental education and the Catholic Church.

2.2 Positioning of environmental education within the Catholic Church

When the history of environmental education is observed in the documents and

\[13\] Having addressed the tension between the terms ‘sustainability’ and ‘environmental education’ I use both terms throughout this thesis. This is especially relevant in light of the data collected during the study’s pedagogical intervention, which is based on the Australian Curriculum where students have been exposed to the cross-curriculum ‘sustainability’ priority, rather than the term ‘environmental education’.
statements from the Catholic Church perspective, it is clear from the outset that the actual term ‘environmental education’ is missing. I now review environmental education positioning within the Catholic Church from the following perspectives: ecological conversion, anthropocentrism and the wider concept of environmental education.

**Ecological conversion**

The Catholic Church commonly uses the term ‘ecological conversion’ or ‘responsibility’ in both official Catholic documents and in academic research and educational writing (Catholic Earthcare Australia, 2012; Hindmarsh, 2008; USCCB, 1992, 2001; 2009). An example of this is found in what is considered to be the pivotal historic awakening call to all Catholics for environmental responsibility, where Pope John Paul II states “An education in ecological responsibility is urgent: responsibility for oneself, for others, and for the earth” (1989). McFague (1993) links the progress from ecological consciousness to ecological conversion in part when people learn about the scientific "common creation story ... (they) will change" (p. 71), and that in turn leads to ecological conversion. When Morris (2002) discusses ecological consciousness from a secular viewpoint, there is a similar sentiment to the Christian perspective in the need for a change to ecocentric thinking that “shifts the focus from human centredness to earth-centredness” (p. 581).

In the more recent Australian context, Catholic Earthcare was formed in 2002 by the Australian Catholic Bishops' Conference with the mission of advising, supporting and assisting the bishops in responding to Pope John Paul II's 2001 call to "stimulate and sustain the ecological conversion throughout the Catholic Church in Australia and beyond” (Catholic Earthcare Australia, 2012; John Paul II, 200, np). Having noted the
importance of the term ‘ecological conversion’ to the Catholic Church writing on environmental education, there is a need to address the anthropocentric position within the Catholic Church.

**Anthropocentrism and the Catholic Church**

An historical thread that has dominated, through to current statements from the Catholic Church, is the anthropocentric message. This perspective goes to the core of Catholic official teaching and its biblical basis from the Creation story, where human dominance over creation and stewardship are central themes in Catholic environmental education documents. Catholic statements on environmental educational philosophy can also be seen as sympathetic, and indeed at times ambiguous, to an ecocentric environmental education model. The following two quotes are examples of this ambiguity; the first reads from an ecocentric point of view where the universe is described as harmonious, with no mention of an anthropocentric bias. The second, in contrast is definitive, in that creation is not to be seen in the light of an ‘ecocentric’ 14 paradigm:

> Theology, philosophy and science all speak of a harmonious universe, of a "cosmos" endowed with its own integrity, its own internal, dynamic balance. This order must be respected. (John Paul II, 1989, no.8)

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14 I acknowledge that the term ecocentric is complex. It cannot merely be reduced to one definition, but Humphrey (2000, p. 249) begins his critique with one definition of ecocentrism that “consists in the denial of any ontological divide between humanity and the rest of nature that would be sufficient to ground a value distinction between humanity and the rest of nature”. After studying the differing points of view he concludes there is a common thread from the research, that “The person who has achieved ecological consciousness must recognize themselves as part of a single unfolding reality and yet retain a sense of their own individuality” (Humphrey, 2000, p. 254).
An ordered love for creation, therefore, is ecological without being ecocentric. We can and must care for the earth without mistaking it for the ultimate object of our devotion. (USCCB, 1992no. IV)

Another example of a confusion of messages between anthropocentrism and ecocentrism can be found in the words of the Australian Bishops’ Committee for Justice, in its 2002 Social Justice Sunday Statement, *A New Earth: The Environmental Challenge*:

In justice, it is an urgent task for Christians today to be reconciled with all creation, and to undertake faithfully our responsibility of stewardship of God’s gifts. To achieve such reconciliation, we must examine our lives and acknowledge the ways in which we have harmed God’s creation through our actions and our failure to act. We need to experience a conversion, a change of heart. (Australian Catholic Social Justice Council. (ACSJC), 2002, p. 3)

Although this statement is to be commended for its call to reconciliation and the stronger term ‘conversion’, rather than merely ‘awareness’ or ‘consciousness’, it also needs to be questioned in terms of the value-laden anthropocentric word ‘stewardship’ 15. This wording is also echoed in the Sydney Catholic Education Office document, *Indicators of Effectiveness for Catholic Schools, 2011-2016*, where one of the indicators states “Our whole-school integrated approach to learning about environmental stewardship is characterised by explicit teaching of ‘ecological

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15 Debate around the term ‘stewardship’, as used in Catholic Church documents, can promote an anthropocentric message but it is also acknowledged that in some documents the term is interrelated with the ecocentric term ‘kinship’. This is evidenced in the following statements from The Australian Catholic Bishop’s Conference where “A relationship of kinship exists among all of God’s creatures… the natural world, indeed the whole universe.” (2002, p. 2). Later in the document Catholics are asked to “to exercise good stewardship of the fragile ecosystems that support life on earth” (p. 8).
conversion’ as the key motivator of sustainability” (2011, p. 35).

These two examples demonstrate clearly that, when reading Catholic Church documents, there needs to be an awareness of the anthropocentric wording, amidst well intentioned ecocentric environmental education aims. One such well-intentioned statement comes from the United States Conference of Catholic Bishops (USCCB, 1992). Its pivotal statement displays a humility and broader environmental education vision when it calls for scientists, environmentalists, economists, and other experts “to continue to help us understand the challenges we face and the steps we need to take. Faith is not a substitute for facts; the more we know about the problems we face, the better we can respond” (1992, p. 12). More recently, in 2014, Pope Francis I addressed people from all faiths to promote the care of the earth as our common home, citing that “everything in the world is interconnected” (Francis I, 2015), whilst also naming the need for ‘ecological conversion’ six times in the document. His call has been endorsed in ensuing, related Catholic writing (Brisbane Catholic Education, 2014; Catholic Earthcare Australia, 2017; Longbottom, 2015).

Having highlighted the disparity in Catholic Church documents of the term ecological conversion, seen at times within an anthropocentric overtone, I now review the concept of environmental education in Catholic Church writing.

The Catholic Church and the wider concept of environmental education

The wider concept of environmental education has continued to need clarification amidst social and political impacts. Local and global environmental crises, including climate change and the growing awareness of environmental disasters, provide the impetus for large numbers of people to send clear messages to their leaders that they
feel environmental action is paramount (see Lowenstein, Martusewicz, & Voelker, 2010). As discussed earlier, this groundswell of urgency for governments to address environmental problems has been evident in international statements, particularly those of the United Nations, including the *Bonn Declaration* (UNESCO, 2009a) and *Ahmedabad Declaration* (UNESCO-UNEP, 2008). Catholic Church documents have also reiterated environmental degradation (Catholic Climate Covenant, 2011; Catholic Earthcare Australia, 2012; United States Conference of Catholic Bishops, 2012a, 2012b; USCCB, 1992). The wider human reaction to the current prevailing environmental issues are signposts that current studies in environmental education are crucial if common understandings of the issues and directions for action are to succeed. In 2017, Pope Francis I continued to address this topic, reminding his audience that life flows through people’s interactions and relations with each other where, “the future is, most of all, in the hands of those people who recognize the other as a you and themselves as part of an us” (Francis 1, 2017).

**Summary**

In this section I outlined the Catholic Church documents and terms used in its understanding of environmental education. In particular, I outlined the prevalence of the terms ‘ecological responsibility’, ‘consciousness’ and ‘conversion’, used in deference to ‘environmental education’. The dichotomy was also addressed of the anthropocentric nature of the hierarchical Catholic Church structure, alongside the ecocentric messages given, stemming from the primacy of all God’s creation.

The next section explores further the anthropocentric/ecocentric and sustainability debate within primary education and Catholic schooling.
2.3 The emergence of environmental education in the primary school curriculum, with particular reference to the Catholic school context.

The relevance of environmental education in schooling is broadly echoed in the 2005 UNESCO document, which affirms, “education is essential for moving toward a more sustainable future. We cannot imagine how the people of all nations could move toward a more sustainable world without the contribution of educators from around the globe” (p. 11).

In Australia, the Melbourne Declaration of 2008 set the direction for Australian schooling for the next ten years, pronouncing that “a focus on environmental sustainability will be integrated across the curriculum” (MCEETYA, 2008, p. 14). These sentiments run through much of the current environmental education research, but there is a lack of study into the relevance of its implementation and impact in the primary school (Bartlett & Burton, 2006; Cutter & Smith, 2001; 2003; Edwards, 2011; Kennelly & Taylor, 2007; Lowenstein et al., 2010). A similar finding can be attributed to the Catholic school system (see Hindmarsh, 2008; Salomone, 2006). Chawla (2008, p. 21) notes that, from her study of fifty-six environmentalists in Kentucky and Norway, only one person noted being influenced in environmental attitudes by primary school experiences; “all (other) references to education related to junior high, secondary school or the university”. Recent PhD thesis projects (Bannan-Watts, 2009; Hindmarsh, 2008; Widdop-Quinton, 2015) continue to support the concept that research strategies in this area promote and track the success of individual case study achievements, yet wider mandatory and systems-based educational initiatives are lacking.
In reviewing the emergence of environmental education in the curriculum I will now discuss the implementation of an environmental education curriculum in support of learning, relevant to both students’ development and environmental education in an integrated curriculum.

**Implementation of an environmental education curriculum**

The above finding needs to be seen in a wider context: that the practice of environmental education has changed markedly in the last decade, within the changing nature of contemporary childhood, and that there is competing literature that suggests the early years and primary years are vital for the success of environmental education IUCN (see Cutter-Mackenzie, 2017; Gostev, 2007; Johnston, 2009; Langley, 2009; Lewis & Baudains, 2007; Loughland, Reid, & Petocz, 2002; Sutton, 2009). The literature, describing success in the primary years is not yet widely implemented, as supported by Tilbury et al. (2011), “There is an abundance of information available about the specific objectives and outcomes of projects, but a noticeable lack of data to show how these objectives and outcomes are achieved” (p.105).

The lack of widespread implementation within primary schools is also supported by other researchers (see Bartlett & Burton, 2006; Cutter-Mackenzie, 2003). However, some recent research suggests that there is a groundswell of environmental education activity in Australian primary schools as a consequence of substantial policy, program and resource investment. Speaking directly to the latter, Cutter-Mackenzie (2010, p. 177) states that there is “a growing culture of sustainability” in Australian primary schools.
The Re-Emergence of Values in Science Education (Corrigan, Dillon, & Gunstone, 2007) calls for reconsideration of values within nature and place. The study of values and ethics is becoming increasingly pertinent in environmental education research, as exemplified in Leiserowitz and Fernandez’ description “as part of, and emergent from, nature and natural processes, with attendant moral duties, responsibilities, and obligations” (2008, p. 19).

Education departments in Australia embed values into all subject strands of current syllabi, as evidenced by aims and objectives in NSW Board of Studies documents: “Students will engage in learning experiences which will enable them to develop positive and informed values and attitudes” (Board of Studies, 1993, p. 7; 2012). Catholic religious education, primary school documents do likewise (Catholic Education Office: Sydney, 2012, np). A Year Four values outcome states, “Students will demonstrate that they are aware of the importance of living in harmony with the earth community” (np.). The significance of this study is further evident in that the rhetoric of these documents need to be researched for evidence of how these values are successfully embedded across all subject areas to enhance environmental learning, particularly within multidisciplinary, interdisciplinary and transdisciplinary approaches (see Table 2.1).

Tucker (2012) maintains that world religions historically display basic elements of environmental ethics that are found in current environmental education research and that religions have much to offer sustainable development discussions. One relatively recent Catholic environmental education resource addresses this claim: A Strategic, Systems-based, Integrated Sustainability Initiative (ASSISI) is a large-scale project
developed by Catholic Earthcare (2008). ASSISI “provides a theological, spiritual and practical base for implementing Earthcare's ecological vision for Catholic schools and communities. Its hope is to achieve ecological sustainability for the Catholic Church in Australia” (np).

Another offering in this area is a Catholic document that has been rolled out progressively for different states since 2006. The latest edition, published in 2010, is the South Australian edition of On Holy Ground (Catholic Earthcare Australia, 2010). It is a joint initiative of Catholic Earthcare, ASSISI and the Archdiocese of Adelaide and uses similar wording to the IUCN (1970) in defining Ecological Education as:

> A life-long process of recognising values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness of all creation; it also entails practice in decision making for living a life that is ecologically and ethically sustainable.

(Catholic Earthcare Australia, 2010, p. 7)

Despite the examples cited above, it is obvious there is scant research from a religious perspective in Catholic primary education and that a crucial concern to be addressed, in particular, is whose values are being expressed in the teaching of environmental education (Agyeman, 2006; Kollmuss & Agyeman, 2002). The significance of the values agenda to this study requires the search for quality teaching, encompassing student centred scrutiny of values across all subject areas within Catholic primary education. There is a definite need for the development of an integrated, cross-discipline approach including environmental education, thus ensuring both knowledge and values are more fully addressed. Research in this area needs to centre on the
significance of how children make informed choices and decisions about the environment.

There has been a definite lack of research into the perceptions of learners within the processes of environmental knowledge, attitudes and opportunities for values to be formed. I contend, with the implementation of the Australian Curriculum (ACARA, 2014), and its inclusion of sustainability as a cross-curriculum priority\(^\text{16}\), this is an ideal time to be developing new research around the knowledge-action gap in environmental education. With this in mind, I now transition to investigating evidence that supports relevant developmental learning.

**Evidence in support of learning relevant to students’ development**

Further evidence of a breakdown between what researchers have identified as good environmental education practice, compared to its wider implementation (Tilbury, 2004; UNESCO, 1977, 1997, 2008; UNESCO-UNEP, 1978, 1988) does not transfer to the actual primary teaching curriculum in Australian primary schools. The rhetoric of the documents has become increasingly evident in education department policies over the past ten years but, until the recent release of the *Australian National Curriculum* (ACARA, 2014)\(^\text{17}\), primary students’ depth of exposure to relevant

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\(^{16}\) The following extract from the Australian Curriculum website elaborates that “Cross-curriculum priorities are only addressed through learning areas and do not constitute curriculum on their own, as they do not exist outside of learning areas. Instead, the priorities are identified wherever they are developed or have been applied in content descriptions. They are also identified where they offer opportunities to add depth and richness to student learning” (ACARA, 2014, np.).

\(^{17}\) The new Australian curriculum (2009) was trialled in 2013, implementation begun in 2014 and updated yearly, is timely in that one of its three cross-curriculum priorities is ‘sustainability’, thus ensuring the term holds a central place in the curriculum: “For each cross-curriculum priority, a set of organising ideas reflects the essential knowledge, understandings and skills for the priority. The organising ideas are embedded in the content descriptions and elaborations of each learning area as appropriate” (2009, np.).
sustainability concepts in official teaching units of work has been limited (Cutter-Mackenzie, 2017, p. 357; Fereira, Ryan, & Tilbury, 2006; Tilbury, 2011).

This point is reiterated in Cutter-Mackenzie’s work (2010, 2017; 2008; 2003), where she argues that environmental education is developmentally inappropriate when children are exposed to abstract studies of threats to distant and exotic ecological environments, rather than starting with “their own lives, their own places, their own environment, and the other-than-human” (Cutter-Mackenzie, 2017, p. 358). Her concerns were borne out in the previous NSW Board of Studies Primary Human Society and its Environment K-6, Units of Work document (Board of Studies, 1998, p. 11) with an environmental unit of work for 10 to 11-year-olds titled Current Issues: Antarctica, which does not begin with, or relate back to what the students have studied in their own, local environment. Although the Board of Studies, as a footnote, does offer alternative suggestions that would allow for local study comparisons, teachers usually accept the unit of work that is ready to implement. The current Australian Curriculum, with its inclusive sustainability cross-curriculum priority, addresses this problem, in that it calls for an holistic education where sustainability

Develops the knowledge, skills, values and worldviews necessary for people to act in ways that contribute to more sustainable patterns of living. It enables individuals and communities to reflect on ways of interpreting and engaging with the world. Sustainability education is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through informed action. (ACARA, 2014)
The continuing updates applied to the current Curriculum (see ACARA, 2014, 2017) support the need for subsequent in-depth teacher education to empower teachers to choose suitable, age-appropriate areas of study that addresses the holistic education that ACARA are mandating for all students. This viewpoint is supported by Stone (2010, p. 36), who cites one of the guiding principles for the understanding of curriculum as “Sustainable living is rooted in a deep knowledge of place.”

The need for a more expansive understanding of age-appropriate study within a local environment has been established. I now turn to investigating the assumption of environmental education within and integrated curriculum.

Environmental education in an integrated curriculum

Greenwood’s advocacy that teacher education is “narrowed by a school-centric worldview, and is further controlled by a relationship with state government” (2010, p. 142) has been upheld by other research. There is some evidence that Government departments (Australian Education for Sustainability Alliance, 2014; Department of the Environment and Heritage, 2005; NSW Board of Studies, 2014) and UNESCO (2010, 2014) have produced some papers to counteract this hurdle. Research, however, still indicates that environmental education is isolated within both the current curriculum structure and the lack of teacher understanding and confidence (see Cutter-Mackenzie et al., 2008; Fien et al., 2010; Greenwood, 2010; Payne, 2016; Pearson, Honeywood, & O'Toole, 2005; Savage & Drake, 2016; UNESCO, 2014)

Scott (2009) adds voice for the need to address the isolation of environmental advocacy in schools. He argues for an inclusive age-appropriate integration of values and knowledge, where critical knowledge is taught alongside the promotion of
environmental causes. There needs to be a reciprocity of what education can do for sustainability, alongside what sustainability can do for education. Academic rigour is essential for education across all fields, inclusive of environmental education.

The studies on environmental learning displayed in primary schools are generally teacher driven, and students are disengaged with authentic environmental learning. UNESCO (2010, 2014) calls for learner-centred pedagogy, within an integrated curriculum that enhances environmental education. The knowledge-behaviour gap identified by Agyeman (2006) and Courteney-Hall (2002) further supports the need for continued research into action-based and behaviour-based environmental education experiences for primary aged children. Likewise, in Catholic education, the policies are in place but there is a need for wider Catholic education evidence, rather than isolated research papers (see Bannan-Watts, 2009; Edwards, 2011; Hindmarsh, 2008) that are seldom referred to in Catholic system policies. There is little evidence that values-based environmental education is being implemented across the curriculum in an integrated, structured teaching and learning framework.

Catholic schools in Australia have clear documentation that encourages the teaching of environmental education within the religious education and education for sustainability (EFS) frameworks (see Catholic Earthcare Australia, 2010; Catholic Education Office: Sydney, 2006; Catholic Education Office: Sydney, 2012). The implications for future direction for environmental education in the Catholic primary school are necessarily of a different nature to state education schools, in that there is a given structure of core beliefs within which religious education, scientific values and environmental education must sit, as evidenced in more recent Church documents (see Francis I, 2015; Vatican, 2005, 2012).
Summary

In this section the initial findings, when applied to the emergence of environmental education in the primary school years, strongly indicate, at least in policy documents, that both secular and Catholic education policies are increasingly embracing environmental education, albeit that Catholic schooling, by its very nature of being ‘Catholic’ must be guided by Church documents. There is sufficient research indicating that environmental education needs to be included in an integrated curriculum to ensure authentic teaching and learning. However, the implementation in the classroom and consequent effectiveness of environmental education approaches is a significant area in need of further research.

As such, I now turn to the next section, which explores the relevance of incorporating story into the implementation of primary environmental education.
2.4 The relevance of story, in particular, the emerging scientific origin story in environmental education

Our place in nature, on earth, and in the universe could be woven throughout the entire curriculum. (Leiserowitz & Fernandez, 2008, p. 46)

The significance of this section is to explore the limited research into the effectiveness of incorporating environmental and scientific values, as told in the emerging scientific story of the universe, and the extent to which they could underpin values in environmental education in the primary Catholic curriculum. I now discuss the following points to help interpret environmental education through the use of metanarrative, interrelated systems and spirituality, the place of story and religious education and lastly, systems interconnecting the Big History storyline to environmental education.

A significant area of research into educating towards a connection to the environment is through the study of a sense of interconnectedness, spirituality and reverence (see Bonnett, 2002, 2009, 2012; Bowers, 2010a; Cassell & Nelson, 2010; Goleman, Barlow, & Bennett, 2010; Hart, 2010; Lowenstein et al., 2010; Naess, 2011; Riordan & Klein, 2010; Stone, 2010). Barry (2006, 2010) sees as an environment-society disconnect where current metanarrative taught in schools does not promote environmental education that fosters equality and interdependence. The loss of cosmological context is also debated in Liererowitz and Fernandez (2008), who support the promotion of a need for reattachment to cosology which links to research based on limited anthropocentric values compared to an interconnectedness.
of human and non-human (also see Irvine, 2014; Latour, 2014; Stephen. Sterling, Glasser, Rieckmann, & Warwick, 2017; Tucker, 2012). Lieserowitz and Fernandez argue that, although “the humanities increasingly severed ties with religious cosmologies, such as in Genesis … the new cosmology emerging from theoretical physics, astronomy, and biology” has not been embraced in education (2008, p. 19).

There is an increasing spotlight on the familiarity of the emerging story of the Universe to engender a sense of belonging, purpose and interconnectedness (see Agelidou, 2010; Benjamin, 2009; Bowers, 1993, 2012; Christian & Gates, 2011; IBHA, 2012a; Masien, 2012; Nazaretyan, 2005; Swimme & Tucker, 2012).

**Catholic education stance**

Official Catholic Church thinking has developed its ideas along similar lines to the above references where, in Catholic documents at least, there is an understanding of interconnectedness, reverence and spirituality within the Catholic belief system that is quoted as “the common good” (see Australian Catholic Social Justice Council (ACSJC), 2002; Catholic Education: Sandhurst Diocese, 2014b; Education; Francis I, 2015). This term is historically defined and quoted as early as 1963, in the landmark Catholic Church encyclical, ‘Pacem in Terris’: “There will always be an imperative need … to promote in sufficient measure the universal common good; the good, that is, of the whole human family” (John XXIII, 1963, np).

The substantial significance of the term in the hierarchy of the Catholic Church is evident in that it is quoted forty-six times in the one document. This term was the foundation for future Church documents pertaining to calls for a sustainable environment (see Benedict, 2009; Catholic Earthcare Australia, 2010; John Paul II & Bartholomew I, 2002).
The Catholic Earthcare website (2012, np) offers Catholics a practical and spiritual Catholic underpinning to environmental education for schools and parishes. Part of its definition of ecological education emphasises the interconnectedness of creation, in that it “is a life-long process that recognises, values and clarifies concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness of all creation”. The same document supports its definition, citing Edwards, a prominent Australian Catholic researcher: “We are part of the interconnected community of creation, inter-related with all other creatures” (np).

Further evidence of the commitment of Catholic Earthcare to correlating religious education to the emerging scientific story is their 2013 release of an online educational interactive program, ‘The awesome cosmic story’, which “explores the creation of the universe and the world as we know it, through an inspirational blend of theology and science” (2013, np). Having established the importance of the emerging story of the Universe in environmental education to engender a sense of belonging and interconnectedness, as opposed to the worldview of the anthropocene, I now investigate that story in relation to religious education.

### Story and religious education

The education of children … is influenced by the deepest metanarratives of the cultural group. (Bowers, 1994, p.71)

I contend that Bower’s quote, although written in 1994, still resonates with the significance of my research queries, namely investigating the extent of the influences of the emerging and current metanarrative: the scientific story of the universe and the
influences this metanarrative may have in promoting student and teacher values in environmental education. I add extra layers to the paradigm in that I am viewing my study through the lens of the Catholic Church’s metanarrative and within the Catholic education context. Below I quote two proponents of the universal story: the first was written over thirty years ago by Thomas Berry, a Catholic eco-theologian and cultural historian, while Christian’s recent quote laments the fact that societies have not embraced a unified story.

Within this [universe] story a structure of knowledge can be established with its human significance from the physics of the universe and chemistry, through geology and biology to anthropology, and so on to an understanding of the entire range of human endeavour…In all these studies and in all these functions, the basic values depend on conformity with the earth process. To harm the earth is to harm man (sic), to ruin the earth is to destroy man [sic]. (Berry, 1978, p. 13)

It is one of the many odd features of modern society, that despite having access to more hard information than any earlier society, those in modern educational systems…teach about (our) origins in disconnected fragments. We seem incapable of offering a unified account of how things came to be in the way they are. (Christian, 2011, p. 2)

The abovementioned quotes, from secular and Catholic writing, are indicative of environmental education findings over thirty years, yet evidence for their implementation is doubtful. In 1978, Berry called for an integration of studies that he believed would aid ecological understanding and renewal by unifying the new story that science is continuing to discover. Christian’s similar message was written thirty-
three years later; this similarity of messages further clarifies the significance of my research within the field of environmental education, that possible new paradigms are yet to be incorporated into current, mainstream primary environmental education directions; Orr in his call for the earth to be valued beyond the era of the anthropocene asks, “In such rapidly changing ecological, technological, economic, and social changes, what is worth knowing? What is of enduring value? How do we teach?” (Orr, 2017, p. ix).

Pope John Paul II’s call (1990) for an education embracing ecological responsibility, is similar proof, in that it was a call to all members of the earth community, yet twenty-eight years later, with recent religious education documents (Catholic Education Office: Sydney, 2006; Catholic Education SA, 2008; Catholic Education: Sandhurst Diocese, 2014a, 2014c) promoting environmental education, the effectiveness of the implementation is not evident. The implications for further research are significant in this area. With this in mind I now investigate ‘story’ within the perspectives of a systems-thinking framework and Big History.

**Systems thinking framework and the Big History storyline**

Systems thinking, as previously documented in Chapter One in the context of this research, is to understand local or macro environments within an holistic educational approach, involving networks and relationships across a variety of disciplines (Laszlo & Krippner, 1998), that in turn enables informed decision making and possibility of agency to act on the new information (Catholic Education Office: Sydney, 2006; Laszlo & Krippner, 1998; Stephen Sterling, 2010; Stone, 2010).

There is a need for further research into incorporating emerging educational
perspectives into environmental education. This extends to investigating environmental education systems-based research that integrates multi-disciplines towards a cohesive, knowledge system and embraces environmental education (see Benjamin, 2009; Christian, 2012; Christian, Brown, & Benjamin, 2013; Fereira et al., 2006). Lieserowitz and Fernandez contend, from an environmental studies stance, that this is a necessary direction as “many researchers can no longer understand the breadth of their own discipline, much less how their discipline might intersect with others” (2008, p. 20). They acknowledge that holistic and systems perspectives are beginning to be viewed as important to the environmental crisis, but funding is lacking.

A broader systems-based framework in the Australian primary school is yet to incorporate the emerging study of a scientific-based theory, encompassing the evolving knowledge of the 13.8-billion-year history of the universe.

The need for education to embrace the broad perspective of a universal history is addressed in research through the concept of deep time, including Cheek (2012), who questions the ability of students to place geologic events on an historical universal scale (Cheek, 2012, pp. 1047-1048). Delgado (2014) views deep time through a “landmarks framework”, consisting of the learnt evidence of key chronological events, that then allow the learner to develop a mental framework for deep time and to enable a deeper understanding of new information. In demonstrating his viewpoint, he cites the example where a lack of understanding of deep time of the age of the Earth can lead to resisting the theory of evolution (2014, p. 2).

The importance of an awareness of deep time is accentuated when consigning it to
addressing future sustainability that stems from society’s contemporary understanding of changes to the Earth through human activity and anthropocentric thinking (see Crumley et al., 2015, p. 1721; Irvine, 2014, p. 158; Zalasiewicz, Williams, Haywood, & Ellis, 2011, p. 840). Crumley et al. emphasise the centrality of the need to link deep time to current environmental issues and anthropocentric response to these issues that they identify as the “unifying concept of the Anthropocene in the Longue Durée” (2015, p. 1723).

The following excerpt from a radio interview with Brian Green links the concepts of awe and wonder to a deeper knowledge of the origins of creation; he argues that educators should,

Not just teach ‘kids’ the details of mathematics and science - which is important - I'm not going to underplay the values of rigorous training, but you have to have a parallel track that takes them out to the stars and shows them what they'll be able to do if they learn these details. They'll be able to grasp all of this wonder - the origin of the universe, the origin of life; all these wonderful features of reality will be available to them in a deeper way … and we can do that, we can do that, but we don't. (2017, 17-19 mins)

Many members of the International Big History Association (IBHA, 2012b, 2018) were involved in the launch of the multi-disciplinary initiative, The Big History Project (2018) in secondary education. The Big History Project addresses an existing significant gap in accessibility to a deep time historical story through interdisciplinary and transdisciplinary learning (refer to Table 2.1). Although the Big History Project and IBHA are separate organisations, they continue to be supportive of each other,
encouraging research into implementing the project in primary education. The evolving Big History Project course explores the story of time, from the moment of the big bang and has gained both academic support and funding embedded in the project. The particular significance in what Big History has to offer environmental education in the primary school is yet to be researched.

It is also acknowledged within the available literature there is some criticism of the relatively recent Big History concept when viewed from the limited metanarrative perspective, including Fleming (2015, p. 965), who warns that the “telling all-inclusive ‘just so’ stories will increase the reach and relevance of history” if it is limited to one or two grand solutions to today’s complex environmental problems. Parks (2014) writes in a similar vein, where he questions the relevance of teaching a singular meta-narrative of the universe. Jackson and Finn (2015, p. 7) query that if Big History is attempting to avoid fragmenting the entire history in one selective and constructed version of a creation myth amongst competing metanarratives, why would all of humanity view it as an answer for the ills of the universe? The validity of these views will be investigated further in the development of the theoretical framework and methodology for this research.

Leiserowitz and Fernandez believe in a broader vision of meta-narrative, that “The sense of an enchanted, awe-inspiring universe and creation can reawaken a commitment to the Earth that the scientific narrative alone tends not to stimulate” (2008, p. 39). There is dissent with this point of view in other research. Ashley (2006) argues that, because of the anthropocentric stance of Christianity, there is little opportunity to be optimistic for Christianity to lead the way in the ecological movement with a sense of awe. Benjamin (2009) conversely believes that, in
integrating studies to teach a ‘big’ history of the universe, it allows the teacher to meet students where they currently are, taking into account both faith and non-faith backgrounds. Bonnett’s approach (2009) links to the above two arguments in that he discusses the ‘selving’ of nature and the ‘unseling’ of self as a way of appreciating the natural environment within a systemic framework.

The significance of this research is evident in the need for an analysis of the various possibilities to promote values in primary school environmental education and religious education within awe for creation (see Catholic Earthcare Australia, 2012, 2017; Gustafson, 2017; Hitzhusen, 2006; Podger, Piggot, et al., 2010; Swimme & Tucker, 2012; Sydney Catholic Schools, 2016). In particular, I believe there is a dearth of research into the significance of Catholic teaching and beliefs into environmental education within the broader Catholic primary education systems. The Catholic religious education curriculum especially lends itself to an interpretation of the emerging scientific story within its ‘Creation’ content strand that states:

Teaching and learning in the content strand Creation, enables the students to identify and respond to the presence of God in all creation. Students come to know the interconnectedness of all creation … students are invited to accept their responsibility to care for and live in harmony with all creation. (Catholic Education Office: Sydney, 2012, p. 13)

I have established the need for further research of the effect on values when studied from within Catholic education and the emerging account of the universe from a scientific perspective. I now summarise the insight I have gained from reviewing the relevance of story to this research.
Summary

This section explored the research behind, and the relevance of incorporating the emerging scientific story into environmental education in the primary curriculum. This research seeks to encapsulate wider research advocating the significance of using a whole-systems and deep time framework to teach environmental education. The idea was further explored in relating what possibilities systems-based thinking and the Big History Project can bring to the directions of this research. It is also significant that the Catholic religious education documents allow scope to correlate the values also found in environmental education documents.

2.5 Literature review conclusion

The underpinning concepts for the literature review were identified as ‘story’ and ‘values’ and, within this framework, four relevant areas of research were established.

Firstly, the significant global events in the history of environmental education were outlined, and a growth in the understanding of environmental education and its subsequent terms were identified.

Secondly, the positioning of environmental education within Catholic Church statements and documents revealed significant alignment with global environmental education documentation, specifically in the area of anthropocentrism and ecocentrism. The emphasis on ecological awareness, consciousness and conversion contributes to the direction of this study in relation to values education.

Thirdly, the emergence of the call for interdisciplinary and transdisciplinary approaches to environmental education in primary curriculum and pedagogy were
explored, with particular reference to the Catholic school context.

Lastly, the relevance of story, in particular, the emerging scientific origin story, led to a particular focus of environmental education, directed away from anthropocentric thinking and focusing on the broader context of Big History with the possibility of opportunities to incorporate this story within the Catholic religious education curriculum.

I now turn to the theoretical framework and the methodology that will inform and guide my research.
CHAPTER THREE

FRAMING THE STORY - THEORETICAL FRAMEWORK

Introduction

The theoretical framing for analysing the data in this thesis is derived from the literature review’s significance of historical and current research in environmental education within the broader scope of education. The centrality of ‘story’ and the underlying importance of values in environmental education are vital to this study. In Chapter Two, literature was explored from the vantage point of emerging trends in environmental education in international and educational policy imperatives, compared with and in contrast to, those of the Catholic Church and Catholic educational institutions. There is significant evidence, from the literature review, of the vital importance of values in the planning, implementation and assessment of environmental education programs in the primary education sector.

The particular area identified as warranting further study is the extent that teaching the emerging scientific and historic origin story of the universe could affect the informing of primary students’ values, which have been clearly identified in both secular and Catholic environmental education statements. The call for an interdisciplinary approach to the effective teaching of the universe story necessarily calls for a theoretical framing where values can be viewed through the lenses of systems theory, curriculum theory and socioecological learning. Interdisciplinary pedagogies are essential for the validity of this research, and the above three theories are highly relevant to investigating integrated student critical enquiry, not only in environmental education but also across multi-disciplines.
The theoretical framework establishes links between values and the scientific universe story, within the parameters of Catholic and secular primary education, environmental education, the interdisciplinary whole systems theory and curriculum theory. Figure 3.1 summarises the key concepts explored above in order to develop a theoretical model for my research.

**Figure 3.1 Developing a theoretical framework**
I now critically discuss such concepts raised in Figure 3.1., dealing with them sequentially from a values perspective, relating them to curriculum and whole systems theories and developing my theoretical model suited to this research.

3.1 Story framing: Values and value-based education

People may hold thousands of beliefs, which combine to form attitude orientations toward responding to an object or set of circumstances in a certain way, and attitudes are the building blocks of values. An adult has hundreds, or thousands of beliefs, a smaller number of attitudes and only dozens of values. (Caduto, 1985, pp. 8 and 16)

Caduto’s words situate a person’s values as preciously attained through a process involving many beliefs and the formation of attitudes. I contend that the particular strand of environmental education research, centring on the metanarrative/grand story aspect, would belie its integrity if it were placed in silos of individual education disciplines. Rather, the theoretical framing needs to be studied from an understanding of values in environmental education, within a holistic, interdisciplinary perspective.

In this section I explore the validity of defining the term ‘values’ within the above paradigm and with particular reference to the following:

- Defining ‘values’;
- Australian values education (Department of Education; Department of Education: Science and Training, 2005a, 2005b; Lovat & Toomey, 2009; Lovat, Toomey, Dally, & Clement, 2009);
- The varied interpretations of environmental education statements (Gough, 2011; MCEETYA, 2008; Tilbury, 2002; UNESCO, 1980, 2009, 2012;

- Environmental scholarship (al-Naki, 2004; Barry, 2006; Blake, 1999; Bowers, 2002; Burford et al., 2013; Hungerford & Volk, 1990; Leiserowitz & Fernandez, 2008; Palmer & Wagner, 2013; Podger et al., 2010; Sauve, 2005); and

- Catholic education (Berry, 1996; Brown, 2004; Catholic Earthcare Australia, 2010; Catholic Education Office: Sydney, 2006, 2012).

Defining values: The place of ontology and epistemology in theoretical framing

Values are in turn formed by a meld of closely aligned attitudes. A value is an enduring conviction that a specific mode of conduct is ... preferable to an opposite mode of conduct. (Caduto, 1985, p. 7)

(Values are) the principles, fundamental convictions, ideals, standards, or life stances which act as general guides or as points of reference in decision-making or the evaluation of beliefs or actions and which are closely connected to personal integrity and personal identity. (Halstead, 1996, p. 5)

Caduto (1985) and Halstead (1996) encapsulate the essence of what values are, yet neither can be taken as the ultimate definition of ‘values’. Bowers verifies the multiplicity of pathways in attempting to form a single definition from an epistemological stance; he writes of the vast variety of “cultural epistemes … and that many of these epistemes encode both technical knowledge and moral awareness of
the limits and possibilities of the cultural group's bioregion” (2001, p. 5). While Bowers relates his discussion to both limits and possibilities, when trying to understand ideas within cultural settings, Sterling (2003) expands the possibilities further. He introduces the concept of ontology, epistemology and methodology, from an ecological worldview and the viewpoint of whole systems thinking, as:

Revisioning ontology, epistemology and methodology in terms of wholeness.
In so doing, it attempts to bring together and syncretize the methodology of systems thinking, a co-evolutionary ontology, and the worldview and ethical orientation of ecological thought. (Sterling, 2003, p. 46)

I adapt Sterling’s model (2003, p. 96) for this study in that it provides an inclusive approach beyond the anthropocentric worldview for the focus of my theoretical framing of this research. Sterling (2003, pp. 130-132) adds credence to his reorganisation of the terms as interdependent and systemic thinking, as seen in Figure 3.2, by quoting Bateson’s similar view of epistemology “in inclusive terms: the great bridge between all branches of the world of experience – intellectual, emotional, observational, theoretical, verbal and wordless. Knowledge, wisdom, art, religion, sport and science are bridged from the stance of epistemology” (Harries-Jones, 1995, p. 9, cited in Sterling, 2003). Figure 3.2 is adapted from the broader worldview that Sterling offers, opening up an epistemological understanding of values within ethical and ecological thinking from a whole-systems’ point of view, yet also encapsulated within cultural settings.
As described above, there is no one definition for the term ‘values’ in education. This signposts the need to incorporate differing epistemological perspectives where the field is characterised by a multiplicity of interpretations and propositions across multidisciplinary and interdisciplinary fields, as outlined by Sterling’s diagram, reproduced in Figure 3.7 below. I now review various explanations of values in order to identify the ‘types’ of values central to this thesis.
3.2 Whose story? Whose values?

As stated earlier in this section, values in educational research are interpreted across a multiplicity of disciplines and cannot be translated to a single definition within environmental education research. For the purpose of my theoretical framing I critique the concept of values from the perspectives of values education, environmental education and relevant Australian Curriculum documents and the particular perspectives of NSW Board of Studies (Board of Studies, 2010, 2012; NSW Board of Studies, 2014) and Sydney Catholic Education Office\(^\text{18}\) (Sydney Catholic Education Office, 2005, 2011).

**Values education, not values neutral education**

According to Huckle (1991) “values education develops comprehension of the sources of beliefs and values, how they are transmitted, and the interests they support” (p. 54). As a comparison to the latter definition, values education and the *Australian Curriculum* (Department of Education Employment and Workplace Relations, 2011) bases its report on the following definition of the 2005 National Framework for values education report:

> Any explicit and/or implicit school-based activity which promotes student understanding and knowledge of values and which develops the skills and dispositions of students so they can enact particular values as individuals and as members of the wider community. (2005a, p. 8)

\(^{18}\) Particular reference is made to NSW BOS Australian Curriculum, as of 2017 renamed NESA (NSW Education Standards Authority, 2017), and the Sydney Catholic Education documents because that is where my research is situated.
The Department of Education abovementioned definition highlights the tension in the understanding of values education; Huckle’s definition omits the wording ‘knowledge … skills’, whereas they are explicit in the current *Australian Curriculum* (ACARA, 2014; Department of Education Employment and Workplace Relations, 2011).

The following analysis is framed within a discourse of how the use or omission of particular wording in historical and current understanding of values has influenced current research into the meaning of values and values education.

Lovat et al. (2011) overturn beliefs that schools should not be teaching values education; rather, they assert education is crucial in supplementing the values of home and religious beliefs. When investigating values education it is clear that values neutral education is not seen as an option in current educational research (See Bezzina, 2014; Bonnett, 2013; Halstead, 1996; Hamston, Weston, Wajsenberg, & Brown, 2010; Lovat & Toomey, 2009; Lovat, Toomey, Clement, Pring, & Noddings, 2010). Lovat (2010) argues that the concept of public education as values neutral is misguided and clarifies this point by citing the historic 1880 *New South Wales Public Instructions Act*, which stressed the need for students to be "inculcated into the values of their society, including understanding the role that religious values had played in forming that society's legal codes and social ethics" (Lovat et al., 2010, p. 4). Lovat cites that "Public education's charter includes responsibility for personal integrity and social justice" (2010, p. 4), and he applauds the fact that, since the early 1990s, Australian education and academic documents have been actively reversing the mistaken concept of values neutrality education. The positive view of values as being promoted to help students see themselves as Australian and global citizens (2010, p. 3), is not only a basis for further exploration of the importance of values in
environmental education, but importantly within an holistic education model. This view continues to be supported in recent literature, including Dahl (2012) and Garrison, Ostman and Hakansson (2014).

The Catholic Church stance, regarding its views against the concept of neutrality of values needs to be acknowledged in this discussion. The Congregation for Catholic Education (1982) states that Catholic teachers are not to present Christian values as abstract facts but that values need to be presented sincerely so that they can “generate human attitudes, and these attitudes must be encouraged in the students” (1982, no. 30.). As recently as 2014, Pope Francis I spoke specifically about the values in education in an address to 300,000 students in Rome, where he reminded all educators that “Education cannot be neutral, either it is positive or it is negative; it enriches or impoverishes; it helps the person grow or it suppresses or even corrupts them” (Wooden, 2014, np). This statement emphasises an open pedagogical approach in Catholic education, already identified in this research. This approach is significant to the value of education generally, where a critical, objective approach to acknowledging the ‘other’ (Wright, 2003, p. 97) and restoring unity to the educational process (Bezzina, 2014) is a paramount educational value. Values-based education now needs to be explored within this context.

**Values-based environmental education**

The variety of documents relating to how values are perceived in environmental education is a challenge in managing the direction of this research (See Ardoin, 2006; Cassell & Nelson, 2010; Cutter-Mackenzie & Smith, 2003; Leduc & Warkentin, 2006; Leiserowitz & Fernandez, 2008; Palmer & Wagner, 2013; Sterling, 2003). As stated clearly in previous sections, the understanding of values in environmental
education, for the purpose of this research, needs to be situated in the context of interdisciplinary, holistic and systemic thinking, where the metanarrative also sits comfortably (See Barry, 2010; Benjamin, 2009; Berry & Swimme, 1992; Bowers, 1994; Catholic Earthcare Australia, 2010, 2013; Christian, 2011; Edwards, 2012; P. Johnson & Duberley, 2000; Wallette & Edgren, 2013).

Hart (2003) acknowledges that values are fundamental to environmental education and across disciplines; he also raises the question of why some values are seen as more important over others. He cites policies, based on values, that have refined environmental education (UNESCO-UNEP, 1976, 1978; United Nations, 1992) and asserts that community debate could address significant values for particular cultures and public education (2003, pp. 104-105). Hart (2010) adds voice to the need for more open philosophical discourses in ideological and critical enquiry. He cites his basis for this approach through observations over several decades, of trends in foundational UNESCO documents that “portray traditional educational mandates as sustaining certain social values based in particular ideologies that is, in particular moral philosophies” (Hart, 2010, p. 3).

Hildebrand (2007) adds credence to Hart’s research (2003, 2010, 2012) on the need to study values from a wider concept; she directs their quest to ask “what values?” need to be taught (2007, pp. 45-47). Values are viewed in an holistic sense, in order to see that current science values follow broader interdisciplinary educational values, acknowledging that there is an overlapping domain of values that generally influence values in science education. The domains specifically named by Hildebrand are those of community, science and education values.
An holistic sense of values and ecological thinking is taken up by Sterling (2008): “Systemic change in thinking and practice, informed by ... ecological thinking and values – (is) essentially a new paradigm, emerging around the poles of holism, systemic thinking, sustainability and complexity” (Sterling, 2008, p. 65).

As alluded to above, Sterling calls for a new systemic and responsive education to address the uncertainty and complexity of our current world. As part of those expectations for education, Sterling names the following values that students will need: “adaptability, creativity, self-reliance, hope and resilience in learners” (2008, p. 65). Sterling summarises his stance by calling for sustainable education to be encapsulated within the whole system of education, enabling it to be “more transformative and appropriate to our times” (p. 66). This in turn will allow for a new consciousness that is able to connect with a wider world view, as discussed in Hart (2003), or as Wright advocates (2003), a connection with one’s alterity, a consciousness of listening to the ‘other’. Krasny and Rose (2013) discuss the concept of entering into an ethical relationship when the ‘other’ is sensed from an aesthetic knowing; they contend that “Aesthetic sensibility ... invites interrogation as opposed to mere retention or passive acceptance” (p. 7). When citing interdisciplinary research within curriculum studies, Krasny and Rose identify the interrelationship played between the values of aesthetics and ethics as a highly important theme. Their conclusion is powerful in directing my study on values related to worldviews and social justice, as outlined below.

The Sustainability Curriculum Framework (Department of the Environment, 2010) aligns with the above values named by Sterling (2008), albeit with different terminology. The Framework advocates for ‘world viewing’, with the need to reflect
on and possibly change fundamental values, and secondly, ‘systems thinking’, where
the complexity of many systems create uncertainty and risk that need to be managed
effectively (2010, p. 10). As vital as these perceptions are to values formation within
environmental education, they are also vital to encouraging the formation of values
across the curriculum.

Tucker (UNESCO, 2012) calls for a broader definition of sustainable development to
include the social justice perspective in addressing the alleviation of poverty
alongside environmental protection. She acknowledges that the problems cannot be
solved by a few isolated disciplines and that there needs to be a values oriented ethical
dimension. She cites the establishment of an international website, The Forum on
Religion and Ecology (School of Forestry and Environmental Studies, 2014), as
bringing religious and ecological research together. Tucker acknowledges, “While
religions have their problematic dimensions … they also have served as wellsprings
of wisdom” where they can balance the dialectic of change and continuity (UNESCO

Researchers’ calls for wider worldviews and systemic thinking, as cited above, is
further encapsulated in Payne’s use of the term ‘non-anthropocentric’ thought. Using
this term, he questions Western thought that uncritically accepts anthropocentric
epistemologies (2015, pp. 166-170) when research needs to be broadened to
“emphasise the affectivity of all beings in their becoming” (p. 170).

In investigating values and values education, the above references provide evidence
for the need for an interdisciplinary and systemic approach, within the various
perspectives of worldview and social justice. The discussion on values education is now explored from the Australian perspective.

**Values-based education: The Australian context**

*The National Framework for Values Education in Australian Schools* (Department of Education: Science and Training, 2005a) is identified in the *Values Education and the Australian Curriculum Report* (Department of Education Employment and Workplace Relations, 2011) as the beginning of a renewed interest in values education and has been a core component in successive governmental and independent reports on values education (See Curriculum Corporation, 2006, 2008; Department of Education; Department of Education Employment and Workplace Relations, 2011; Department of Education: Science and Training, 2005a; Hamston et al., 2010; Lovat & Toomey, 2009; Lovat et al., 2009; Mitchell, 2012). It is further identified as providing a rationale for values education as the centre of school culture (Department of Education; Mitchell, 2012).

*The Melbourne Declaration on Educational Goals for Young Australians* (2008) is pivotal to gaining an understanding of values, both for this research and in the context of the current Australian Curriculum (2014). The *Declaration* is publicly acknowledged as the foundation of the Australian curriculum in the Australian Curriculum, Assessment and Reporting Authority (ACARA) documents and other research in this area (see ACARA, 2012a, 2012b; Board of Studies, 2014; Department of Education; Hamston et al., 2010; Lovat et al., 2011; MCEETYA, 2008; Mitchell, 2012). One example of this is found in *The Shape of the Australian Curriculum: Version 4, 2012 Report* (ACARA), where the changing expectations for curriculum are highlighted by quoting the *Melbourne Declaration’s* promotion of successful
learners (MCEETYA, 2008, pp. 8-9).

Importantly, for this study the ACARA Report (2012b) emphasises that the curriculum development, guided by the *Melbourne Declaration*, is committed to developing “... personal values and attributes such as honesty, resilience, empathy and respect for others ... (and) have the knowledge, skills, understandings and values to establish and maintain healthy, satisfying lives” (2008, p. 8).

The ACARA report also references the *Melbourne Declaration* in declaring a commitment to “national values of democracy, equity and justice, and participate in Australia’s civic life” (2008, p. 9). As discussed above, ACARA (2014) has highlighted the primary guidance of the *Melbourne Declaration* (MCEETYA, 2008) to underpin the curriculum with values; it is therefore significant to list those values below, as highlighted in Goal 2 of the *Declaration*. The bold type in the following table is my interpretation of values named in the list.
Table 3.1 *Melbourne Declaration values* (bold type is my emphasis)

Active and informed citizens

- have a sense of **self-worth, self-awareness** and **personal identity** that enables them to manage their emotional, mental, spiritual and physical wellbeing
- a sense of **optimism** about their lives and the future
- **enterprising**, show **initiative** and use their **creative** abilities
- develop personal values and attributes such as **honesty, resilience, empathy** and **respect** for others
- knowledge, skills, understanding and **values to establish and maintain healthy, satisfying lives**
- **confidence** and capability to pursue university or post-secondary vocational qualifications leading to rewarding and productive employment
- relate well to others and form and maintain healthy relationships
- are well prepared for their potential life roles as family, community and workforce members
- **embrace opportunities**, make rational and informed decisions about their own lives and **accept responsibility** for their own actions.

Confident and creative individuals

- **act with moral and ethical integrity**
- **appreciate Australia’s social, cultural, linguistic and religious diversity**, and have an understanding of Australia’s system of government, history and culture
- **understand and acknowledge the value of Indigenous cultures** and possess the knowledge, skills and understanding to contribute to, and benefit from, reconciliation between Indigenous and non-Indigenous Australians
- **committed to national values of democracy, equity and justice**, and participate in Australia’s civic life
- **relate to and communicate across cultures**, especially the cultures and countries of Asia
- **work for the common good**, in particular sustaining and improving natural and social environments
- **responsible global and local citizens**

The Australian Curriculum addresses environmental education from the perspective of sustainability cross-curriculum priority and values, including the development of “the knowledge, skills, values and worldviews necessary for them to act in ways that contribute to more sustainable patterns of living” (ACARA, 2012b, p. 18). Gough (2011) and Cutter-Mackenzie (2010; 2014) raise the concern that sustainability is named as an essential cross-curriculum priority of the Australian Curriculum, yet there is little cross-referencing of the term within the individual subject disciplines for it to be seen as promoting environmental education values as, its name would presume, a ‘priority’. The lack of cross-disciplinary referencing of the sustainability priority may be seen as a limitation to my research. However, an alternative is to view
values from the perspective of the intention of the *Melbourne Declaration* (2008) and taken up in *The Shape of the Australian Curriculum Report* (ACARA, 2012b). The report clearly reinforces the personal and national values of the *Melbourne Declaration* and emphasises “the importance of knowledge, understanding and skills of learning areas, general capabilities and cross-curriculum priorities as the basis for a curriculum designed to support 21st century learning” (ACARA, 2012b, p. 4).

In the table below I identify, in bold type, the values I believe to be relevant to this study from the ‘Organising Ideas’ in the following extract of the sustainability cross-curriculum priorities (ACARA, 2014, p. 1:1).

<table>
<thead>
<tr>
<th>World Views</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OL.4</strong></td>
<td>Worldviews that recognise the dependence of living things on healthy ecosystems, and value diversity and social justice are essential for achieving sustainability.</td>
</tr>
<tr>
<td>Futures</td>
<td></td>
</tr>
<tr>
<td><strong>OL.6</strong></td>
<td>The sustainability of ecological, social and economic systems is achieved through informed individual and community action that values local and global equity and fairness across generations into the future.</td>
</tr>
<tr>
<td><strong>OL.7</strong></td>
<td>Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.</td>
</tr>
<tr>
<td><strong>OL.8</strong></td>
<td>Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.</td>
</tr>
</tbody>
</table>

The Australian context on values education now needs to be viewed from within Catholic education.

**Catholic education**

Adding religious teachings to the environmental education mix greatly broadens the base of values available to support environmental citizenship—
not by attempting to convert students to a new environmental belief system, but by empowering students to develop their environmental values within whatever pre-existing value system they already occupy. (Hitzhusen, 2006, p. 13)

The above quote is supported by Benjamin (2009, p.4), who contends that the rationality of teaching students in Big History’s interdisciplinary teaching does not need to negate any faith value engagement students may also bring to their learning; rather, Benjamin sees that teachers, in teaching students ‘how’, not ‘what’ to think, can enrich and reconcile religious values and rational knowledge. The questions my research poses opens the dialogue between the place of Catholic values in education, environmental education and values articulated in the interconnectedness of the religious education units on God’s creation throughout the Catholic primary school years (Catholic Earthcare Australia, 2010; Catholic Education Office: Sydney, 2012). Those questions need to address the ‘what’ and ‘how’ of values in Catholic education where Catholic values are seen as being integrated across the curriculum (Catholic Education Office: Sydney, 2013b):

Building on the call, at this time of significant change for the implementation of the new Syllabus with the Australian Curriculum, Catholic Schools are challenged to ensure that Catholic Values are named, understood, planned for, explicitly taught, assessed, monitored and explicitly evident in the teaching and learning process…One potential strategy in moving towards explicit integration, is to consider Catholic Values as a learning across the curriculum priority along with the BOS cross-curriculum priorities and the general capabilities. (Catholic Education Office: Sydney, np 2013b)
Keeping the above holistic educational statement on values in mind, Catholic environmental education, aligned with the BOS NSW Australian Curriculum (NSW Board of Studies, 2014) needs to be viewed within this holistic concept. It is therefore important for this study to take into account the specific Catholic values, outlined in the “Sydney Catholic Education Office Teacher” learning modules in the *Australian Curriculum* (2013b). The following table of Catholic values, based on the values of the Christian Gospels, was retrieved from that website and is significant in understanding Catholic Education’s stance on those values, to be integrated across the curriculum, including environmental education.

**Table 3.3 Catholic values, based on the values of the Christian Gospels**

<table>
<thead>
<tr>
<th>Catholic Value</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awe and Wonder</td>
<td>An ability to marvel at the complexity of the created world.</td>
</tr>
<tr>
<td>Celebration</td>
<td>Appreciating the human need to commemorate important events and life stages by various rituals.</td>
</tr>
<tr>
<td>Common Good</td>
<td>Total human well-being which takes into account the needs of the whole community. Individual rights must always be assessed in light of the Common Good.</td>
</tr>
<tr>
<td>Community</td>
<td>A sense of belonging among a group of people with a shared vision committed to loving service.</td>
</tr>
<tr>
<td>Conservation</td>
<td>Maintaining and cherishing what is good in the environment with a view to ecological/environmental sustainability.</td>
</tr>
<tr>
<td>Courage</td>
<td>Choices, commitments and actions made in accord with what one believes to be true and right; a willingness to persevere in the face of suffering and opposition.</td>
</tr>
<tr>
<td>Cultural Critique</td>
<td>Informed awareness of the injustices and inequities in society and a willingness to work to change these.</td>
</tr>
<tr>
<td>Dignity of each person</td>
<td>The person in created in the image of God. Therefore, all human life is sacred. The basic source of human dignity lies in humanity’s call to communion with God. Respect for life, and above all the dignity of the human person, is the ultimate guiding norm of any sound economic, industrial or scientific progress.</td>
</tr>
<tr>
<td>Family</td>
<td>However it is expressed or understood, the family is cherished and fostered as the primary unit of belonging in society. It assumes personal values of identity, love, commitment and self-sacrifice for the sake of the family unit.</td>
</tr>
<tr>
<td>Global Solidarity and the Earth Community</td>
<td>All creatures and all of creation are intrinsically valuable and linked.</td>
</tr>
<tr>
<td><strong>Hope</strong></td>
<td>A spirit of optimism and joy sustained by faith; an enduring and sustaining trust in providence</td>
</tr>
<tr>
<td><strong>Hospitality</strong></td>
<td>An attitude of openness, understanding and welcome to others.</td>
</tr>
<tr>
<td><strong>Human Rights</strong></td>
<td>All people have the universal human right to live with dignity and freedom from oppression.</td>
</tr>
<tr>
<td><strong>Justice</strong></td>
<td>The right ordering of relationships and right exercise of power in a way that is life-giving for all people.</td>
</tr>
<tr>
<td><strong>Love</strong></td>
<td>The gift of sincere care, concern, empathy and compassion extended to others; love is patient, kind, humble, forgiving and trusting (cf: 1Cor 13:1-13). The love ‘which is poured forth in our hearts by the Holy Spirit which is given to us’ (Rom 5.5)</td>
</tr>
<tr>
<td><strong>Multicultural Understanding</strong></td>
<td>Positive interaction with other cultures for mutual enrichment; an openness to understanding and dialogue toward those of different cultural backgrounds.</td>
</tr>
<tr>
<td><strong>Peace</strong></td>
<td>Peace is the fruit of justice and is dependent upon right order among humans and among nations; seeking peaceful, life-enhancing solutions to conflict; peace is more than simply the absence of war or conflict.</td>
</tr>
<tr>
<td><strong>Reconciliation</strong></td>
<td>Reaching out in a spirit of dialogue, forgiveness and mutual respect; closely linked to love and justice.</td>
</tr>
<tr>
<td><strong>Sacredness of Life</strong></td>
<td>Seeing life as a gift from God to be respected.</td>
</tr>
<tr>
<td><strong>Service</strong></td>
<td>Loving care for the needs of others.</td>
</tr>
<tr>
<td><strong>Stewardship of Creation</strong></td>
<td>Honouring the created universe as a gift from a loving Creator God given in trust for all. People respect and share the resources of the earth, since we are all part of the community of creation. By our work we are co-creators in the continuing development of the earth.</td>
</tr>
<tr>
<td><strong>Structural Change</strong></td>
<td>Addressing root causes of injustice and changing unjust systems and structures; the transformation process which seeks a society which is life-enhancing for every person</td>
</tr>
</tbody>
</table>
| **Self-Respect (Self Esteem)** | • Proper esteem or regard for the dignity of one’s character and person;  
• Due respect for one’s character, and one’s conduct;  
• The deep conviction of one’s own inner worth; |

*A Sense of the Sacred* (Catholic Education Office: Sydney, 2006) is based on the integration of Catholic values across the curriculum and is supported by online resources. Although largely secondary based, the general statement informs this research in that its values integration across all subjects in the school curriculum draws on Gospel values, Church tradition and Catholic social teaching. Students are therefore enabled “to think reflectively and critically, entering the process of values
clarification, analysis, acquisition and judgement and to appreciate the integration between faith and life and faith and learning” (2006, np). The teaching methods identified on the website state that students be assisted ‘to clarify, analyse, acquire and make sound judgments about values and to appreciate the integration of faith with life and learning’ (2006, np).

We share as teachers in Catholic schools to help our students to make sense of the world, and to engage with it equipped not only with knowledge, but with skills and attitudes which draw on the treasures of the Gospel and the values of our tradition. (Bezzina, 2014, np)

Indicating its alignment with teaching values from the Australian Curriculum (ACARA, 2013a, 2014; NSW Board of Studies, 2014) within a Catholic framework, the “Sydney Catholic Education” learning modules highlight the Australian Curriculum priorities and capabilities that are consistent with the teaching of values education and align them to relevant Catholic Church statements and teachings (Catholic Education Office: Sydney, 2013b). An essential implication for this research is that the understanding of the centrality values education in the Australian Curriculum is evident and interpreted as such, within the Sydney Catholic Education Office directions for curriculum (2012, 2013b).

**Pedagogy and values**

Unfortunately, the problem with a critical pedagogy approach to environmental education, for both teachers and students, is that it is based on the same root metaphors (progress, individualism, anthropocentrism, etc.) that co-evolved with the Industrial Revolution. (Bowers, 2001, p. 12)
The Australian Curriculum attempts to address the above concerns articulated by Bowers. Mitchell (2012) acknowledges three major reports on values education projects (Curriculum Corporation, 2006, 2008; Hamston et al., 2010) have helped to lay the foundations and to shape the *National Framework for Values Education in Australian Schools* (Department of Education: Science and Training, 2005a). For the purpose of investigating the interdependence of pedagogy and values I turn to two of those reports; namely, the stage two and three final reports of the *Values Education Good Practice Schools Project* (Curriculum Corporation, 2008; Hamston et al., 2010). This report identifies good practice in values education where pedagogies are values-focused and explicit and student-centred with open-ended tasks throughout the curriculum. Further, the report argues that to be effective, pedagogies necessarily “engage students in real-life learning, offer opportunity for real practice, provide safe structures for taking risks, and encourage personal reflection and action” (Curriculum Corporation, 2008, p. 9).

Another practice the report advocates is the development of values education within an integrated curriculum, “rather than as a program, an event or an addition to curriculum” (Curriculum Corporation, 2008, p. 10). In another pedagogical directive, the report supports the explicit teaching of values to enable students to know their meaning and how they can be lived, that they become “part of the embedded consciousness within every school activity” (2008, p. 10). Within this recommendation the report warns that the explicit values taught need to be mirrored with their implicit modelling by teachers, in turn encouraging student clarity and empowerment, otherwise values education is compromised and therefore less effective. The report further asserts that successful values education initiatives are
often disturbing and disruptive when they challenge the traditional curriculum (Curriculum Corporation, 2008). The findings of the *Stage Three* report (Hamston et al., 2010) enhance the findings of the *Stage Two* report, identifying interrelated impacts from the analysis of data. The important identified impact for this study is values consciousness raising, where students, teachers and parents developed an “increased consciousness of the meaning of values and the power of values education to transform learning and life” (Department of Education Employment and Workplace Relations, 2011, np; Hamston et al., 2010).

A central argument of this research is that values education is integrated across all areas of the Australian Curriculum (ACARA, 2014; NSW Board of Studies, 2014), therefore values education necessarily embraces environmental education and the sustainability cross-curriculum priority. Catholic education (Catholic Education Office: Sydney, 2013b), with its mandate to implement the Australian Curriculum, and through its articulation of a student-centred pedagogy in its framework documents (see Catholic Education Office Sydney, 2006; Catholic Education Office: Parramatta, 2014; Catholic Education Office: Sydney, 2005, 2011), can effect a similar impact on an increased consciousness of the power of values. In fact, Catholic Education has an extra means of imparting values in environmental education, and thus education, through its values articulated in religious education (Catholic Education Office: Sydney, 2012, 2013b).

The values promoted in environmental education, Australian Curriculum and Catholic education have been investigated in the light of historic cultural influences and beliefs, alongside recent education reports that have led the way to the development of the *Australian Curriculum* (ACARA, 2014). The inclusive, interdependent
parameters of values education become clearer when viewed from the premise that this area is not values neutral and is studied from the perspective of the Melbourne Declaration (MCEETYA, 2008). The Declaration underpins the major education documents’ stance on values for this study: the Australian Curriculum (ACARA, 2012b, 2013a, 2014) and Sydney Catholic Education (Catholic Education Office: Sydney, 2012, 2013b). The values in above curricula documents are based on the Declaration’s overarching personal and national values and incorporate the organising ideas of the sustainability cross-curriculum priority. One significant factor to be noted is the values specific to the Catholic values; those of awe and wonder, celebration, sacredness of life and love. These affective values are also important to consider in this research, not only from the point of view of authentic Catholic education, but also when contemplating movement away from anthropocentric thinking to an holistic, systemic education.
3.3: Developing the story framework: Values, curriculum theory, whole systems theory, socioecological education and Big History

In accepting Sterling’s diagram (2003, p. 96) reproduced in the introduction to this section, *Framing the Story*, as a basis of the direction of my research, I now turn to envisaging and interpreting Sterling’s paradigm within an holistic framing for my research. Rather than being restricted to researching isolated disciplines of environmental education and religious education, I investigate a framework where a broader education model of curriculum theory and systems theory informs the investigation within, across and between disciplines.

**Values, Curriculum theory and Big History**

Curriculum theory is an integrated cluster of sets of analyses, interpretations and understandings of curricular phenomena. By curriculum, I mean what students have an opportunity to learn in school, through hidden and overt curriculum and what they do not have an opportunity to learn … referred to by Eisner as the ‘null curriculum’. (McCutcheon, 1982, p. 19)

Elaborating on her definition above, McCutcheon discusses the characteristics that embody curriculum theory (1982, p. 19) from the perspective of Eisner (Eisner, 1979, p. 83; ). I summarise those characteristics below as they all give credence to the direction of this research.

Curriculum theory must be:
• Open to challenge, with researchers able to openly support or challenge the theory;
• Underpinned by a strong value base, where the researcher needs to be aware of and name the value base they work out of for the reader to understand the researcher’s value bias; and
• Drawn from a multiplicity of disciplines, including what influences a certain culture may have on values and beliefs and their importance.

The three above characteristics encapsulate a theory that is open to questioning from research scholars and teachers, values bases and interdisciplinary: these three points are all hallmarks of my research. McCutcheon (1982, p. 22) leaves the reader with possible research directions but also a sense of a definite lack of curriculum theories’ research in 1982. The naming of the lack of direction is still obvious in more contemporary reviews. Wraga and Hlebowitsh (2003), writing twenty-one years later, identify the field of curriculum theory as being in crisis and disarray. They call for a reconceptualisation of the theory that needs to be progressive and inventive as it moves into the future, “we must build upon past accomplishments and develop a constructive synthesis of historic principles and practices and new ideas” (2003, p. 431). Priestly (2011) also notes that the development of national curricula requires fresh theoretical approaches, including specified ‘knowledge/content’ within a greater understanding of the dynamics of educational change (p. 234).

These appraisals of curriculum theory offer a revisioning of the field from the perspectives of understanding and incorporating history, open criticism, values bias, multidisciplines and looking to the future with new ideas. This encompassing, inclusive perspective of curriculum reinforces the validity of adapting the secondary-based, interdisciplinary Big History Project (Big History Project, 2018; Christian &
Gates, 2011; IBHA, 2012a) to primary education. The following Big History outcome locates the individual’s values within a world view of “one’s own place … one’s community and humanity as a whole – within the Big History narrative and reflect(s) on how Big History … frame(s) the past, present, and future” (IBHA, 2012a, p. 6).

In light of the above call for revisioning curriculum theory, another definition of curriculum theory warrants mention. Pinar (2012) incorporates and expands on the above directions for research, in that he identifies curriculum theory as:

A form of autobiographically informed truth-telling that articulates the educational experience of teachers and students as lived. As such curriculum theory speaks from concretely existing individuals’ subjective experience of history and society, the inextricable interrelationships among which structure educational experience … the role of language … in such ‘truth-telling’ is key. (2012, p. 35)

Pinar calls for an opening up of curriculum theory where the key question asked would be ‘what knowledge is most important?’ He ponders on this question as ongoing, framed within ethics, history and politics. This research, with its investigation of interdisciplinary and systemic thinking in education, links well with Pinar’s claim that “we find the future not in the present however, but in the past” (2012, p.49). Pinar is disparaging of what he terms anti-intellectual interventions of governments, which leads to an accountability mentality rather than an enriching one. He refers to Aoki’s call (cited in Pinar, 2012, p. 35) for ‘curriculum improvisation’ rather than the current thinking about ‘curriculum implementation’.
As my research question involves the word ‘scientific’, I limit the following two examples of how the discipline of science is being reviewed through curriculum theory, aiming to move the discipline out of a silo and into the realm of interdisciplinary, values-based and broader educational learning.

*Example 1:*

If primary students start to appreciate some of the major scientific ideas that help us to understand the objects, events and phenomena that comprise our day-to-day lives, as well as start to develop competencies in making informed decisions about everyday issues that involve scientific ideas, then they will be taking a step towards scientific literacy. (Skamp, 2012b, p. 4)

Scientific literacy, as outlined above, points to a growing advocacy for students to incorporate critical thinking and reflection to learnt scientific ideas and phenomena, with the aim of developing a wider understanding of the world they inhabit (Corrigan et al., 2007; Huckle, 1999; Skamp, 2012b). Huckle expands this viewpoint further to include education for sustainability as the need for a “‘transformative’ education that provides (students) with the knowledge, skills and attitudes to realise sustainability democratically along with others. (Huckle, 1999, p. 40)

Skamp (2012b) makes the point that school science goals have markedly changed in recent decades, where the goal of scientific literacy is currently being seen as “making a significant contribution to the overall general educational development of students and, in particular, helping them develop a sense of personal agency in engaging with science” (p. 5). Further, Skamp acknowledges that recent primary science curricula are generally aligned with an understanding of scientific literacy. He interprets this as
students being given opportunities to apply a better understanding of how the world works and how current scientific ideas have come about, to inform and possibly change their ideas and worldviews (p. 12).

The Big History Project also supports scientific literacy and a larger worldview in that “science should be part of a multi domain approach that truly supports curriculum development. In that way, scientific literacy can be a goal that will have real impact on students’ learning” (IBHA, 2012a, p. 10).

Bonnett (2013) adds voice to the need for a broader perspective of the science curriculum when he describes the necessity to move away from teaching a narrow view of the mechanical aspects of science and turn to an “inter-subjective hermeneutic practice, (which) acquires a potential to disclose the benevolent supportiveness of nature, and its fragility” (Bonnett, 2013, p. 195). Likewise, Krasny and Rose (2013, p. 5) argue that, in reconceptualising curriculum studies it is essential to engage in the affective qualities of educational experience. Such points of view necessarily embrace a movement away from anthropocentric thinking to embrace what Bonnet calls ‘nature’s inherent otherness’ and Payne names ‘the other’ (Bonnett, 2015; Payne, 2015).

Krasny and Rose (2013) discuss the centrality of affective, emotional qualities in educational experiences, situated in the area of curriculum studies and framed by Pinar’s writing on reconceptualisation (Pinar, 1994). They also alert researchers of curriculum studies to continue their significant contribution in challenging individuals to relate to both their external and internal worlds. The assertion is that the ensuing hermeneutic enquiry would involve curriculum research into the epistemology of
knowledge as to who mobilises knowledge and for what reasons; hence the need for a conversation about curriculum, “which both helps us to locate ourselves in identity, in place and also dislodges us from the familiar, from ourselves” (2013, p. 4). A wider worldview across disciplines is imperative for a dynamic and broader perspective of curriculum theory.

Example 2:

The Major point … is one of illustrating the fact that schools teach far more than they advertise … it is important to realise that what schools teach is not simply a function of covert intentions; it is largely unintentional. (Eisner, 1979, p. 93)

Eisner’s quote above, reiterates his first concept of the implicit curriculum of a school as unintentional and that it is learnt, not from what is done but because of the place it is and that children learn implicitly from being immersed in that culture. Eisner (1979, 2002) claims that the implicit curriculum is one of three types of curricula schools teach. A second is the explicit mandated, content curriculum, which Eisner claims is also affected by the implicit nature of the values and pedagogy of the teacher, values relayed in resource material and those values presented in school expectations of the curriculum taught. The third curriculum Eisner argues is the null curriculum or what he terms as “what schools do not teach” (1979, p. 97), which includes the lack of student learning of a variety of intellectual processes and therefore restricts their capacity to think alternatively. Eisner’s original critique from over three decades ago continues to have valuable insight for this research, in that it directs the contemporary field of curriculum theory to reflect that “school programs emanate values that are explicit and operational as well as those that are tacit and covert” (1979, p. 107).
The recognition of explicit and implicit values is essential for the directions of this research. This direction is acknowledged in the science-based discipline, where there is a move to an interdisciplinary, values-based learning, as illustrated in Hildebrand (2007). When investigating values in science education Hildebrand turns to a broader understanding of curriculum and employs a similar stance as Eisner, where she considers differing and broader perspectives of curricula (2007, pp46-48) as the following:

- **Intended**: where students interpret the teacher’s values and then interpret these values as representing those of the larger science discipline;
- **Enacted**: the curriculum that is actually implemented (what Eisner termed ‘explicit’);
- **Hidden**: those outcomes not explicitly taught (what Eisner termed ‘implicit’);
- **Null**: where the learning is excluded by the curriculum or teaching, specifically relevant to this study from the perspective if critical enquiry is excluded from the pedagogy (same terminology as Eisner); and
- **Realised**: consists of the messages that the learner has retained years later from the enacted, hidden and null curriculums.

Such an inclusive understanding of science education within an holistic framework, as illustrated in the two examples above, is needed if the science curriculum is to embrace the Australian Curriculum’s vision of values underpinning all disciplines, capabilities and cross-curriculum priorities (Corrigan et al., 2007; Eisner, 1979, 1982; Krasny & Rose, 2013; Skamp, 2012a, 2012b).
Krasny and Rose (2013) articulate their concern that curriculum authorities are demanding knowledge and skills needed to compete in the global economy. This concern is also evident in the preamble to the *Melbourne Declaration* where, for example, the report states that “Schools play a vital role in … ensuring the nation’s ongoing economic prosperity” (MCEETYA, 2008) and that “providing educational outcomes for all students is central to the nation’s social and economic prosperity and will position young people to live fulfilling, productive and responsible lives” (p. 4). While acknowledging the great importance of the *Melbourne Declaration*’s stance on values and values education it is noteworthy that the Declaration has also allowed some economic efficiency rhetoric to be incorporated into its vision, which could cloud the vital call of curriculum studies to foster student critical enquiry across interdisciplinary curricula (2008, p. 7). Bowers (2012) asserts that the indiscriminate use of language, as I have cited in the *Melbourne Declaration*’s incorporation of the term ‘economic’, perpetuates “moral values that are learned at a taken-for-granted (that is non-reflective) level of awareness” (p. 236).

Morrison (2004) challenges curriculum planners to integrate “voices, rationalisations and rationalities, arguments, ideas, stories, exchanges, and experiences” (p. 493) if they are to remain relevant in their field and produce dynamic curriculum theory. Payne (2006, p. 33) adds his voice to this call by naming learners, teachers, policy makers and researchers as the stakeholders who add to a creative and enabling approach to curriculum theory. In relation to environmental education he therefore calls for curriculum theories that are inclusive of holism, integrative and creative. Critical enquiry necessarily places values in environmental education within a broader holistic educational framing. I assert that the *Big History Project* embraces such a vision, as stated in its key outcomes, which include that students “consider the
integrative and interdisciplinary approach of Big History as one approach, in comparison to other more traditional approaches to knowledge” and that they “use various disciplines to analyse, evaluate, and justify one’s own and others’ claims about the past and the present” (IBHA, 2012a, p. 6, conceptual outcome 5 and literacy outcome 1).

Taking into account the above concerns, it is critical to frame this study within the broader context of the words from the Australian Curriculum, that it is “designed to meet the needs of students by delivering a relevant, contemporary and engaging curriculum that builds on the educational goals of the *Melbourne Declaration*” (ACARA, 2012b, np). Placing the vision of Big History alongside the Australian Curriculum vision in this research, encourages the promotion of an engaging, critical enquiry based curriculum that stimulates student value bases by asking “what life will be like in the future, how humans will use innovation to meet our growing energy needs … and what role (they) will play in shaping the future” (2018, np; IBHA, 2012a).

Sinek’s ‘golden circle principle’ (Sinek, 2009) could be incorporated into studying the need for a revitalised and integrated curriculum theory perspective. The following figure is used on the Sydney Catholic Education Office website to promote curriculum priorities in the learning modules for BOS Australian Curriculum (ACARA, 2014).
Figure 3.3 Sinek’s ‘golden circle principle’

The website uses Figure 3.3 to describe the importance of firstly looking at ‘why’- the powerful reasons for exploring new practices of incorporating the cross-curriculum priorities; secondly, ‘how’ the cross-curriculum priorities inform the learning content and finally, ‘what’ will this mean for choosing and teaching content?

**Values, whole systems theory and Big History**

A course in Big History, with its broad opportunity for use of both cognitive and affective learning modalities—could augment a student’s knowledge of systems thinking, providing the student with an even stronger sense of the interconnectedness of all things in space and time. (Collins, Genet, & Christian, 2013, p. 224)

The above quote asserts the broad dimensions and implications for student learning, in both the cognitive and affective domains, which have also been referred to in the previous section within the context of an emerging, transformative curriculum theory.
In also stressing the interconnectedness of things, Collins et al. (2013) allude to both systemic thinking and within that concept, the need for an interdisciplinary approach to inform the call for that interconnectedness. The previous section’s study of curriculum theory highlights an interdisciplinary approach as an essential element of that field of study. I also contend that it is essential that interdisciplinary educational thinking be developed further in conjunction with this section, to tease out its place in whole systems theory and Big History.

**Whole systems thinking and whole systems theory from the perspective of Sterling**


Sterling (2003) admits the difficulty of writing up his thesis about a broad, relational and holistic topic of ‘whole systems thinking and theory’, while needing to locate that thinking within a linear model of writing. He consciously chose nesting system models\(^\text{19}\), which I explore later in this section, to impart the relational, interconnection

\(^{19}\) In describing the origins of his systems models, Sterling cites Koestler’s (1967) idea of ‘holons’ where “reality can usefully be modelled as a hierarchy of systems nesting within each other, where the
of the parts pertaining to the whole system for his research. It is therefore fitting that Sterling’s view of whole systems theory, as adapted in Figure 3.4, is seen in relation to whole systems thinking. The importance of adapting Sterling’s view to build my own theoretical perspective for the purpose of my research will become evident in the development of this chapter, especially within the framework of conformative, reformativc and transformative learning (refer to Figure 3.10 as an example).

What is also often missing is a theory of why paradigms are resilient and resist change, or indeed, of how they can change. Here too, whole systems thinking offers a theory of learning - based upon Bateson and his successors - which offers powerful and useful insights. This theory centres on the idea of nested levels of learning. (Sterling, 2003, p. 37; 2008, 2010a)

Figure 3.4 Three learning levels: Towards higher level learning (adapted from Sterling, 2008, 2010a; 2011, p. 24)

Three learning levels:
- **Learning**: cognition, seeks effectiveness/efficiency ('doing things better'-conformative)
- **Meta learning**: seeks to examine and change assumptions ('doing better things'-reformative)
- **Epistemic learning**: seeks paradigm change('seeing things differently' - transformative)

bigger context (suprasystem or metasystem) shapes, limits and helps give meaning to the smaller part (subsystem)” (Sterling, 2003, p. 73).
Sterling’s definition follows from his concern that paradigms of learning are difficult to change. He cites Bateson’s claim that “We are most of us governed by epistemologies that we know to be wrong” (1972, p. 461). To overcome deeply entrenched cultural paradigms, Sterling advocates an holistic vision of whole systems thinking, where there is a blending of both ecological views of the world and methodology of systems thinking. Such a blend results in “critical thought and a sense of connectedness, yielding what might be termed ‘systems as worldview’” (2003, p. 38).

The term ‘world view’ is another window through which the narrow concept of anthropocentrism can be viewed from whole systems, interconnected and holistic contexts of environmental education, set in the broader framing of education (See ACARA, 2012b, 2013a; Department of the Environment, 2010; Dunlap, 2008; Kopnina, 2011; Mulherin, 2011). The Sustainability Framework (Department of Environment and Heritage, 2010), applies the term ‘world viewing’ as one of the learning areas in the sustainability action process. “World viewing involves practices associated with reflecting on, comprehending, negotiating and changing fundamental beliefs, perceptual orientations, ethical principles and values” (p. 10), and viewed in this light, the choice of those words adds to the holistic framing of systems theory.

Bowers (2001), too, argues that paradigms limit students, so they are generally unaware of the cultural patterns that influence their “natural attitude toward everyday life - including the habit of keeping science and culture in distinctly separate conceptual and moral categories” (p. 10). Big History, with its interdisciplinary approach, addresses the concerns of similar researchers that education is being taught in ‘disciplinary silos’ (Christian, 2012; Leiserowitz & Fernandez, 2008, p. 27).
Christian clearly states that Big History’s “interdisciplinary nature … search(es) for an underlying unity beneath the various accounts of the past told in different historically oriented disciplines” (2011, p. xxiv). He also promotes the need for interdisciplinary and transdisciplinary research to solve a wide variety of complex current and future problems. Christian asserts that, while Big History can provide a new framework for interdisciplinary thinking, it is through transdisciplinary research that insights from multiple disciplines will be developed. He affirms:

The very success of research within disciplines explains why more and more interesting and important problems now lie between disciplines. As interdisciplinary research becomes increasingly important, big history can offer a new model of scholarly expertise, that demands breadth of knowledge and an alertness to unexpected interdisciplinary synergies. (2017, p. 15)

An interdisciplinary theoretical framework, set within whole systems thinking is therefore vital to this study, in that it embraces an underlying common theme among the stakeholders: Catholic Education Office, Sydney policies (2011, 2013a), the Australian Curriculum (ACARA, 2014) and Big History (Christian, 2012; Christian & Gates, 2011). The commonality among their educational mandates, visions and documents, as outlined in the literature review and in the theoretical framework to date, is the underpinning of the Australian Curriculum. Founded on The Melbourne Declaration on Educational Goals for Young Australians report, the Australian Curriculum (2013b; Department of Education, 2009) issues a directive that the curriculum "provides the foundation for interdisciplinary approaches to innovation and complex problem solving " (MCEETYA, 2008, p.13). The general capabilities are a key component of the Australian Curriculum, which states they “play a significant role in realising the goals set out in the Melbourne Declaration” (ACARA,
2014, np; MCEETYA, 2008). The above directive would ‘nest’ in with Sterling’s systems theory; however, systems theory also envisages a wider view of education “that responds to new systemic conditions of uncertainty and complexity … that nurtures the increasingly important qualities of adaptability, creativity, self-reliance, hope and resilience in learners” (Sterling, 2008, p. 65). Sterling acknowledges that in a current world system that produces such uncertainty, there needs to be openness to re-evaluating existing assumptions and values through the nurturing of the above qualities.

Sterling’s visionary whole systems framework is an ideal lens for studying Big History with its three core themes of collective learning, thresholds of increased complexity and interconnectivity (IBHA, 2012a, p. 4). An important culminating investigation in The Big History Project is that the scientific narrative is seen as one that is emerging with increasing complexity; therefore, students use their learning concepts from the past and present to analyse and to ask questions about future needs of humans, within the ecological paradigm of how future energy needs “will be met with limited natural resources, and what role (they) and their peers (will) play in shaping the future” (IBHA, 2012a, p. 10). The open and critical learning from the above example of Big History’s course delivery demonstrates Sterling’s call for ongoing critical analysis to allow for changing paradigms to occur in learning and therefore student values where needed. Paradigm shifts occurs through the process of deep learning when a belief not only informs but also transforms how we perceive situations. This is the hope of Sterling (2003, 2008, 2011) and Christian (2011a, 2011; 2011b).

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20 An understanding of deep learning is integral for later analysis of the collected data in Chapter Five where possibilities for transforming student thinking are collated and discussed. Alliance for Excellent Education defines deep learning as “the delivery of rich core content to students in innovative ways that allow them to learn and then apply what they have learned” (2015, p. 10). The term is familiar in Australian Education and particularly referenced on the Victorian Department of Education website (2017).
IBHA, 2012a). Lewis (2012, p. 284) cites deep learning as an important contribution to whole systems thinking in sustainability education, in that it interconnects environmental, social and economic issues; this emphasis, alongside new technological opportunities, enables student-centred learning that connects to broader worldviews (Sterling, 2008, p. 63).

Recent research, adding insight to whole systems educational research comes from et al. (2014). In the preface, Wattchow considers applying a socioecological philosophy, centring on the interrelationships of “personal, social, community, environmental and political dimensions” (p. v), to educational learning experiences. Social ecology’s potential for education is located within the following four central concepts:

- student’s lived experience of learning... a responsiveness to the learner’s context and situation... (the consideration of) what kind of teaching and learning practices are likely to be most successful...(and finally)...learners, through genuine participation in their educational experience, will develop a powerful sense of agency. (Wattchow, 2014, pp. v-vi)

**Figure 3.5 Nesting the four central concepts of socioecological education**

1. Student’s lived experience of learning
2. Respond to the learner’s situation
3. Experiential pedagogies
4. Learners’ participation in pedagogical experiences lead to the possibility of agency.
When comparing Figure 3.4 with Figure 3.5, the parallels of both socioecological and whole systems approaches are observed; both call for a broader world view of environmental education, situated within an inclusive educational model. In the fourth point of Figure 3.5 I have added the wording ‘possibility’ to emphasise that students will not automatically develop empowerment, which is also an understanding of Sterling (2003, 2009, 2011) and Christian (2010, 2011). In addressing this issue, Brown et al. call for an holistic framework in education that encourages agency, while providing “participants with the opportunity to critique and examine how the various layers of the socioecological framework constrain and enable agency more broadly” (Brown, T., Jeanes, J., & Cutter-Mackenzie, A. 2014, p. 39). Kyburz-Graber (2012) promote socioecological approaches to learning as building on assuming that an environmentally sustainable world has no pre-set worldview, but rather, relate learning to a social process of ‘critical reflection’ and problem solving. Critical reflection, through a socioecological shared-learning approach, studies “interrelationships between how ‘nature’ is conceived and valued on one hand, and political interests and knowledge production and dissemination in society, on the other hand” (p. 29). Sterling, although writing at an earlier date, is conscious of needing a whole-systems view from a “socioecological context” and suggests “that the participation and full engagement of the learner is essential to transformative change”. (2003, p. 329)

The term ‘interdisciplinary’, an essential element of a whole systems approach, is also identified as important to the socioecological approach, where its interdisciplinary potential in social ecology education is acknowledged. Brown et al. promote a framework that “encourages collaboration across academic disciplines, attempting to
break down discipline ‘silos’ that often pervade the research and education climate” (2014, p. 24). It is relevant to note here the terminology ‘silos’ is a common term in other scholarly work pertaining to the interdisciplinary nature of education (Christian, 2011a, 2011; Leiserowitz & Fernandez, 2008; Lewis, 2012).

Sterling’s and Big History’s interdisciplinary and whole systems basis is reinforced by Stein (Curriculum Corporation, 2008), who acknowledges that syntheses of interdisciplinary fields is complex, in that it transcends differences among those fields; therefore, within that integration, “a higher-order knowledge that is more than the sum of its parts” (Stein, Connell, & Gardner, 2008, p. 402) is required. Henchey (2007) ties the concept of a synthesis of past, present and future to a curriculum requiring the integration of

The script for a dialogue between a society and its young people, a narrative about what we think is important, an idealization of what is significant in our past, a selection of what we know and believe in the present, and a vision of what we would wish for the future. (pp. 446-447)

Sterling’s view (2008) of systems thinking as “practices associated with comprehending and working rationally with complexity, uncertainty and risk, so that they can be managed effectively” (p. 65), relates directly to the thinking of Big History as preparing students, through interdisciplinary, critical enquiry to deal with unknown futures of greater complexity (Christian, 2011a). I now consider the implications of these approaches within a ‘nesting’ model.
Nesting systems models

In developing his whole systems theory, Sterling validates the possibility of converging and transforming relationships within differing learning contexts, which include environmental education and its broader educational context, worldview paradigm change and whole systems thinking, which he defines as “modes of thinking which recognise relationship and process as the primary reality” (Sterling, 2003, p. 44). He centres his conceptual ideas for whole systems theory on a nesting systems model, defined earlier in this section; he reasons that the ‘nesting’ visually displays how different contextual levels of learning are seen in relationship to each other. Figure 3.6 below is adapted from Sterling to nest the contextual levels I identify as central to this research, noting the identified contexts embrace whole-systems worldviews, as opposed to limited anthropocentric relationships. The varying ellipses’ sizes and colourings demonstrate the multiplicity of interacting dimensions and concepts. These include the educational, ecological and sustainability dimensions that, in turn, are nested in their relevant perspectives.
The need for inter-relationships across systems, or within a larger system, is expanded by Stein et al (2008). They believe it is unrealistic in current research projects, that one person can contain all the knowledge needed and they call for interdisciplinary syntheses “involving several individuals capable of melding theories, methods, and data from different disciplines” (2008, p. 402).

Mitchell (2012) argues that the unique place of values in the Australian Curriculum (2012) is essential and relevant to all parts of schooling. Her argument is particularly relevant when considering how discreetly the integration of values spans across curriculum disciplines, especially within cross-curriculum priorities and the “general capabilities of ethical behaviour, intercultural understanding, personal and social competence, and critical and creative thinking: (ACARA, 2014, np; NSW Board of...
Studies, 2014). These then provide the springboard and resources for the integration of subject disciplines that “overcome the conceptual and methodological boundaries between the prevailing fields of research” (Huutoniemi, Klein, Bruun, & Hukkinen, 2010, p. 81) that will “allow for cross-disciplinary learning that broadens and enriches each student’s learning” (ACARA, 2012b, p. 22).

Loughran, Smith & Berry (2011) see a new paradigm emerging when ecological thinking and values inform systemic changes through the lenses of “holism, systemic thinking, sustainability and complexity … (a paradigm) that nurtures the increasingly important qualities of adaptability, creativity, self-reliance, hope and resilience in learners” (2011, p. 23). The envisaging of whole-systematic change is advocated in ongoing educational research (see Burns, 2014; Cassell & Nelson, 2010; Collins et al., 2013; Garavito-Bermúdez et al., 2014), which adds credence to the ensuing section focusing on the validity of integrating values into both curriculum and whole systems theories.
3.4 Developing a ‘whole’ story framework: Integrating values into curriculum and whole systems theories, Big History and socioecological education

Figure 3.7 Domains, aspects and dimensions of experience (triadic model) (reproduced from Sterling (2003, p. 96))

Sterling’s diagram (2003, p. 96), reproduced in Figure 3.7, is the key to the development of my theoretical framework for the purpose of this research. It is where I find Sterling’s inter-relational, nesting concept, as opposed to a lineal understanding, of whole systems emerging as he interrelates ontology, epistemology and
methodology. I summarise the information in Table 3.4, based on Sterling (2003, p. 90).

### Table 3.4 Interrelating ontology, epistemology and methodology

<table>
<thead>
<tr>
<th>Ontology</th>
<th>Eidos</th>
<th>Cognitive or intellectual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Epistemology</td>
<td>Ethos</td>
<td>Affective level: values and norms</td>
</tr>
<tr>
<td>The key domain through which knowledge and experience are framed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Methodology</td>
<td>Praxis</td>
<td>Theory in action, behaviour – what is and is not done</td>
</tr>
</tbody>
</table>

Sterling believes that the significance of whole systems thinking potential is found in epistemology as the key domain, in which ‘knowing and experience’ as a whole is framed; he claims there is a greater chance of achieving or attaining a paradigm shift of worldview within an ecological system in crisis (Sterling, 2003).

**Theoretical framing**

I now turn to the theoretical framing towards my research. I believe, within the framing of whole systems theory and thinking, it is vital to incorporate the breadth of my investigations realising, as with Sterling’s concern of studying the ‘whole system’, the depth for each area cannot be thoroughly investigated. This is where I see the strength of Sterling’s ‘nesting systems model, where the play of relationships of the parts to the whole and among each other is paramount within a whole systems approach. As in the words of the *Melbourne Declaration*, “the way of seeing curriculum…requires an integration rather than an addition” (MCEETYA, 2008, p. 13).
In Figure 3.8, I use Sterling’s concept of ‘nesting’ to display the interrelationship of the major perspectives I have identified for a working theoretical framework of investigating whole systems theory and thinking. I believe this nesting model is in keeping with Sinek’s own ‘nesting’ model (2009), reproduced earlier in the curriculum theory section – that my emphasis for adapting a whole systems theory approach begins with the ‘why’ question: Why am I using a whole systems thinking as a basis for my theoretical framing?

**Figure 3.8 Interrelationship of whole systems thinking**

Keeping the above relationships in the essential framing of this thesis, it is also necessary to incorporate the key documents to this whole system framework. The Big

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**Theoretical framework: major perspectives**

- Environmental education and the ecological crisis
- Curriculum & pedagogy
- Critical inquiry
- Values
- Systems
- Holistic
- Increasing complexity
- Interdisciplinary
- Interdependence
- Opportunities for paradigm shifts and transformative learning

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History Project, religious education and the relevant learning disciplines need to be ‘nested’ within an authentic whole systems theory, under a values perspective. The above elements interconnect and inform the learner within a critical enquiry approach.

In clarifying the non-linear thrust of whole systems theory and thinking, I order my thinking within another nesting model in Figure 3.9 which builds upon Figure 3.8. Figure 3.9 identifies the key themes of the research, in that it centres the earlier figures in this chapter to values through the lenses of whole systems thinking when related to Big History and religious education in the light of Catholic education.

Figure 3.9 Theoretical framework: Whole systems thinking, Big History, Catholic education and socioecological education
3.5 Theoretical framework conclusion

This section has investigated the importance of values in education, with particular emphasis on their placement in Australian and Catholic documents. The values prioritised in the individual documents were found to have a generally universal commitment to the same or similar values. It was noted that Catholic education values, whilst religiously grounded with explicitly named spiritual and Catholic based values, are also aligned to the Australian Curriculum’s stated personal, national and environmental values.

I have identified curriculum theory and whole systems theory and thinking, set within value-based education, as the theoretical framework for this thesis. The major theoretical model emerging is centred on whole systems thinking, which, in its essential identity, views inter-related parts of the whole system; this interdisciplinary and holistic framework necessarily embraces the complexity of curriculum theory and values within a critical enquiry pedagogy. Both whole systems thinking and curriculum theory are mindful of including explicit, implicit, hidden and null learning.

Having identified the concepts relevant for my research, I now formulate my theoretical model: an adapted version of Sterling’s ‘ecological and transformative educational paradigm’ (2003; 2010a, p. 526), which broadens learning opportunities beyond any prevailing and limited anthropocentric worldviews. The model has been informed by scholarly research in my literature review and theoretical framing, particularly by the work of Sterling (2003, 2008, 2010a, 2011) and the Catholic Church call for an ‘ecological conscience’ (see Brown, 2004; Edwards, 2012; Francis I, 2015; John Paul II, 1989, 2001; Salomone, 2006; Vatican Radio, 2009). The model
I illustrate below is underpinned from my research on values and the emerging scientific universe story, as it is understood in the Big History Project (IBHA, 2012a, 2012b) and in Catholic Australian education (ACARA, 2013a, 2014; Catholic Earthcare Australia, 2010; Catholic Education Office: Sydney, 2012, 2013b; IBHA, 2012a, 2012b); therefore, I envisage my theoretical model in Figure 3.10 below as ‘An Tairseach: a framework for transforming our story’ where I have incorporated the earlier figures from this chapter to finalise my developed theory.

Figure 3.10 An Tairseach: A framework for transforming our story

Ecological awareness
Cognitive learning: ‘doing things better’
CONFORMATIVE
Personal, cultural, community values

Ecological consciousness
Meta cognition learning: ‘doing better things’
REFORMATIVE
Introduced to other world views and values

Ecological conversion
Epistemic learning: ‘seeing things differently’
TRANSFORMATIVE
Dramatic shift of consciousness: seeing our worldview rather than seeing with our worldview – possibility of value change

N.B. Epistemic learning is fed by (and feeds back to) cognitive and metacognition nesting.
In Chapter Five, I use the Figure 3.10 as a lens to interpret and analyse data. I also refer to it in Chapter Four as the developed framework for my methodology and research design.

It will be recalled that my overarching research question is:

To what extent can the emerging scientific story of the universe inform children’s environmental values through Catholic education?

The theoretical framing of this thesis is centred on values-based education within whole-systems thinking and curriculum theory in the context of environmental education. The interrelated concepts of environmental values are children’s critical knowledge, Catholic education, curriculum, interdisciplinary and transdisciplinary learning, all nested within socioecological learning.

In theoretical terms, the research question therefore can be rearticulated as:

How does the emerging scientific story of the universe inform children's socioecological values through the principles of whole-systems learning?

In the following chapter I explain and justify the methodological approach I adopt to undertake the investigation of the above questions.
CHAPTER FOUR

DESIGNING THE STORY - METHODOLOGY AND RESEARCH DESIGN

Introduction

The heart of… (Whole systems) education is an ecological orientation. Other descriptors which help capture this sense are ‘holistic’, ‘systemic’ and ‘participative’; they indicate a redesigned educational paradigm”. (Sterling, 2008, p. 64)

In citing whole systems theory as oriented towards an ecological perspective, Sterling’s transformative view of education must be positioned within a whole systems thinking methodology. As previously discussed in the development of my theoretical framing in Chapter Three, I built on the writing of Bateson, Bowers and Sterling (1972; 2001; 2003) to adopt Sterling’s revisioning of ontology, epistemology and methodology. His ecological point of view embraced wholeness within systems thinking and worldview, framed within environmental education and the wider context of values education. I assert Sterling’s concept is essential for my research in that I underpinned my investigation with a transdisciplinary pedagogical intervention that encompassed the possibility of student empowerment towards transformative thinking of environmental education values in the local school setting.

In this chapter, and in keeping with my developed framework from Chapter Three, I outline a qualitative action research methodology appropriate for researching values within Catholic primary education and environmental education, from a whole
systems thinking perspective. I divide this in two sections.

In Section One I set out a case for applying a qualitative critical action research methodology, from child-framed and ethnographic perspectives, within a whole systems thinking paradigm (Sterling, 2003, 2011). Section Two outlines the research design methods, which include a description and outline of the data collection and analysis methods. Methodological limitations to this study will also be discussed. I now turn to Section One.

SECTION ONE: METHODOLOGY

Introduction

I investigate the research questions from a qualitative action research positioning of whole systems thinking, drawing upon an interpretive perspective and participatory paradigm. The interpretive and participatory perspective is embedded in whole systems and action research methodologies. I define the significant terms below and within historical settings for clarity. I also justify them from the perspective of my theoretical framing, displayed in Figure 3.10, ‘An Tairseach: A framework for transforming our story’. In particular, I place emphasis on Sterling’s whole system theory and thinking (Sterling, 2003, 2008, 2010a, 2011). As stated in Chapter Three, the interwoven concepts involving whole systems theory, necessarily relate to the ‘whole’ as opposed to individual silos; if this study is to do justice to the breadth and understanding of the inter relationships within the theory a larger worldview of systems needs to be upheld (Fereira, Ryan, & Tilbury, 2006, pp. 24-25).

I now turn to defining and justifying this action research design within a qualitative,
interpretive, participatory methodology.

4.1 Defining and justifying a qualitative interpretative participatory methodology

Qualitative research has broad and competing definitions and paradigms evident in the field (Hammersley, 2007; May, 2002; Willis, 2007). In catering for its open-ended nature, Denzin and Lincoln (2011, p. xiii) discuss a generic focus for qualitative research. Rather than a single definition, they see the field moving in different directions at the same time, including an emphasis on interpreting the local context, ethnographic studies, new pedagogical practices leading to critically interpreting cultural analysis in local contexts and the possibility of a future framed within social justice. Within a qualitative framework, Somekh and Zeichner (2009) also envisage action research challenging oppression championing social justice.

An interpretive perspective is essential to qualitative research in that it caters for the multiplicity of projects, where ordinary actions and language need to be understood within a particular natural setting (Denzin & Lincoln, 2011). Hart (2010) summarises the researcher’s interpretive interests as “discovering the meanings and beliefs underlying the actions of others” and that “science and scientific knowledge have both to be interpreted in terms of values they represent” (2010, slide 2). An interpretive perspective, seen in the light of interpreting knowledge and values are two vital aspects of this research and therefore to the methodological approach I take.

Sustainability, as an ecological worldview is also a central premise of this research and the interpretive perspective it demands is in keeping with Kemmis’ view (2010, p. 422), that it “prepare(s) us to interpret the world more sensitively and to act in it more
Participatory research is identified by Willis (2007) as when there is involvement of the participants in the study “in the design, execution, and analysis phases of the research”. Although there are varying types of participatory paradigms, one common element is that all participants are treated as colleagues and partners. Kemmis and McTaggart (2005) cite the following three attributes of participatory research: “shared ownership of research projects, community-based analysis of social problems, and an orientation toward community action” (p. 560). In later writing they also contend that practitioners are the best resource for changing practice and therefore "teachers' research is the most potent force for changing educational practice" (Kemmis, McTaggart, & Nixon, 2013, p. 25).

A critical participatory research paradigm, as justified above, validates the framing of my action research from a values perspective in environmental education using:

- The Big History project and its narrative (Christian, 2011a; IBHA, 2012; Spier, 2009).

Operating on these ideals and assumptions of qualitative interpretative participatory research, I now further the discussion of action research, within whole systems thinking as the chosen methodology applying a qualitative, interpretative paradigm.

**Origins of action research**

Action research emerged in the USA and Europe early in the twentieth century. The
term ‘action research’ is commonly credited to Lewin (1948), who focused on the role of social action and change as a cyclical spiralling process of steps, using the knowledge gained to inform social action. Corey (1949) used the term ‘cooperative action research’ which added to the sense of action research having a societal base.

Subsequent cultural, political and economic changes affected its popularity (see McNiff, 2002; Somekh, 2005; Somekh & Zeichner, 2009), including the introduction of the term in 1970s Britain. One significant influence was the work of Lawrence Stenhouse (cited in McNiff, 2002), who believed that the curriculum should not be centrally controlled; rather, it needed to be organised within individual schools to ensure that the students’ experiences were relevant to their situation and that they become responsible for their own learning. He also promoted the idea of ‘teacher as researcher’. The roots of current action research are evident in this earlier body of writing with their calls for the inclusion of social action, cyclical process of steps and the emphasis on the natural, local setting.

**Current thinking on action research**

Action research methodology crucially engages with the spiral interplay between action and research. Dick defines the methodology as:

> A flexible spiral process that allows action (change, improvement) and research (understanding, knowledge) to be achieved at the same time. The understanding allows more informed change and at the same time is informed by that change. People affected by the change are usually involved in the action research. (2012, p. 2)
The fluidity of the interplay of action and research are vital for all participants, in this study the researcher, co-researcher teacher and students. Dick (2012) articulates a set of principles, characteristic of action research as tending to be cyclical (see Kemmis, 2010; Kemmis & McTaggart, 2005), participative (see Kemmis in Reason & Bradbury, 2013), qualitative, dealing with language more often than numbers (see Hammersley, 2007; Ritchie, Lewis, Nicholls, & Ormston, 2013) and critically reflective. Similar defining of the term is found in other scholarly articles by Costello (2003), Holly et al. (2009), McTaggart and Kemmis (1988) and Somekh (2005).

McNiff (2002, p. 25) believes the criteria for action research begins with the researcher’s personal values, addressing why they are doing the research and then they “do action research as a way of helping them understand how they can influence social change”. McNiff’s statement is relevant for this study, which embraces values and the possibility of transformative whole systems thinking in environmental education and in Catholic primary education: “Part of the joy of doing action research (is) it resists closure. Each ending is a new beginning. Each event carries its own potentials for new creative forms” (p. 20).

McNiff’s summary of action research resisting closure captures both the cyclical and reflective components of the methodology. Mertler (2008, pp. 13-17) adds to the understanding of the cyclical process of action research in his description of various cyclical models and concludes that each model shares common elements and therefore are variations of each other. A continuous action research cycle of ‘plan, do, study, act’ monitors and evaluates intended values education outcomes (Stein, Connell, & Gardner, 2008, p. 408). For the purposes of my research I plan to use and adapt Kemmis’ model (2005, p. 6) with its recurring reflective cycle as in Figure 4.1 below. Kemmis attributes his cyclical approach to Lewin’s original concept of action
research (Carr & Kemmis, 1986; Lewin, 1948). The recurring cycle is evident in the model of ‘plan – act and observe – reflect – revise plan’.

Figure 4.1 The action research spiral (Kemmis & McTaggart, 2005, p. 6)

Kemmis’ cyclical model segues into the nesting of the narrative thresholds of Big History, summarised later in this section in Figure 4.1, and its reoccurring central themes of shared collective learning, thresholds of increasing complexity and connectivity within a interdisciplinary approach (IBHA, 2012, p. 4).
The above cyclical model is crucial to the authenticity of the data collection phases, within the structure of the pedagogical intervention. Each unit of work, in the guise of Big History’s nine thresholds, is to be evaluated from reflection and discussion among researcher, teacher co-researcher and student interviews. The structure and pedagogical presentation was adjusted accordingly throughout the 17-week data collection period to maximise learning within conformative, reformative and transformative nesting (see Figure 3.10 An Tairseach: A framework for transforming our story). Ongoing cyclical consideration for students’ learning needs incorporated a transdisciplinary approach to content, concepts and skills, thus empowering students in inquiry learning within a values-based framework.

**Qualitative action research linked to values**

A key underpinning of this qualitative research is the investigation of the extent to which values can be formed through action research. Somekh and Zeichner (2009) call for an upholding of the value of democratic rights, where oppression is fought and social justice is nurtured. They assert that action research is “a methodology grounded in the values and culture of its participant-researchers and hence it is flexible to local agency” (p. 6). As such, action research methodology grounds my research within Sterling’s concept (2008) of a ‘redesigned, relational educational paradigm’ where values of both the students and myself are essential to the research inquiry. Elliott (2007) bases his theory of teaching as a practical educational science on the practical philosophy of Aristotle, particularly in terms of viewing ‘moral action’ within a ‘praxis’ approach. His assertion that “Ethical values are realised in, rather than as a result of praxis” (2007, p. 107), affirms the choice of participatory, interpretative paradigms for this action research. Values that underpin Australian schooling (ACARA, 2012b, 2014) were identified and embedded within the
pedagogy, interdisciplinary and whole systems thinking of the research methods. Students, as research participants, used critical inquiry to interpret the meaning of the universe narrative (Christian, 2012; IBHA, 2012) for themselves and to discover possible directions for agency (Wattchow et al., 2014).

Somekh and Zeichner (2009), assert that action research is capable of making “a unique contribution to educational reform because it challenges the body–mind divide that has fractured ‘Western’ conceptions of what it means to be human” (p.6). Action research has the capability for this study to engender social transformation. Sterling’s three levels of higher learning, illustrated in Figure 3.4, affirms the place of knowledge (eidos), but within the larger vision of the learner being engaged in ‘participative and collaborative’ praxis and therefore the possibility of an affective and transformative educational paradigm (Sterling, 2003, p. 205). Christian, in expressing the emerging story of the universe, uses language that suggests affective transformation and awe as he contemplates “Each stage is magical because it creates the impression of something utterly new appearing almost out of nowhere in the universe” (Christian, 2011a, np). A study of this type of affective praxis is a key aim of the action research I undertake, if I am also to include the values specifically articulated in Catholic gospel values, presented in Table 3.3: love permeating all values, awe and wonder and celebration of God’s creation.

**Transience as an attribute of action research**

Another attribute of action research, significant to this research is the need for the researcher and participants to view the world as transient, rather than within set cultural and environmental paradigms. Selby (2006) provides a clear description relevant to environmental education and sustainability goals, where he outlines the
disarray and disturbance within nature and cultures of the world; to overcome this discord he calls for the need “to embrace transience in everything … (when) nature and society … both are characterised by the impermanence of flow, the elusive and ineffable dance of things? (p.363)” Transience is a necessary underpinning of the interdisciplinary Big History Project (IBHA, 2012), where learning is ‘nested’ in nine thresholds, beginning with what science can inform us about the beginning of the universe. The Big History curriculum defines thresholds where the universe has become more complex, as illustrated in Table 4.1.
Table 4.1 Big History thresholds (Big History Project, 2018)

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The Big Bang: Creation of the Universe -13.8 billion years ago</td>
</tr>
<tr>
<td>2</td>
<td>Stars light up: Creation of stars – 13.6 bya</td>
</tr>
<tr>
<td>3</td>
<td>New chemical elements: Creation of chemical elements in dying stars -12.8 bya</td>
</tr>
<tr>
<td>4</td>
<td>Earth and the solar system: Creation of planets and Earth - 4.5 bya</td>
</tr>
<tr>
<td>5</td>
<td>Life on earth: Creation of life on Earth – 3.8 bya</td>
</tr>
<tr>
<td>6</td>
<td>Collective learning: Creation of our species - 250,000 years ago</td>
</tr>
<tr>
<td>7</td>
<td>Agriculture: Creation of agriculture - 11,000 years ago</td>
</tr>
<tr>
<td>8</td>
<td>The modern revolution: Creation of the modern revolution – since the industrial revolution</td>
</tr>
</tbody>
</table>

**Future**

Big History isn’t finished. How does knowing so much about the past change the way you think about the future? How might human innovation ensure that we continue to thrive?
Christian (2011a) explains thresholds as ‘‘Goldilocks conditions’ - not too hot, not too cold; just right for the creation of complexity … We refer in big history to these moments as threshold moments. And at each threshold … it's more difficult to create complexity” (Christian, 2011a). Transience and transformation of paradigms were important understandings for this action research, within the scope of the Big History Project, the transient narrative it tells and its core themes of increasing complexity and interconnectivity of the universe. The future threshold particularly, needs different transient thinking and possibility of transformation to new paradigms within this research’s parameters of values, environmental education, sustainability and whole systems if students are to address the following:

What life will be like in the future, how humans will use innovation to meet our growing energy needs with limited natural resources, and what role will students and their peers play in shaping the future, among others. (IBHA, 2012, p. 10)

Deep learning, as discussed in Chapter Three and outlined in Figure 4.2 below, is significant in identifying the need for transient learning and possible transformation to deeper worldviews that are able to embrace future possibilities.
The above deep learning skills are markers in current educational trends that encourage students to cultivate linking of ideas and learning in their constantly changing world, while also providing them with the skills and concepts needed for collaboration in unknown future global interconnections (Fullan & Langworthy, 2013).

**Justification for qualitative action research**

The local setting is vital to this study of action research, where a case has been put forward that values are inherent in both a particular community and the research participants (Podger et al., 2010; Podger, Velasco, Luna, Burford, & Harder, 2013),
including myself as researcher and as an experienced classroom teacher. Action research is significant in education, according to Somekh and Zeichner (2009) because one of its critical core principles is to combines action with research, thereby challenging the ‘status quo’. Teachers as researchers, then have “the means to develop agency to bring about change; and the changes they introduce are locally appropriate within the globalised world they inhabit" (Somekh & Zeichner, 2009, pp. 18-19). Locating my research in a local primary school, gives me the opportunity to frame my methods within the local values as well as the broader Australian Curriculum and environmental education values identified in my theoretical framework.

McNiff & Whitehead (2002; 2010) add to the understanding and importance of values in action research from the points of view of ‘transformative education’ and ‘agency’, discussed in Section Three, in the light of the research of Sterling (2003, 2011) and Wattchow et al. (2014). McNiff sees action research as instrumental in helping participants, including the researcher, identify the values that are important to them and then think about how they can use them as organising principles to become agents for change. McNiff’s perception informs the directions of this research where values do not have a neutral stance in education; she too warns that complete lining up of our values with our daily living is unlikely, so again there is a message that there is ‘possibility’ of transformation where “we are not aiming for ‘end products’; we are aiming to find right ways of living” (2002, p. 17).

Hammersley and Atkinson’s assertion (2007), that ethnography follows a relatively open-ended and reflexive approach in the quest for knowledge, is relevant to my research in that I was involved in the daily lives of class learning in the form of the Big History intervention. I observed and interviewed students and teachers to collect data that threw light on the issue of values and environmental education. Students’ actions and accounts were studied “in the field” of the class setting within an evolving
structure generated by the process, rather than a fixed research design. I focused on a small group of fifteen students to facilitate in-depth study involved, “the interpretation of the meanings, functions and consequences of human actions and institutional practice, and how these are implicated in local and perhaps also wider contexts.” (Hammersley & Atkinson, 2007, p. 3).

Having defined and justified this action research design within a qualitative, interpretive, participatory methodology, in the following section I discuss the relevance of ethnographical inquiry and child-framed inquiry to my action research design.

4.2 Relevance of ethnographical inquiry and child-framed inquiry to my action research design

Relevance of ethnographical inquiry to the research

The utilisation of ethnography clarifies particular real-life settings as identified by Cohen, Manion, & Morrison (2007, p. 170). Ethnography is central to the style of the cyclical nature of my research where the majority of participants are eight to nine-year-old students and the inferred voice of a child, within a particular social setting and knowledge base, needs to be made explicit to the reader. Brewer’s definition of ethnography includes the above premise of the researcher participating directly in the study of people in their familiar settings, while adding a further dimension of the researcher possibly being involved in the activities of the participants “in order to collect data in a systematic manner” (2000, p. 189). This relates to my research in that as researcher I was involved in teaching a pedagogical intervention, as outlined in Section Two below.
A further indication that ethnography is suited to my research is in the observations of Punch (2014, p. 129), that it is both process and product, where process indicates a methodology, an approach to the research, and product in ethnography produces a research report. Punch also sees the ethnographic approach as a method of discovery and is therefore particularly beneficial when the research is dealing with something new, different or unknown. I assert that this sheds particular insight into my data collection because of my application of the theory of environmental education values to a specific school setting whilst also trialling the Big History Project in the same primary school situation. The relevance of ethnographic inquiry therefore is interdependent on adopting a child-frame inquiry approach to this research and this point will be expanded upon in the next section.

For the purposes of further explanation of the particular significance of ethnography to this research, I correlate some of the more noteworthy elements of ethnography nested in Figure 4.3.

*Figure 4.3 Elements of ethnography (adapted from Cohen et al., 2007, p. 84)*
I have deliberately portrayed the above diagram within a nested perspective, in keeping with Sterling’s nested environmental education model of an interdependent whole system (Cassell & Nelson, 2010; Sterling, 2010a). This approach is also in keeping with the significance that deep learning plays in the understanding of whole system models. The various rich skills of deep learning interplay with the four elements of ethnography, as purpose, focus, key terms and characteristics that promotes open perceptions and differing viewpoints. I now turn to the relevance of child-framed inquiry from the above perspective.

Relevance of child-framed inquiry to the research

The section discusses the significance of a participatory emerging child-framed research design approach, including the perception of the child as researcher or as researched (Barratt Hacking, Cutter-Mackenzie, & Barratt, 2013, p. 438). Research involving children as active researchers is receiving increasing attention in environmental education research (see Barratt Hacking et al., 2013; Kellett, 2005, 2010; Percy-Smith & Thomas, 2009; Spyrou, 2011). The varying degrees of that participation is an evolution, and at times amalgamation, of research to encourage valid and new views for children’s voices to be heard and addressed in both educational practice and policy (Barratt Hacking et al., 2013, p. 456).

Child-framed research is oriented to children as active participants and it may also include them as co-researchers. By aligning my research design with a child-framed methodology, there is an assertion that children contribute as active participants in their learning and hence, have the means to interact and contribute to the ongoing cyclical learning and connectedness with the findings of the collected data. I now move on to validate the incorporation of a participatory child-framed methodology.
within the areas of knowledge and curriculum, empowerment, agency and the development of relationships to gain reflexivity and transparency.

**The place of knowledge growth and curriculum in qualitative, child-framed participatory research**

Although participatory research involves engaging children in a variety of methods, the results of participatory child-framed research design are only validated with the inclusion of opportunities for growth in knowledge within a child-centric local culture with prospects for child agency (Gallagher, 2008). Gallagher, from this point of view, validates that it was vital that children be given the power of a new and informed knowledge base, within their appropriate developmental language framework. To this end, I adapted the Big History Project pedagogical intervention for this particular age group, giving them the power to use the knowledge gained and confidently articulate their new learning. This approach was aimed at giving children maximum opportunity to engage in child-framed, oriented participatory discussion where I could critically evaluate the extent to which their values were informed through the cyclical action research methodology. For the authenticity of the data collected during interviews, children were encouraged to reflect, not only on their growth of knowledge throughout the pedagogical intervention, but also previous understanding of local school values, environmental education values and their personal Catholic education understanding of God’s creation of the world (Brisbane Catholic Education, 2014; Mulherin, 2011; Sydney Catholic Education Office, 2012).

As has been discussed in the literature review, the importance of curriculum theory needs to be a continuing part of this research conversation. The social and cultural significance of the cyclical data collected came from children’s voices before, during
and after the innovative Big History Project pedagogical intervention. That could then provide justification for critical analysis, from the perspectives of the children’s particular interpretation (Spyrou, 2011, p. 160). Evidence could then be gathered of children as the purveyors of a wider worldview of knowledge, concepts and skills in the teaching of the transdisciplinary curriculum of Big History.

The place of empowerment in qualitative, child-framed participatory research

As will be recalled in theoretical framing (Figure 3.10), children require the invitation to learn a whole systems, wider worldview beyond conformative cognitive learning or ecological awareness, to reformative or ecological consciousness and the possibility of transformative learning or ecological conversion (see Catholic Earthcare Australia, 2010, 2017; Francis I, 2015; Sterling, 2003, 2008, 2010a, 2011). It then follows that they were invited to genuinely participate, to openly discuss and to take the lead through critical inquiry learning, informed by their new learning (Big History Project, 2015b; Kellett, 2005).

If children were to be empowered to openly discuss their values and the possibilities of transformative learning the child-framing perspective required a platform of common language, learnt knowledge and a framework of familiar common values within their cultural setting of the local Catholic school. This platform allowed the opportunities for data to be collected that displayed students’ increased confidence in active participation (Kellett, 2005, p. 11) when they are supported in their ‘zone of proximal development’ by a more able ‘other’ (Vygotskiï, 1972, p. 12).
Child-framed research, when it is accompanied by a cyclical action research model, allows for the researcher to build rapport and understanding with children and enable a more critical and reflective interpretation of the intent of children’s language, through the actual shared research context of the pedagogical learning cycle (Spyrou, 2011, p. 158). The actualisation of children being heard in the local context allows for understanding of their concepts to be made more transparent.

As discussed when outlining my theoretical framework in Chapter Three, the place of values viewed through the lens of curriculum theory is at “the heart of the matter” (Curriculum Corporation, 2008). The pedagogical curriculum intervention I adapted from the Big History Project is based around child-framed critical inquiry learning, required child appropriate resources. This varied approach of including teaching intervention accessible research tools, including picture books, Seesaw website resources (SeesawLearning Inc., 2015), Newsela reading articles (Newsela, 2017) and Big History Project resources (2018) empowered children to use these as examples when interacting with myself and the teacher co-researcher. These interactions informed my research journal notes and interpretations of the cyclical interviews (see Gardner, 2006; Greene & Hogan, 2005; Hattie, 2013; Murdoch, 2015).

**Agency in qualitative, child-framed participatory research**

Students are empowered to seek transformative agency when they are introduced to wider whole systems learning processes and pedagogical innovations through authentic new curriculum frameworks. (Payne, 2006, p. 25)

As Payne indicates, the design of a curriculum that presents a wider worldview enables the possibility of transformative agency and that thinking is in keeping with
the cyclical and increasingly complex transdisciplinary curriculum of Big History. The students, through a deeper knowledge of the cohesive story of the universe, were given an informed platform to air their opinions and values.

One particular concern that I raised in my personal orientation to this research is that there are many examples of children involved in adult-led environmental education activities that are, in Hart’s words, “highly superficial short-term actions to save the earth” (2008, p. 3). If children are to have agency as active participants in child-centred research their participation must be planned, with due recognition of their age-appropriate proficiencies and cultural settings, thinking and acting within a local setting, yet being exposed to a wider world view of global learning and issues it entails.

I contend that the subject of child agency is essential to address if child-centred research is to be valid; however, I do note one caution raised by Hart (2008, p. 17) that could be relevant to my data collection and analysis, that my critical reflections on the children’s voices do not pre-suppose that children who simply have contact with nature in a highly urbanised local setting, therefore automatically have a positive relationship with nature. I take this caution as an alert for me to remain open, allowing the urban child’s voice to be heard. This observation is in keeping with the notion that my research needed to remain faithful in the local school setting where my research took place, that both learners and educators influenced each other in the implementation of the cyclical research design (Wattchow, Burke, & Cutter-Mackenzie, 2008).
Addressing child-framed participatory research design to two participatory research models

The above justification for using a child-framed methodology for this research has addressed the issues of knowledge, empowerment and agency to involve children as active researchers (Alderson, 2001; Barratt & Hacking, 2008; R. A. Hart, 2008).

Children’s local expertise enhances the insights and perspectives they bring to child-framed research approaches. Their involvement in the research incorporates varying levels of participation with respect to a particular research case. For the purposes of this research I have noted Hart’s participatory ladder of participation and its adapted versions (see Barratt Hacking et al., 2013; R. Hart, 1992; Kellett, 2005; Percy-Smith & Thomas, 2009; Widdop Quinton, 2015). Together these studies informed my research, justifying a child-framed methodology that incorporates both Hart and Treseder & Smith (2008; 1997). In the figure below, adapted from Jones (2010), I highlight in bold italics the areas of relevant child participation to my research.

Figure 4.4 Degrees of participation
(adapted from Treseder and Hart's models; see Jones, 2010, p. 5)
I have included Hart’s levels of participation on periphery of the above diagram, but I have deliberately made Treseder’s ‘Degrees of Involvement’ model central in that it can be displayed as nested, equal and cyclical rather than a linear hierarchy. Jones’ assertion (2010) captures this theme in that Treseder’s model relies on children’s wishes, the context of their developmental stage and the local organization being studied.

**Developing relationships to enable reflexivity and transparency in child-framed research methodology**

Barratt Hacking et al. (2013) emphasise the requirement of developing relationships between adult and child. A child-centred inquiry approach of the pedagogical intervention and the cyclical interviews were central to building this relationship with both the co-researcher class teacher and my presence in the classroom as teacher and researcher. This was evident in the familiarity of children during interviews, where I could introduce a topic and then be superfluous at times to the ongoing discussion and debate among a particular group of interviewees. Furthermore, as the interviews progressed some children actually identified themselves as Big Historians and inferred that they were the experts who could teach others about Big History. This clearly sent a message that the students viewed themselves as equals in the learning process.

The voluntary nature of students’ participation was positive and an example of this was where two students were away for the initial interviews. They did not approach me to remind me until the learning cycle was well underway and student interest was palpable in the classroom. That was when they confidently approached me to remind me they had signed up for the research and were keen to be part of the interviews. I
was surprised by their enthusiasm to confidently join in with interview discussions without me needing to invite them into the dialogues.

Meaningful ethnographic study requires rigorous interaction with children to enable their worldviews to be revealed as the cyclical nature of the participatory research continues (see Barratt Hacking et al., 2013; R. A. Hart, 2008; Mack, 2012; S. Punch, 2002). In this study the initial visits to the classroom, along with the pre-pedagogical interviews, set the scene for ongoing building of relationships between researcher and teacher co-researcher, with time spent in the classroom teaching and sharing in inquiry learning practices with the children. Students also became more relaxed as the familiarity with me grew after I had broken my leg, as I needed help to continue visiting the school, both for the pedagogical intervention and cyclical student interviews. In this unexpected context they inadvertently met and engaged with my two adult daughters who visited on a few occasions to help with the recording and during classroom work.

This research relied on the development of student-framed learning through an emerging transdisciplinary curricula (Barratt & Hacking, 2008, p. 286) of the Big History Project (2018). In this context children can view themselves as emerging experts, informed by Big History, so they are then empowered to transfer that learning to inform their environmental education values and to guide their parents and wider school community. Within the above context I was aware that as a lead learner interacting with Year Three students, it was important to heed the advice of Lofland et al. (2006): to “reveal a degree of insider knowledge, skill or understanding” (2006, p. 70), in this case from the perspective of Big History learning. Reflexivity and transparency are essential to child-framed methodology when it is
viewed from the perspective of assisting in questioning prevailing cultural ideologies and to reinterpolate what children envisage as being important in their lives (Alldred & Burman, 2005, p. 189). For the benefit of engaging meaningfully with students, I have adapted Cohen et al. guidelines in 4.5 below to summarise the identified issues for authentic data collection within child-framed action research and ways to address those issues. The central green shape represents the issues the researcher needs to include in the data collection phase, while the overlapping, irregular-sized blue shapes are reminders to cross-check that child-framed perspectives are maintained.

**Figure 4.5 Possible data collection issues**

![Diagram of Possible data collection issues](image)

Figure 4.5 summarises the authenticity of my qualitative action research design which relies on child-framed participatory learning, involving agency through a larger worldview knowledge base to then allow children to engage in deep, critical inquiry learning.
In concluding this section on the significance of child-framed action research to this study I believe the following reflection from Jones (2010) on Articles 12-17 of the United Nations Convention on the Rights of the Child (Unicef, 1989) highlights my belief that children’s voices be heard and empowered.

If young people are to be able to express their opinions about issues that affect them (Article 12), they need information (Article 17) and they need to be able to gather with others to discuss issues (Article 15). Without freedom of expression and freedom of thought (Articles 13 and 14), children cannot have a voice. (Jones, 2010, p. 9)

Child-framed action research is based on the flexibility of inquiry-based curriculum learning (Payne, 2006, p. 27) and of local agency to empower children to reflect on the environmental education values inherent in a particular local culture (Somekh & Zeichner, 2009, p. 6). Student voice needs to be viewed as paramount to the data collection methods and to the ensuing representative data analysis (Mack, 2012, p. 147).

**Summary of Section One**

This section has set out a rationale for the methodology selected for the empirical research component of this proposal, namely a qualitative, action research approach. The ethnographical and child-framed methodology selected, situates well within the chosen overarching worldview, theoretical model of values embedded in whole systems theory. Whole-systems thinking necessarily encompasses and interrelates values in the emerging scientific story of the universe, interdisciplinary curriculum theory, Catholic primary schooling, the Australian Curriculum and environmental
education. Action research, with its participative, cyclical, qualitative and reflective processes provides a means for elucidating my chosen theoretical framing: An Tairseach: a framework for transforming our story, as displayed in Figure 3.10.

The specific data collection methods employed under this methodological approach are detailed in the following section.

**SECTION TWO: RESEARCH DESIGN**

**Introduction**

Story, in the current idiom, is a portal through which a person enters the world and by which their experience of the world is interpreted and made personally meaningful. (Clandinin, 2006, p. 375)

In this section, within the story and values paradigms underpinning this research, I outline the methods to collect and analyse data, taking into account Punch’s understanding of research design (2014, p. 115), as dealing with four main questions in collecting and analysing data: following what strategy, within what framework, from whom and how?

I qualify that, although I represented a series of traditional, sequential research steps to explain my methods in this section, in reality field research, as stated by Lofland et al. “is complex overlapping and interweaving” (2006, p. 11). I also heeded Bernstein’s caution that “the researcher has first to learn the language of the group or society and know the rules of its contextual use” (1996, p. 137); therefore, the reality
of collection methods and data analysis needed to be emerging and interweaving to maintain the authenticity trustworthiness and ethics (P. Hart, 2002) of child-framed and ethnographical research methodology. As such, children and co-researcher teacher were empowered with agency and voice to construct a dynamic interweaving of data collection and analysis (Widdop Quinton, 2015).

Taking into consideration my above caveat on the emerging and interweaving nature of data collection and analysis, I now detail my research methods plan, informed by Lofland et al. (2006), Miles and Huberman (2014) and Shenton (2004), as follows:

- Entry into the field including the number and type of participants involved in contributing data, the length and the time period over which the data is to be collected;
- Research methods and data collection phases;
- Data analysis techniques;
- Perceived data collection problems; and
- Minimising bias and inaccuracy with Data collection and analysis phases.

The framework I choose to explain the above plan is as follows:

- Establishing the validity of the research design and phases of data collection techniques; and
- Data collection and analysis techniques.

I now turn to discussing my methods within the above framework
4.3 Establishing the validity of the research design and phases of data collection techniques

An essential component of this section is to establish the validity of the research design. Although the key terminology for addressing the trustworthiness of rigorous and vigilant qualitative research varies (Richards, 2006), the criteria to address the quality of my research methods are derived from Lincoln and Guba (1986). They argue that the strength of data collection and analysis, when assessing qualitative research, depends on the following four dimensions:

- **Credibility** where the researcher demonstrates thorough attention to ensuring the research is rigorous;
- **Transferability** where sufficient analysis to allow judgment by others to apply relevant findings to further research;
- **Dependability** with the use of overlapping methods and detailed in-depth coverage of the processes involved in the research (Shenton, 2004, p. 71); and
- **Confirmability** which Lincoln and Guba explain as “the data are linked to their sources for the reader to establish that the conclusions and interpretations arise directly from them” (1986, p. 63).

Shenton’s table below (2004, p. 73) outlines possibilities for a researcher addressing the four criteria.
Table 4.2 Provisions that may be made by a qualitative researcher wishing to address Lincoln and Guba’s four criteria for trustworthiness

<table>
<thead>
<tr>
<th>Quality criterion</th>
<th>Possible provision made by researcher</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credibility</td>
<td>Adoption of appropriate, well recognised research methods</td>
</tr>
<tr>
<td></td>
<td>Development of early familiarity with culture of participating organisations</td>
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<td></td>
<td>Random sampling of individuals serving as informants</td>
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<td></td>
<td>Triangulation via use of different methods, different types of informants and different sites</td>
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<td></td>
<td>Tactis to help ensure honesty in informants</td>
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<td></td>
<td>Iterative questioning in data collection dialogues</td>
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<td></td>
<td>Negative case analysis</td>
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<td>Debriefing sessions between researcher and superiors</td>
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<td></td>
<td>Peer scrutiny of project</td>
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<tr>
<td></td>
<td>Use of “reflective commentary”</td>
</tr>
<tr>
<td></td>
<td>Description of background, qualifications and experience of the researcher</td>
</tr>
<tr>
<td></td>
<td>Member checks of data collected and interpretations/theories formed</td>
</tr>
<tr>
<td></td>
<td>Thick description of phenomenon under scrutiny</td>
</tr>
<tr>
<td></td>
<td>Examination of previous research to frame findings</td>
</tr>
<tr>
<td>Transferability</td>
<td>Provision of background data to establish context of study and detailed description of phenomenon in question to allow comparisons to be made</td>
</tr>
<tr>
<td>Dependability</td>
<td>Employment of “overlapping methods”</td>
</tr>
<tr>
<td>Confirmability</td>
<td>In-depth methodological description to allow study to be repeated</td>
</tr>
<tr>
<td></td>
<td>Triangulation to reduce effect of investigator bias</td>
</tr>
<tr>
<td></td>
<td>Admission of researcher’s beliefs and assumptions</td>
</tr>
<tr>
<td></td>
<td>Recognition of shortcomings in study’s methods and their potential effects</td>
</tr>
<tr>
<td></td>
<td>In-depth methodological description to allow integrity of research results to be scrutinised</td>
</tr>
<tr>
<td></td>
<td>Use of diagrams to demonstrate “audit trail”</td>
</tr>
</tbody>
</table>

Credibility

Taking into account the above table, for the purpose of my research, I ensured that credibility was maintained in that the voices of the participants were genuinely heard through the triangulation technique, using the differing perspectives of researcher observations and interpretations being scrutinised confirmed and validated by the participant co-researcher teacher and students (Denscombe, 2010, pp. 346-347). To this end the class teacher was a co-researcher and her voice was documented through my research journal and transcripts from a post-pedagogical interview on 15 November 2016. As students became familiar with the increasing complexity of Big History concepts they provided meaningful feedback during the cyclical interviews, which gave direction to ensuing student-based learning and possibilities, through their eyes, of how Big History affected their perception of local school values when applied to environmental concerns.
Transferability

To provide information regarding possible transferability for future research situations, I specify the research setting below, including the number and type of participants involved in contributing data, entry to the field, the data collection methods, the three phases of data collection and the length and the time period over which the data was collected (Lofland et al., 2006; Shenton, 2004, p. 70).

Dependability

The research methods and tools I discuss later in this section address the dependability of my research, including detailed research phases, and organisation of assessment tools to collect and interpret data (see Appendices 1-3).

Confirmability

Confirmability of the research was made transparent through the triangulation of researcher, co-researcher teacher and the agency of the voices of children through the use of child-framed language and appropriate learning resources, as iterated further in the detailed description of the phases of the research, outlined below.

In addition to discussing student learning under the themes of the local school’s explicitly taught values, an extra dimension to the learning and outcomes was investigated through the eyes of teacher as co-researcher, student suggestions for Big History learning and the researcher’s own observations from research diary entries. Such analysis allowed the research question to be explored at greater depth from the perspective of the extent the emerging scientific story of the universe could inform children’s environmental values through Catholic education.
Having described the validity of my research design I now incorporate those validations as I discuss, describe and reflect upon the phases of the research data collection and analysis.

### 4.4 Data collection and analysis techniques

The data collection and data analysis were carried out in three phases represented in the following Table 4.3 and discussed in more detail under each of the three phases.

**Table 4.3 Proposed data collection and analysis**

<table>
<thead>
<tr>
<th>Preparation phase</th>
<th>Data collection</th>
<th>Data analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre teaching phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Teacing and monitoring phase</td>
<td>Preliminary analysis to inform and, if need be, adapt values and Big History program.</td>
</tr>
<tr>
<td></td>
<td>Post teaching phase</td>
<td>Phases 1&amp;2 research data analysed by researcher</td>
</tr>
<tr>
<td>Approval granted:</td>
<td>• Small group – student videoed semi-structured interviews</td>
<td></td>
</tr>
<tr>
<td>• University ethics</td>
<td>• Individual student mind maps of the universe (think, know, feel, what is important to us and why)</td>
<td></td>
</tr>
<tr>
<td>• Catholic education ethics</td>
<td>• Student drawings of the universe</td>
<td></td>
</tr>
<tr>
<td>• School Principal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Class teacher</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Parents</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Establish a common and shared values language from within the local school context:

- Meeting with Principal and class teacher to localise values and indicators to be evaluated within the parameters of the research

Program and class preparation:

- Class teacher and researcher jointly adapt Big History Project online for 8-9 year old students – enquiry learning and values focused
- Connect students’ knowledge of school values to wider worldviews, offering opportunities to inform students of agency.
- Class displays of Big History thresholds
- Student, teacher and researcher Big History journals

<table>
<thead>
<tr>
<th>Approvals granted:</th>
</tr>
</thead>
<tbody>
<tr>
<td>University ethics</td>
</tr>
<tr>
<td>Catholic education ethics</td>
</tr>
<tr>
<td>School Principal</td>
</tr>
<tr>
<td>Class teacher</td>
</tr>
<tr>
<td>Parents</td>
</tr>
</tbody>
</table>

The data collection and data analysis were carried out in three phases represented in the following Table 4.3 and discussed in more detail under each of the three phases.
**Phase 1: The preparation**

The preparation phase includes the number and type of participants involved in contributing data, the length and the time period over which the data is to be collected.

1. **The informants/participants**

Expanding on the above table, phase 1 of the data collection was the preparation phase when firstly, approvals needed to be granted from university ethics, Catholic Education Office, local Catholic school, class teacher and students and parents. (See Appendices 2, 11 and 12 for copies of the above relevant documents and samples.)

A number of schools were initially approached via email and phone call, and I did meet with three different principals but only one principal believed the Big History pedagogical intervention fitted in with the school’s teaching and learning scope and sequence. The particular Catholic primary school chosen is located in Sydney. Year Three students and class teacher were selected as the informants for the research and letters to seek consent for the study were sent to the principal, class teacher and all families of Year Three students (see Appendices A and B). Fifteen consent forms, including permission to video interviews, to take photographs of students and their schoolwork were signed by both parents and students. I intentionally asked students to sign the forms as well, to give them a sense of transparency and agency in the research from the beginning of data collection. Six boys and nine girls who volunteered ranged in ages from eight to nine years old with varying academic abilities.

The participants chosen for this study were primary aged children, approximately eight to ten years of age and typically in a Year Three class. The ratio of boys to girls...
was reasonably distributed across a class size of approximately thirty students. They participated in a 17-week inquiry-based approach to the Big History Project (see Appendix C) in their usual classroom setting with their classroom teacher and myself as teachers and joint participants in the learning and research process (Lofland et al., 2006; McNiff & Whitehead, 2010 Ch.6).

The chosen school setting was a city based Independent Catholic primary school where the Sydney Catholic Education Office religious education curriculum is taught alongside the New South Wales, Board of Studies Australian Curriculum. (ACARA, 2014; Catholic Education Office: Sydney, 2012, 2013a, 2013b).

Due to the fluid nature of action research it can “proceed in a developmental transformational way in which new questions are addressed as they emerge through the process” (McNiff & Whitehead, 2010, p. 11). Keeping this in mind, the data collection focus was made in conjunction with the class teacher and participating students who had volunteered to contribute to the direction of the research method as the study evolved.

2. Entry into the field

I now describe the preliminary requirement to establish a common and shared language around values in the local school context for all stakeholders: students, researcher and class teacher. Values were central to the parameters of my research questions and therefore the values of the local school’s shared vocabulary was intended to give children agency and empowerment to have their voices heard in shared interview discussions.
In the preparation phase it was essential, once approvals were granted, that a common and shared values language was established with the participating school to ensure that the research was authentic to the local setting and that relevant themes could be established from a values-based indicators, as advocated by Podger et al. (2010; 2013). Following this projectory, my research was conducted in a Sydney local Catholic primary school where values are already embedded in the broader context of daily school and classroom life. This was unexpected and fortuitous as I could omit one initial expected step outlined by Podger et al. (2010; 2013), that I would need to meet with the principal and relevant staff and students to decipher what indicators and values were present in the school. Students and staff had access to the familiar language of these values and, in turn I had the same access, so all stakeholders in the research used them as a platform to confidently articulate their learning and behaviour. The student-based language was familiar through the school-based acronym of ‘PRhOJECT LOVE’ that reminded students of each value. It was readily displayed on the school website and referred to by teachers and students regularly around the school, including classroom and school assemblies:

- Peace
- Respect
- hOnesty
- Justice
- Empathy
- Compassion
- Tolerance
- LOVE

This is in keeping with Podger et al.’s findings that “specific indicators, developed as expressions of values-in-practice, are more clearly communicated and agreed upon” (2013, p. 24). This approach then allowed my data collection to be analysed from the possibility of more than one value being informed by multiple indicators and vice versa. The two figures below (Podger et al., 2013, pp. 13, 23) demonstrate this strategy; Figure 4.6 represents a linear approach whereas Figure 4.7 displays possible
open relationships between values and indicators.

**Figure 4.6 Linear representation of values and indicators**

![Linear representation of values and indicators](image)

**Figure 4.7 Open representation of values and indicators**

![Open representation of values and indicators](image)

In adapting Podger’s research, I identified the local school’s identified values alongside the values in the *Melbourne Declaration* (Table 3.1) and Catholic education documents (Table 3.3). The Australian Curriculum sustainability, cross-curriculum priority organising ideas (ACARA, 2013; Board of Studies, 2012) have been identified in this research as additional filters. Included in the above identified
overarching values were the four pillars of the Earth Charter (2000; Podger et al., 2010) and the specific affective Catholic values of ‘awe and wonder’ and ‘celebration’.

3. Entry into the field of the classroom

My entry into the classroom situation was being introduced to the class as another teacher working alongside the classroom teacher and the students. I visited the class initially and found the children to be friendly and welcoming; I did not feel as though I was treated as an ‘outsider’; rather the children were excited to meet me and to discover that I was a ‘learner’ at university and was enabling them to learn with me about the universe. Because of the nature of the Big History curriculum within its scientific based thresholds, I therefore found that I was of little threat to all other participants in being labelled ‘the expert’, as I truthfully told them I had little specific training in science and portrayed myself as lead learner, partnering students in deep learning tasks (Fullan, Hill, & Rincón-Gallardo, 2017). Big History uses the term of ‘lead learner’ to emphasise it is impossible for a teacher to have command over 13.8 billion years of history and that the teacher’s role is to empower children with systematic and deliberate exploration methods where “the teacher moves from being the source of knowledge into the role of lead learner” (Big History Project, 2015a, p. 18).

Although I have a sound knowledge of the outline and structure of the Big History curriculum, I also saw myself as a co-learner and facilitator of the student-led inquiry learning as it evolved around specific scientific and interdisciplinary knowledge, concepts and skills (Big History Project, 2015a, p. 6). In this respect I was learning and researching with the students, in keeping with the view of Lofland et al.: “In
being viewed as relatively incompetent … the investigator easily assumes the role of one who is to be taught” (2006, p. 68). I therefore envisaged one important role for me was as a participant observer, where I participated in the learning as an active member who honestly shares in the excitement of new learning (Mertler, 2008, p. 80).

I planned to initially engage the students in the research project through classroom displays and atmosphere, storytelling and by introducing them to the concept of Big History through the Big History Project online resources (IBHA, 2018). These resources needed to be monitored and adapted for the developmental age of the Year Three students, as the Big History Project site caters for Years Nine to Ten students. There is no precedent of any empirical studies relating to Big History in the primary school. In fact, 2015 was the first year where a primary school was supported by the Macquarie University Big History Institute (Macquarie University, 2012) to trial teaching Big History at that level. Other sites and resources were sought to complement the Project (see Biemer; Catholic Earthcare Australia, 2008, 2011; Riley, 2012; UC Berkeley, Moscow State University, & Microsoft Research, 2012).

Confidentiality was discussed with the students and that they had the right to raise any concerns they may have had about data being collected, photos, recordings or group or individual interviews (McNiff & Whitehead, 2010; Mertler, 2008). Confidentiality was also being guaranteed to all participants in the actual storage and in write-ups of the data, pseudonyms were utilised instead of real names. The research approaches in phases one, two and three of the study involved personal interactions between the participant researcher and the student participants; therefore, the students were identifiable to the researcher. The student participant information collected was linked
to student names but this was only viewed by the researcher for qualitative analysis, and any extracts stored or used in reports were in a de-identified form.

I utilised Lofland et al.’s (2006) recommended face and post sheets for all data collection to ensure accurate data (record) collection and storage.

Once the values and their associated indicators were established, data collection and analysis of phases two and three, were implemented and involved semi-structured interviews, preceding and proceeding, a 17-week pedagogical intervention and the resulting data analysis (also see Appendix A).

**Phase 2: Data collection phase**

The data collected was organised into themes from fifteen targeted Year Three students and class teacher as co-researchers. Students were initially videorecorded in random small groups prior to, then at appropriate intervals, during a 17-week classroom pedagogical intervention. Final videorecorded post-pedagogical interviews were conducted at the conclusion of the intervention, with both random student small-groups and the class teacher as co-researcher (Morgan, 2007). I had originally intended to keep the same participants for each interview but my journal entry (3 August 2016) explains, “As some children were away I juggled groups so everyone was part of a group - therefore (I could not continue to record with the) original pre interview groups”.

1. **Research methods and data collection steps**

More specifically the methods used for collecting the data consisted of:
• Pre-pedagogical semi-structured video recorded small group interview (see Appendix 1).

• Observations and student written comments from a 17-week interdisciplinary and transdisciplinary class-based pedagogical teaching intervention (see Appendices 8, 9 and 10).

• Ongoing researcher journal, recording both children and teacher co-researcher observations and recommendations.

• Four semi-structured recorded small group interviews during the pedagogical intervention (see Appendix 4).

• Post-pedagogical semi-structured small group interviews, followed by a written assessment (see Appendix 7) at the conclusion of the pedagogical intervention.

• A post-pedagogical semi-structured recorded co-researcher teacher interview at the conclusion of the pedagogical intervention (see Appendix 5).

Video recorded semi-structured interviews were conducted in a child-framed setting where the student participants were invited to respond to researcher prompts using mind maps, drawings, Atkisson’s ‘sustainability compass’ (AtKisson Group, 2014) and overhead resources of examples of a changing environment.

Ongoing observations during the 17-week pedagogical intervention involved the following:

• Observations I recorded in my research journal, with input from the co-researcher class teacher.

• Collecting original and photographed samples of students’ written and art work
during the pedagogical intervention from students who had given prior permission.

- Students were also encouraged to volunteer comments on their own work or findings, particularly in during class plenaries, interviews and post-pedagogical intervention.

Participant journals were planned to be a key collection tool for Phase Two of this research. However, due to the evolving nature of the student-centred critical inquiry and transdisciplinary learning process of Big History did not follow this planned trajectory; rather, the emphasis developed into a meaningful spoken storytelling that suited the learning style for this particular group of students (Cohen et al., 2007; Kellett, 2011; Miles et al., 2014).

Hart (2002) reminds the researcher of the importance of the use of stories of various kinds “alongside narrative related methods … focus(ing) on an individual within a social context considered over time” (p. 141). In keeping with the centrality of ‘story’ and the interdisciplinary approach to this research, a central focus for the students and teachers was to add to the cyclical and increasingly complex new learning of each Big History threshold. Student and teacher-initiated goal setting and reflective learning were a rich source for student/researcher discussions and analysis of the directions the study took.

2. The significance of the pedagogical intervention to data collection

Religious education was a central concept to this study, where the Creation unit from the Sydney Catholic Schools Curriculum (Catholic Education Office: Sydney, 2012)
was taught concurrently with Big History to allow for the possibility for students to gain a greater sense of mystery and awe and wonder at the Big History narrative and the essential interrelated part humans play.

In this second phase ‘visible learning’ techniques (Hattie, 2012b, 2013) were used as an effective tool to engage participants in planning directions for their learning and to invite ongoing evaluation of the study by all participants. Hattie stresses that effective learning equates to students knowing the directions for their own learning. Students were therefore introduced to the following ongoing sequence, which was visually displayed for each learning task: learning intentions, the sequence of learning and the success criteria, all adapted for every learning sequence. This concept was enhanced by the use of teacher and student shared rubrics, introduced to the students as part of the initial learning activity. Students were also involved in setting their own goals and given feedback as to their progress (Hattie, 2012a; Hattie & Timperley, 2007). At times this feedback was teacher generated but students also had access to a variety of feedback tools, including the Seesaw educational website (2015), which gave them access to upload their own work and to allow them to initiate their own feedback at pertinent times. Students and teachers used their Big History journals to record feedback to topics.

3. The significance of regular interviews to data collection

I chose to use pre- and post-pedagogical interviews to assess the effectiveness of the pedagogical intervention in this research as they provided rich data where the interviewer can “develop conversations that lead to enhanced insights for all participants” (McNiff & Whitehead, 2010, p. 163). Interviews were recorded following semi-structured formats with a few base questions and probes (see
Appendix C). Student answers to the child-framed interview questions depended on the interpretation of the questions by individual children (Mertler, 2008, p. 110). The semi-structured format of the questions was in keeping with child-framed ethnographical methods in that they encouraged children to summarise at appropriate times, ask for clarification, explanations and to address hypothetical questions (McGinty & Waters-Adams, 2014). All students had the opportunity for both pre- and post-pedagogical intervention interviews. They were encouraged to relay their successes and queries, to discuss current learning and to wonder about new learning in both the cognitive and affective domains (Collins, Genet, & Christian, 2013; Hollweg et al., 2011; Morgan, 2007). Each group interview was planned to last for twenty to thirty minutes, taking the age of students into consideration and that two interviews were planned during the pedagogical intervention. However, in keeping with the cyclical nature of the research, it became increasingly obvious during the pedagogical intervention that students had rich data that needed to be collected on a more frequent basis, hence a total of six interviews were recorded. The authenticity of the interviews necessitated they be conducted within flexible time-frames, when it became evident students had built on previous knowledge to offer rich data, rather than be constricted by rigid, regular time-tabled interviews.

4. Participant observation

For the purposes of this research, participants were observed during the 17-week pedagogical intervention, through their involvement in Big History learning and the monitoring of their own goals by using student/teacher shared rubrics and self-assessment proformas. The strength of acting on observations depended on the cyclical pattern of ongoing and timely feedback, reflection, revising and re-planning.
Within the flexible interview time-frames, mentioned above, each interview was recorded, accompanied by researcher observational notes and all participants were encouraged to use their journals to recollect and frame their comments. All participants were given explicit time to articulate their goals at the beginning of each threshold, with the class teacher and myself monitoring their feedback and adjusting the program as needed.

Any effects on students’ environmental education values from their learning about the emerging scientific story of the universe were observed and monitored through interdisciplinary and transdisciplinary learning of the Catholic curriculum, including religious education and environmental education. Any transformation of students’ environmental education values was interpreted through observations of local indicators, previously checked with the school leadership team in the preparation phase of the research. The possibility of transformation of student thinking and understanding to a wider worldview is illustrated in my developed model (see Figure 3.10) within the context of whole systems thinking and the NSW BOS Australian Curriculum.

Teaching Big History in Stage Two of the research infused the methods used and informed my methodological plan as described above in Phases One and Two. In Phase One I established the significance of chosen participants and entry to the local school environment. In Phase Two I discussed the cyclical, evolving nature of the data collection through the 17-week Big History class pedagogical intervention, the recurrent student interviews, co-researcher teacher interview and my research journal.
In the following section I investigate my chosen techniques for data representation and analysis.

**Phase 3: Data representation and analysis techniques**

Data was collected and analysed within an action research cyclical method (see Ballantyne, Packer, & Everett, 2005; Kemmis, 2009, 2010; Kemmis et al., 2013) spanning discussion and reflection before, during and at the conclusion of the pedagogical intervention. Student and researcher participation was used to further develop initial goal setting, self-assessment and evaluation (Barratt Hacking et al., 2013; Kemmis & McTaggart, 2005). The cyclical nature of the pedagogical intervention and ongoing student interviews allowed me to incorporate my own new insights recorded in the research journal and to further tailor the Big History program.

The children were therefore provided with the opportunity to develop ongoing Big History inquiry learning alongside Catholic beliefs, school values and future sustainability. Evidence of Big History’s basic premise of the promotion of cognitive and affective learning (Collins et al., 2013, p. 224) is backed up by Laudato Si (Francis I, 2015) and the call to embrace ethical values in sustainable development goals (Burford et al., 2013).

I utilise the following headings to describe the data collection and analysis issues.

1. **Possible Data collection issues**

In Table 4.4, I have adapted the following guidelines from Cohen et al. (2007), attempting to ensure I incorporated and addressed possible problems involved in the
actual collection of data when interviewing children. Although I have addressed these in tabular form, some of the issues and the way in which they were dealt with did cross over, depending on particular circumstances.

Table 4.4 Data collection issues and strategies to address them

<table>
<thead>
<tr>
<th>Possible data collection issues</th>
<th>Anticipated strategies to deal with data collection issues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishing trust</td>
<td>• Initial time spent in classroom building rapport through conversation and assisting in general classwork as required by children.</td>
</tr>
<tr>
<td></td>
<td>• Introduced to the class as a known and trusted colleague of the Principal</td>
</tr>
<tr>
<td>Maintaining informality</td>
<td>• Student-centred, physical and play-based learning activities incorporated in the pedagogical intervention</td>
</tr>
<tr>
<td></td>
<td>• Chatting to children as they entered or left the classroom at play breaks</td>
</tr>
<tr>
<td>Avoiding assuming that children 'know the answers'</td>
<td>• Circle-based discussion circles</td>
</tr>
<tr>
<td>• Overcoming the problems of inarticulate children</td>
<td>• Re-phrasing questions as I noticed facial cues or quizzical looks from children.</td>
</tr>
<tr>
<td>• Pitching the question at the right level</td>
<td>• Awareness when children had not answered a particular question but had answered on a different tangent</td>
</tr>
<tr>
<td>• Overcoming children's reticence to speak</td>
<td>• Class teacher rephrasing my questions when she saw the need for children to be given a different entry point to the discussions.</td>
</tr>
<tr>
<td>• Moving beyond the institutional response or receiving what children think the interviewer wants to hear</td>
<td>• Addressing a child by name</td>
</tr>
<tr>
<td>• Choosing the right vocabulary</td>
<td>• Rephrasing a question or comment</td>
</tr>
<tr>
<td>• Avoiding the interviewer being seen as an authority</td>
<td>• Using a cue that I had already observed the child working on in class</td>
</tr>
<tr>
<td>• Breaking silences on areas that are reinforced by peer-group pressure</td>
<td>• Whole class exposure to learning of Big History common concepts, skills and vocabulary</td>
</tr>
<tr>
<td>Being aware of the giving and receiving of non-verbal cues</td>
<td>• Use of familiar local school values language that all students have been exposed to since entering the school</td>
</tr>
<tr>
<td>• Keeping to the point</td>
<td>• Deliberate attempt to use child-appropriate language</td>
</tr>
<tr>
<td>Seeing children as being of lesser importance than adults</td>
<td>• Being aware of children’s need to adhere to play-break bells</td>
</tr>
<tr>
<td></td>
<td>• Noting when children were losing interest</td>
</tr>
<tr>
<td></td>
<td>• Giving children more time on a particular discussion point when there was obvious interest from the group</td>
</tr>
<tr>
<td></td>
<td>• Ensure I have covered all points from prepared semi-structured questions before finishing each interview</td>
</tr>
<tr>
<td></td>
<td>• Named children as ‘Big Historians’ which they readily adopted</td>
</tr>
<tr>
<td></td>
<td>• Children called themselves Big History experts</td>
</tr>
<tr>
<td></td>
<td>• Children saw their opinions on Big History learning were valued and acted upon</td>
</tr>
</tbody>
</table>
2. Data analysis approach

Initially I planned a deductive coding approach to my analysis, in that I utilised the NVivo software program to create codes from my research questions, literature review findings and theoretical framework (Miles et al., 2014). However, I heeded Miles et al. suggestion that important local factors are uncovered when the researcher is open to discovering progressively emerging codes that do not fit into their pre-existing deductive codes (Miles et al., 2014, p. 81). I realised the indicators of local school values that I had identified and coded into NVivo in the initial stage of my data collection were too narrow in approach and no longer valid. I therefore moved away from using NVivo and decided on a wider thematic organisation to represent and analyse my data collection; I incorporated Podger’s view, referred to in ‘Entry to the Field’ above, that there is the possibility of more than one value being informed by multiple indicators and vice versa (Podger et al., 2010; Podger et al., 2013). A revised inductive and thematic technique involved incorporating the initial deductive, coded indicators of values into a wider thematic framework. This is in keeping with Cohen’s assertion: “Reflexive researchers will be acutely aware of the ways in which their selectivity, perception, background and inductive processes and paradigms shape the research” (2007, p. 172).

My revised, wider thematic coding involved my discarding of NVivo software in preference for reading and analysing all interview transcripts and research journal notes under the various transdisciplinary perspectives, explained further below. I then used colour coding, enabling me to delineate the cyclical nature of interviews by date. I then coded each of those colour coded relevant comments into a Word document by theme.
In keeping with this line of inquiry I now explain the thematic organisation towards my data analysis.

The thematic organisation for data representation

As stated at the beginning of this chapter, my data collection and representation continued to build on the theme of ‘story’, as outlined in Chapter One of my thesis and subsequently expanded upon in later chapters. The inductive approach to my data analysis where I was open to emerging themes throughout the interviews and pedagogical intervention allowed me to explore the possibilities of a new storyline from the following transdisciplinary perspectives:

1. *The students’ evolving understanding of the historical and scientific universe story as an emerging threshold*: analysis of students’ initial personal knowledge of the scientific universe story and the extent their previous Catholic learning, local school values and a pedagogical intervention provide them with new knowledge across the spectrum of conformative, reformative and transformative learning, as discussed in Chapter Three.

2. *Reviewing of the scientific story and the Catholic story through cyclical action research* (Kellett, 2005, 2011; Kemmis, 2009, 2010; Kemmis et al., 2013): collection of any relevant data that informed students’ environmental education values. The cyclical data collection depended on continuing cyclical reflection throughout the pedagogical intervention and within the local school values framework.

3. *Reframing the transformative learning possibilities for the future story*: representing the extent of students’ growth in environmental education
understanding through transdisciplinary and inquiry learning.

4. *Redesigning the story for students from a socioecological perspective*: collecting data from children as co researchers, while incorporating the possibility of them “seeing our worldview rather than seeing with our worldview” (Sterling, 2011, p. 23).

Using the above perspectives, I revised my data representation to embrace five themes, being mindful of the overall ethnographic and child-framed methods with an environmental, interconnected and increasingly complex cohesive story (Big History Project, 2018), as displayed in Figure 4.8. The codes were treated as part of a unified structure, thus enabling me to “connect different codes with larger wholes … a conceptual web” (Miles et al., 2014, pp. 84-85).

Figure 4.8 Thematic findings from data analysis
As explained above, each interview was examined in light of the five unfolding themes underpinned by local school values. This validated my research analysis within the contexts of broader education, Catholic education and environmental education values. The focus on a thematic approach to data analysis of local school context of values is in line with Chapter Three’s theoretical framing in that “localisation was found unavoidable, and improved rather than reduced overall validity.” (Podger et al., 2013, p. 9). Further, as the pedagogical intervention was crucial to addressing my research questions by building the field within Catholic education, the concepts of ecological awareness, consciousness and conversion were laid alongside the process of inquiry and deep learning (Catholic Earthcare Australia, 2010; Catholic Education Melbourne 2015; Morris, 2002).

The interviews were examined within the educational philosophy and practice where students had engaged meaningfully in a cyclical pedagogical intervention that integrated a broader educational inquiry learning, as discussed in Chapter Three. This educational context is encapsulated in transformative whole systems thinking (see Lewis & Baudains, 2007; Sterling, 2003, 2010a, 2010b) and the socioecological perspective of Wattchow who advocates “adapting a socioecological philosophy and practice to education. This new approach to education considers the personal, social, community, environmental and political dimensions that shape all learning experiences” (2014, p. v). Reflexivity was essential to me as researcher throughout the inductive process of data analysis to ensure I was open to the transparency of reshaping my perspectives, ensuring flexibility, differentiation and integration of emerging patterns (Miles et al., 2014, p. 93). I needed to use my themed coding from the early stages of the cyclical analysis process to embrace the evolving nature of
intertwining student and co-researcher teacher’s interview comments alongside my research journal observations and children’s written samples.

**Interpreting the data through a transdisciplinary values-based lens**


Furthermore, in keeping with Podger et al. (2010), the actual analysis was viewed from the basis of local school values and informed by the following identified themes: knowledge, values, Catholic teaching, transdisciplinary learning and the socioecological learner. These themes allowed for either one or additional values to be identified (Burford et al., 2013; Podger et al., 2010; 2013)). Podger contends that “specific indicators, developed as expressions of values-in-practice, are more clearly communicated and agreed upon” (2013, p. 24). This direction is supported by evidence in my literature review, where the need to move away from a silo focused subject curriculum to a wider worldview (Christian, 2011; Christian, Brown, & Benjamin, 2013; Collins et al., 2013; Sterling, 2003, 2008) allows for the embracing of multiple values and subject disciplines. This approach is imperative to producing a dynamic and broader perspective when analysing the collected data.
Interpreting the data through a transformative socioecological values-based lens

Data analysis was based on Kemmis’ action research spiral (Kemmis & McTaggart, 2005, p. 6), as discussed in Section 4.1, where the recurring theme of ‘plan – act and observe – reflect – revise plan’ was utilised in the three-phased data collection process as outlined above when each phase necessarily informed each other, resulting in revising of plans where needed.

When analysing the data produced from the identified methods for this research, it was vital to incorporate a whole systems approach and the possibility for transformation within the research process. The practices, advocated by McNiff and Whitehead (2010) are highlighted in Figure 4.9. They are essential to this research and its search for the possibility of transformed relationships within the values paradigm, particularly from environmental education and sustainability viewpoints.

Figure 4.9 Transformational relationships (McNiff & Whitehead, 2010, p. 144)
The interrelationships above were also monitored against Kemmis’ cyclical action research spiral, where my learning informed ongoing practices. As a researcher I need to be committed to my personal and professional values, informed that the research methods are appropriate and have intent that I act on the research in a cyclical and ongoing method, defined by Mertler (2008, p. 81) as constant comparative method.

The data analysis needed to be framed from the perspectives of the search for transformative paradigms, especially pertaining to the students’ attitude indicators, as identified by the local school leaders, which in turn informed possible transformation of values in environmental education and agency for sustainability (Podger et al., 2013). An important factor for the data analysis was that it occurred concurrently and in a cyclical mode, using student and teacher interviews and observations recorded in my research journal. Observation of participant reflections on individual goal setting against the class learning intentions and success criteria, along with timely feedback from teachers and peer participants in both written and spoken forms was also utilised. Figure 4.10 shows the data collection, represented as floating diagonal text, and the recurring, cyclical steps for data collection and analysis.
For my model to be valid, it was essential that the whole systems theory of interrelated, interdisciplinary and interconnected approaches be interwoven into my data analysis. Values through the three levels of conformative, reformatory and transformative learning fed into and fed back between cognitive and metacognition nesting, within a cyclical approach (as in Figure 3.10).

**Step 1.**
To this end all written observations from phases one to three, including interview transcripts were highlighted with researcher-initiated coding, adapted from the _Environmental Learning Outcomes Survey_ format (Appendix A, Ballantyne et al.,
2005) to identify any conformative, reformative and transformative learning, along with relevant indicators of values chosen by the school observed.

**Step 2.**

Socioecological learning incorporating conformative, reformative and transformative learning analysed from the step 1 collection and analysis, integrating identified student indicators of value learning. The findings were written and evaluated in an ethnographic method approach; once again, ensuring that a cyclical approach, through the threshold learning was upheld. This fulfils Hammersley and Atkinson's (2007) triangulation position where I drew on a variety of data from different students, who had been involved in the same learning process. Some of my personal bias (McNiff, 2002) was counteracted as I interpreted the differing ideas students present and sort feedback from the co-researcher teacher. As mentioned earlier in this chapter, the time constraints of a busy classroom teacher didn’t allow for my initial plans that she journal her reflections and observations, but I believe that our regular debriefing, emailing and follow-up with cooperative lesson preparation provided me with her insights to enrich my data collection. I ensured I added all relevant conversations to my journal which I discussed with her; she also had shared access to the journal through Google docs.

**Possible data collection and analysis limitations and problems**

As the ethnographer, I realised that there would be possible limitations to my data collection and analysis. I therefore became a regular attendant in class during the 17-week pedagogical intervention, aiming to immerse myself in the local school culture and to gain some understanding of child-framed methods needed to engage the
students as I collected data (P. Hart, 2008; Kellett, 2005; S. Punch, 2002). I was aware that knowledge gained from the data also comes with the caveat that interpretation by the researcher can limit the analysis. I planned to avoid this as far as possible by using reflexivity during my evolving analysis. This was aided by the cyclical nature of the interview process where I could re-check children’s comments as their knowledge of the Big History story, concepts and skills interconnected.

Furthermore, in coding the themes from the children’s perspectives of empowered agency through known local school values and new shared knowledge, I as the researcher I was attempting to deal with these issues.

I therefore identify possible data collection limitations and problems as follows:

- Although my research data collection was limited to one school (Kemmis et al., 2013, p. 12), I need to emphasise that the basis of the pedagogy I have built on is the Big History Project, I adapted from an online, multi-national initiative that is freely accessible. The underpinning of values was also foundational to environmental education documents, as I have outlined in previous chapters;

- At all times I needed to remember the bias of my personal and cultural values that I brought to the research as previously identified in the theoretical framing that values education is not neutral, and, therefore, I brought my personal and cultural bias to the research (see Hart, 2002; Mertler, 2008; O'Brien, 1998; SAGE Publications Ltd, 2002). Within this framing I needed to remain aware of the constraints of working within the time constraints of a busy teacher, classroom and school environment.

- The limitations of one qualitative research study, focusing on values and the
emerging scientific story of the universe, in an area of research that is very limited in Catholic primary schooling; and

- The Catholic culture has a definitive set of values that teachers, parents and children may see as closed for discussion; at times this necessitated presenting a wider Catholic world view of the Church’s inclusive stance on cosmology and the call to ecological awareness, consciousness and conversion, to parents and school staff.

3. Minimising bias and inaccuracy with data collection and analysis phases

The following checks were maintained to minimise bias and inaccuracy during the data collection and analysis phases:

- Participant researcher and participant teacher debriefings after classroom observations and pre and post interview sessions. Any discrepancies and/or additional comments were recorded in researcher’s field journal;
- Checking with the participant student that the participant researcher’s understanding is in agreement with the participant student’s answer or comment;
- Triangulation adding to trustworthiness through teacher, researcher and students as co learners and co researcher; and
- Credibility, transferability, dependability and confirmability checks as outlined in the first section of this chapter (Lofland et al., 2006; Miles et al., 2014).

Overall, I believe the words of Hammersley and Atkinson were the words of caution I needed to particularly heed: that it is important, “to remind ourselves that the ethnographer is very much part of the social world he or she is studying and is
therefore subject to specific purposes, constraints, limitations and weaknesses; like everyone else” (2007, p. 229).

Prior to turning to the data presentation and analysis, Chapter Five, I summarise Section Two, where I discussed, described and reflected upon my plans for, and implementation of, the methods utilised to collect and analyse data. I outlined the data collection of this study consisting of three phases.

Phase One consisted of recruiting a co-researcher teacher and fifteen Year Three students to voluntarily participate in a total of six semi-structured ethnographic and child-framed interviews. Semi-structured child-framed ethnographic interview question guides and visual prompts were prepared for the interviews, along with a laptop computer to video all interviews and a suitable specific microphone that ably captured the voices of the children. Draft face and post-interview summary sheets were also prepared.

Phase Two outlined the process of collecting data in the interviews with groups of three to four students, ranging from a pre-pedagogical interview, through five cyclical interviews and final post-pedagogical group interviews to capture children’s voices as they progressed through their learning cycles of increasing complexity of the child-framed Big History pedagogical intervention. I wrote ongoing research journal reflections via Google Docs. One final semi-structured interview was videoed with the co-researcher class teacher to capture her voice on the cyclical nature of the research data collection from pre-pedagogical interviews through the pedagogical planning and intervention to the final reflections of the students.
Phase three consisted of my attempts to capture the data in a comprehensible form ready for analysis. I initially attempted to utilize the NVivo computer software to code my themes but came to the realisation that I would store, categorise and analyse all data more proficiently by utilising my own thematic coding via transcripts and Word documents. This latter approach was in keeping with my research aim of using ‘universal’ indicators to identify the local school values, from which those indicators had originated (Podger et al., 2010; Podger et al., 2013).

**Chapter conclusion**

The child-framed, ethnographic design, as outlined in this chapter, provided the appropriate tools to investigate the research questions and theoretical model as summarised in Figure 3.10 of the previous chapter. The action research methodology and research design outlined in Chapter Four provided the means for testing the framework developed for this study in Chapter Three: ‘An Tairseach: A framework for transforming our story’. The techniques presented allow data to be collected in a concurrent and cyclical manner in order to analyse the data to enable the interweaving of local school values, within the thematic schema developed in Chapter Five. This chapter also described the ways in which data was collected, codified and analysed, in addition to foreseen data collection and analysis problems.

As I turn to Chapter Five to analyse the collected data, I remind the reader of the nesting of my research methodology and methods described in this current chapter, illustrated in Figure 4.11. This summary therefore forms my directions for the following chapter.
Figure 4.11 Directions for data presentation and analysis
CHAPTER FIVE
DATA REPRESENTATION AND ANALYSIS - EXTENDING THE STORYLINE

Introduction

In this chapter I present the themes that emerged from teaching the metanarrative of Big History and the extent the new learning impacted on the shared learning journey. I discuss and analyse the data collected from fifteen Year-Three students and their class teacher, Nadine, as co-researcher.

The cumulative data was collected from six child-based group interviews and one post-pedagogical interview with Nadine. Fieldwork observations from Nadine and myself were also recorded in my research field notes journal and samples of students’ written work was collected, as discussed in the methodology section of this thesis. As outlined earlier in the thesis, the overarching research question of this study is:

- *To what extent can the emerging scientific story of the universe inform children’s environmental knowledge and values through Catholic education?*

These were further deciphered into two subsidiary questions:

- *To what extent can teaching children critical knowledge of the emerging scientific origin story help them to interpret environmental education values*
within their knowledge of local school values and the Catholic education curriculum?

• To what extent can the transdisciplinary nature of the emerging scientific story of the universe inform children’s environmental knowledge and values as socioecological learners?

As will be recalled in Chapter Four (Figure 4.11), I devised a data collection and analysis framework. Building on that schema, my data representation and analysis were therefore organised under the following five themes, with the caveat that, although presented in a lineal sequence below, for the sake of presenting a cohesive analysis, all themes actually feed into and inform each other. This is an adaptation of Sterling’s nesting framework (2003, 2011, 2016) as presented in my theoretical framework.

• THEME 1. KNOWLEDGE: The extent the emerging story of the universe, taught through the vehicle of Big History, contributed to informing students’ critical knowledge and extending their vocabulary.

• THEME 2. CATHOLIC BELIEF: The extent that students transferred their prior knowledge of the Catholic teaching on God’s Creation to inform their emerging knowledge of the story of the universe.

• THEME 3. VALUES: The extent that environmental education values, particularly in the context of local school values, were interpreted by students through the lenses of the emerging story of the universe and Catholic tradition.

• THEME 4. TRANSDISCIPLINARY LEARNING: The extent of impacts on students’ environmental education values when teaching a whole-systems,
transdisciplinary 17-week pedagogical intervention through the lens of the emerging story of the universe.

• THEME 5. SOCIOECOLOGICAL LEARNER: The evidence that demonstrates students’ values are informed within the conformative, reformative and transformative socioecological learning process (Eames & Cutter-Mackenzie, 2017; Wattchow et al., 2014).

I now turn to the representation and analysis of data by addressing the above themes.
THEME 1. KNOWLEDGE: The extent the emerging story of the universe, taught through the vehicle of Big History, contributed to informing students’ critical knowledge

Orientation to Theme 1

The well documented and researched Big History Project (2018), discussed and evaluated in prior chapters, was chosen as the medium to teach the 17-week pedagogical intervention. As previously outlined, The Big History Project clearly defines student focused critical thinking skills, alongside transdisciplinary emphases on informing students’ knowledge of the emerging scientific story of the universe. Students’ learning through the Big History Project, along with access to a relevant shared vocabulary, allowed them to express their growing knowledge of the unfolding increasing complexity of the universe. The following points will be addressed in this section to verify students’ observations:

a) Accessing increasingly complex knowledge of Big History: students emerging as experts.

b) Developing a common vocabulary through Big History.

c) Building knowledge of thresholds and increasing complexity: inquiry learning and critical thinking.

d) Co-researcher teacher and research journal observations of how Big History contributed to informing students’ knowledge of the universe.

I now address the first subheading.
a) Accessing increasingly complex knowledge of Big History: Students emerging as experts

It was evident from the initial pre-pedagogical interviews that students displayed a range of knowledge about the universe. Even taking this variation into account, students’ lack of actual cohesive knowledge of the topic was apparent in initial interviews as exemplified below:

MA: Do you know what the universe is?
Georgia: Space.
Amy: I don’t know.
MA: ...Do you know how old our Earth is?
Georgia: More than a million years old.
Amy: More than a million.
(Pre-pedagogical interviews, 29-30 June 2016)

Aidan: The universe has a lot of planets, all the planets and it holds stars and no oxygen.
Aidan: No gravity, no oxygen.
Jack: Because gravity is oxygen. If there is no gravity there is no oxygen.
Aidan: Yup. That’s definitely correct. I agree with him 100%.
Jack: I think I know what the Big Bang is. I think it is when all the planets were together. I have seen on some commercial that they said all the planets were like one big planet and maybe the Big Bang was when they exploded into the planets.
Aidan: Meteors. It was meteors.
(Pre-pedagogical interviews, 29-30 June 2016)

When comparing the two excerpts, the first identifies students who had limited knowledge of the universe and a confusion in their ability to perceive grand geological time scales, referenced as deep time in Cheek (2012), Crumley et al. (2015) and Tucker (2012). In the second excerpt, although students displayed some relevant vocabulary, curiosity and interest they still did not possess a cohesive sense of deep time to link their knowledge; rather they presented a fragmented knowledge
of the universe.

It was apparent that a cohesive knowledge base was lacking among the students. However, some students’ comments in the initial interviews revealed that a sense of inquiry was generally present and that they were interested in gaining knowledge about the universe. Georgia’s statement below revealed that she could see there is some connection to knowledge and attitude toward the environment:

*MA:* How do you think (learning about the environment) could affect your attitude towards the environment?

*Georgia* Maybe people would stop hurting it, chopping down trees and polluting the air.

(Pre-pedagogical interviews, 29-30 June 2016)

In contrast to that excerpt, several students were disinterested in the idea of new learning, as exemplified by Mia, Aaron and Indi:

*MA:* Do you think you know everything there is about the universe ...?

*Mia:* I reckon a bit more.

*Aaron:* A bit more.

*MA:* Think of what you know and do you think you need to know other things about the universe?

*Indi:* I know all about it.

(Pre-pedagogical interviews, 29-30 June 2016)

After reviewing the children’s attention and facial expressions in the recorded interview I observed that Mia’s remark was merely a polite reply to my question and then Aaron used her prompt to be seen to answer too. Indi though, confidently expressed no interest in learning new knowledge. In keeping with Spyrou’s warning (2011, p. 161) that eloquent voices of some children can overshadow quieter or less articulate children, I have consciously included Aaron’s comments from any relevant
transcripts throughout this analysis as I was aware that his voice was paled at times by children who spoke more expressively.

The two excerpts represent students’ differing acknowledgements that gaining further knowledge about the universe may affect their attitudes towards the environment and signalled to me that an inquiry-based and child-centred learning program (Big History Project, 2015, 2018) would be vital if the children were to gain authentic deep learning skills and concepts, succinctly articulated in Sydney Catholic Schools’ student learning vision statement (2016)\textsuperscript{21}. My analysis of the child-framed interview data, from within the students’ familiar educational setting addresses McNiff and Whitehead’s call (2010) to improve educational practice through improving authentic evidence-based research. The promotion of authentic education is also consistent with the arguments of Johnson et al. (2015), that institutions choose technology that supports learning and creative inquiry.

As students gained access to Big History knowledge through the pedagogical intervention, their growing confidence emerged in building on previously learnt knowledge in ensuing interviews as represented below:

\begin{quote}
\textbf{Gabby:} \textit{I was surprised because I thought we were just going to learn about it a bit quickly instead of just going into one part, and then keep on going into the same part, and then keep on redoing it like that... if we redo it, the stuff you don’t know, you get to know it.}

\textbf{MA:} \textit{... What is 13.8 billion years of Big History telling you about yourself and about us? Gabby.}

\textbf{Gabby:} \textit{That we've actually spent a long time - that we don't even know it, and...}
\end{quote}

\textsuperscript{21} The Sydney Catholic School’s vision statement states that “Authentic Learning is at the very heart of the work of the Catholic school … Students … will experience learning which is relevant, purposeful and engaging … rigorous and empowering. It is learning that enables students to realise their full potential, develop their social consciences and live lives of promise and meaning in a rapidly changing world. Students will engage in learning which connects to their experiences, enabling them to become lifelong learners who will contribute to society and the wider world as active and discerning citizens” (Sydney Catholic Schools, 2016, p. 10).
it's hard to believe that we have our own origin story.
It's hard to believe that we have our own ... origins story and it's like, how did that happen in 13.8 billion years?

(Second pedagogical interview, 29 August 2016)

The dialogue captures students’ growing sense of ownership of their growth in knowledge of the universe. An acknowledgement of this growing confidence was even expressed by other students who aligned themselves to being ‘Big Historians’ or ‘experts’ in the field of Big History. The expanding knowledge that students ably drew upon in subsequent interviews was the necessary footing in the first step of critical inquiry learning. The building up of the cohesive Big History story provided the opportunity for student knowledge to be interconnected with whole systems thinking as a basis for change in education and is consistent with the findings of Christian (2017), Podger et al. (2010) and Sterling (2003) who advocate authentic learning within a whole systems thinking.

By the last interviews (as represented below) students were very confident in using the cohesive knowledge base of the historical Big History thresholds they had acquired to give concrete examples of a cohesive story that all humans share:

Imogen: We once didn't know how to plant berries, and could only pick from them and hunt animals.
MA: How did that change Imogen?
Imogen: Because, we found out how to plant berries, and then we started going off by ourselves and planting them and breeding animals, and that was agriculture.
MA: In Big History what we call that? When we move, and we learn things?
Imogen: Civilisation.
Gabby: Collective learning?

(Post-pedagogical interviews, 15 November 2016)
The excerpt is another demonstration of how students adapted the formal Big History learning to more child-appropriate language, as advocated by Kopelke (2012). This is consistent with Catholic Church documents (Catholic Earthcare Australia, 2010; Francis I, 2015) and Sterling (2008, 2011) that advocate learning that allows for a shift from conformative to reformative learning.

Another important observation from the extract is, that while using formally introduced knowledge of ‘agriculture, civilisation, migrate, threshold’, Imogen also accurately describes her learning in age appropriate language (See Christensen & Prout, 2002; Punch, 2002). An example of this is in her second comment where she describes ‘agriculture’ before introducing the actual term at the end of the sentence. There is also clear evidence that Imogen applied her understanding, allowing her to transfer knowledge by placing herself and living humans into history in introducing personal voice ‘we’ in her dialogue. The emergence of a wider worldview of our common origin story is also evident in Imogen’s usage of the pronouns ‘we’ and ‘ourselves’ when describing historic human thresholds. This is in keeping with Sterling’s argument (2011, pp. 23-25), to empower the learner with a larger worldview where ‘origin stories’ is one of the key concepts of Big History learning (Big History Project, 2015).

The issues raised by students provided evidence of the importance of building a knowledge base where their learning continued to be underpinned by Big History learning. Gabby, Imogen and Molly’s responses were validation of this when they were asked if they could explain why big History helped them learn about the environment:
Gabby: Threshold five’s - how there's life. We want to keep the life going instead of ending it, and then everything will be extinct and you have nothing left.

Imogen: Yeah, just like almost pandas are extinct. Pandas are really endangered.

Molly: We've actually been around for a really long, long time, but we never knew it...

Gabby: We wouldn't have Threshold six, because it's an ancient civilisation -

Imogen: Agriculture.

Molly: And we wouldn't know about the Thresholds... or we wouldn't know how the world was made.

Gabby: Yeah, and then we wouldn't know science, and everything. We wouldn't have Thresholds six, seven, eight and nine.

(Post-pedagogical interviews, 15 November 2016)

Using age appropriate language contexts, as demonstrated, students articulated a cohesive explanation of factors affecting the environment using knowledge of thresholds, an essential skill of the Big History curriculum (Big History Project, 2015). The case study example of the extinction of pandas, as described by Imogen, is given weight by situating it within the larger threshold of ‘life’. Molly, Imogen and Gabby’s discussion is likewise given credence in the common understanding and use of the term ‘thresholds’.

I have represented the importance of students accessing a common and shared knowledge. The place of specific vocabulary within that knowledge base will now be further expanded below.

b) Developing a common vocabulary through Big History

Within the knowledge base of Big History learning, there was a consistent emphasis on continuing to develop a common vocabulary-learning frame throughout the 17-week pedagogical intervention. Students were thus
empowered to express environmental education values through confidence in their extended vocabulary learning. This was evident where students applied the language learnt in earlier historical thresholds, throughout cyclical interviews in recurring reflective cycles of ‘plan – act and observe – reflect – revise - plan’, adapted in my methodology from Carr and Kemmis (1986). Critical thinking skills were developed through learning vocabulary of ‘scientific claim testers’ (Big History Project, 2015) and used consistently throughout the teaching and learning program.

The following pre-pedagogical comments typify relevant but fragmented vocabulary used by the children:

Theo: I know there was one planet all together and the meteor hit it and split the planets apart...
Aidan: Yes, ice rings on some of the planets...
Jack: Black holes are planets when they explode and then they create a black hole.
Charlie: (Earth is) next to Venus and Mars and it's round, like all the other universes. That's all I can think...
MA: Do you know how the Earth began?
Charlie: I think so. There was the sun created things, and they put them all together, and there's lot of volcanoes rising up, and then there was ... I forgot.

(Pre-pedagogical interviews, 29-30 June 2016)

As evidenced, there was an apparent need for vocabulary to be presented within a cohesive historical time frame, which would then enable Theo, Aidan, Charlie and Jack to converse with confidence and with a shared understanding.

The following two exchanges exemplify growth from the initial limited and fragmented knowledge and vocabulary, to an emerging systemic understanding that
encourages informed critical thinking and authentic deep learning (Big History Project, 2018):

MA: What would you imagine you would see in the universe?
Joe: You'd go past lots of buildings.
Joe: Lots of people walking on the footpaths.
Charlie: The red dwarf. It's a kind of star.

(Pre-pedagogical interviews, 29-30 June 2016)

MA: Are there any words you now know?
Jack: Astronomy, astronomer, scientist, archaeologist, ... origin story, history.
Aidan: Cataclysmic, I heard about that. It means sometimes a disaster happened. It means the same as catastrophic but I like using the word cataclysmic.
Aaron: Goldilocks conditions
MA: What does that mean for Big History?
Aaron: Just right
MA: And what happens when something is just right? What do we call that new thing we put out along the rope? (referring to outdoor activity to display time)
Aaron: Thresholds [looking very pleased with his answer].
Jack: Claim testers
MA: Do you know why we're learning about claim testers Jack?
Jack: To learn about what to ask the experts and knowledge and evidence but in scientific language.
Aidan: Intuition, gut feeling
Theo: Light years
Jack: Authority
Aidan: We're learning the question how many km in a light year.

(First pedagogical interview, 1 August 2016)

The limited vocabulary in the initial interview extract is in stark contrast to the second interview transcript, recorded after only one month of ‘Big History’ learning. Whereas the initial interview excerpts demonstrate no real shared conversation and vocabulary, the latter excerpts show the growth in vocabulary the students were now able to access and to confidently use, enabling them to share their common learning. Despite the fact that Aaron generally used a limited vocabulary and was reticent to join in with routine class discussions, he was able to join in the conversation with the
other three boys, because he was empowered with his newly learnt knowledge and vocabulary.

**Figure 5.1 Representation of an emerging vocabulary used to express knowledge**

The represented data in Figure 5.1 displays a clear indication that the developing common vocabulary empowered students to confidently discuss the Big History story. As I have previously cited, this observation from the collected data is in keeping with the call of the *Declaration of Thessaloniki* (UNESCO, 1997), to place emphasis on knowledge as the strengthening of information, which in turn, supports much needed action in environmental education. Likewise, my research data findings show that the building of knowledge was not an end in itself but a catalyst for students to use that knowledge to inform their inquiry and critical learning, understandings also developed in the writing (Wattchow et al., 2014) of Rodriguez et al. (2011) and Stone (2010). I now address the place of knowledge in inquiry learning and critical thinking below.
c) Building knowledge of thresholds and increasing complexity: Inquiry learning and critical thinking

The building on from previous knowledge and complexity of successive ‘thresholds’ promoted inquiry deep learning and encouraged critical thinking as evidenced in Fullan and Langworthy (2013) and Sydney Catholic Education Office (2011) who promote learning systems that develop student understanding and skills in connecting to a continually emerging world. The ten-unit structured approach to historical and scientific ‘thresholds’ of a Big History pedagogical intervention allowed for rich data collection, when combined with the nature of child-framed interviews throughout those units, in keeping with the recommendations of Barratt Hacking et al. (2013) and Kemmis and McTaggart (2005; 2017).

When students discussed the possibility of learning about the universe in the interview, it was obvious from their initial queries and emotive language that the topic resonated deeply with them and the prospects for authentic inquiry learning opportunities abounded. I believe that the knowledge component of a cohesive Big History framework gave students an informed platform to discuss ‘why’ they are learning the history of the universe, in keeping with Sinek’s Golden Circle (2009), beginning with ‘why’ then ask ‘how’ and lastly turn to ‘what’ to learn. The interrelated story with its consistent vocabulary and increasing complexity of thresholds also addresses the ‘how’ it will be delivered and investigated. The ‘what’ of Big History learning is communicated throughout this interconnected and unfinished story through critical learning inquiry and possibilities for reformatory and transformative socioecological learning cited in my theoretical framework based
around the findings of Sterling (2003) and Wattchow et al. (2014).

The following voices typify the students’ limited responses in discussions during initial interviews, yet also capture their queries and the possibilities for inquiry learning about the universe:

**Gabby:** I would like to learn how the universe is and how does the planet get there and what happened. How did Saturn get its rings and why did Pluto become a dwarf planet when it was actually a planet?

**Molly:** I would want to know how the planets work...no...How the universe works.

As demonstrated, Gabby and Molly displayed an innate sense of inquiry. This was important for me to acknowledge as part of this research, in that I was not claiming to teach inquiry learning; rather I was building on that innate sense of discovery, within the varied fragmented knowledge differing students expressed. I had the foundations to justify teaching a cohesive, scientific and historical narrative of the universe using a critical interpretive approach to students’ new learning as in the Big History Project curriculum (2015). This approach enabled students to critically discuss and to express the knowledge from their shared learning.

Following on from this innate sense of curiosity that students displayed, I also was able to attain that the children’s perception of animals, nature and humans were not viewed as interdependent within a whole systems ecological framework; rather there was definite scope for them to develop a whole systems and wider worldview as socioecological learners, learning within a broader knowledge base, as advocated by Lewis and Baudains (2007) and Gruenwald (2004).
Students’ initial thinking tended to be somewhat anthropocentric where humans are external to nature. The children though did not entirely describe humans as external, rather as Molly eloquently phrased it, ‘humans are in the middle’ which Deleuze and Guattari (1988) refer to as ‘milieu’ [the middle]:

MA: Are animals nature ...?
Gabby: They live with the nature but they're animals, they move around and get food and stuff like that.
MA: ... Are humans animals then?
Imogen: Yeah, no.
Molly: Yes, we are (animals). We're mammals, aren't we?
Imogen: Yeah.
Gabby: Yeah, we're mammals. We're Homo Sapiens.
Imogen: Animals belong with nature so they kind of nature and at the same time they're not. They kind of blend.
MA: Do we all agree that humans are nature or they're not part of it?
Molly: In the middle, nature, not nature, in the middle of that.

(Pre-pedagogical interviews, 29-30 June 2016)

The children’s discussion provides evidence of the need for building informed knowledge and coherent structure to allow authentic inquiry learning to take place and to provide opportunities for the development of a transformative and wider worldview. The knowledge base developed throughout the pedagogical intervention was crucial to this analysis as it gave students the platform to grow in confidence and understanding and therefore articulate their perceptions of the history of the universe for the purpose of this research. An additional, important point regarding the comments is Molly’s final comment of being “in the middle”, representative of what several children were indicating: even at pre-pedagogical intervention stage, their views were not entirely anthropocentric, rather they needed to proceed and develop their understanding from “in the middle” of humans and nature. My data analysis, as applied to children’s limited view of nature-human relationship, upholds Dickinson’s
call (2013) to rethink Louv’s viewpoint (2008), that claims children see nature as entirely external. Dickinson’s critique of Louv’s “fall-recovery” narrative of adults presuming children are separated from nature and must be returned validates both Deleuze and Guattari’s (1988) and Malone’s stance (2016).

The ongoing introduction of new, relevant vocabulary enabled students to communicate their newly learnt knowledge using pertinent technical words, while at the same time displaying an understanding of that knowledge while using child-appropriate language as seen below:

Mia: It's [a zipper is] an example where (DNA) just keeps on splitting and splitting and splitting...
MA: What happens every time it splits?
Mia: It makes more DNA.
Aidan: DNA is in many things. It can be in my blood and when the zipper opens, sometimes it can't make the exact same DNA parts so it's slightly different, but they're not really different. That's how everyone looks different.
(Fourth pedagogical interview, 17 October 2016)

Mia and Aidan’s exchange exhibits students’ growth in knowledge, which in turn emphasises the need for cyclical, ongoing building of the scientific and historical universe story that gives children the basis of clarity and a depth of understanding to pursue their inquiry learning. The clarity gained by the students is supported by Bonnett’s critical review of the pressing need for a grand narrative that encourages society to break away from an anthropocentric mindset, “a cultural change (that) must seek to disturb and disrupt some powerful current cultural grand narratives” (Bonnett, 2015, p. 53). Advocacy of such a rich grand narrative sustains the importance of Big History with its inquiring, wider worldviews emphases.
Specific knowledge-based vocabulary, such as ‘light years, big bang, threshold, Goldilocks conditions’ was also used by children as a basis to clarify their initial, limited understanding of the universe story alongside their new learning as outlined:

**Charlie:**  The Big Bang started and then stars came and then the other things came. In the timeline (of thresholds) the last one was the future.  
(First pedagogical interview, 1 August, 2016)

**Indi:**  First, [first life forms] started off as a simple creature then... They adapted to the environment how it was then and started knowing how to climb trees, and was starting to get more hair, and they were getting bigger and more...

**Mia:**  Complex.

**Indi:**  In order for the eggs to stay alive with the reptiles, they learned to get out of the water so the eggs started to get hard.

**Mia:**  Amphibians.

**Aidan:**  The shell got harder.

(Fourth pedagogical interview, 17 October 2016)

The children’s newly learnt vocabulary is representative of the need for a meaningful tool to empower students to reflect on how Big History’s thresholds of increasing complexity are capable of framing human and nonhuman history in the past, present, and future (IBHA, 2012, p. 6).

Students’ new learning in Big History timeline Thresholds, gave them a sense of pride of achieved knowledge to date, wonder at what was to be learnt and understanding of the need to build a knowledge base before proceeding with critical understanding as outlined in extracts below:

**MA:**  Ok so Big Historians, in your Big History learning so far what do you now know about Big History?

**Aidan:**  Now I know light years are real ’cos I used to think they were just fake

**Jack:**  That there was no time or space before the Big Bang

**Aaron:**  I didn’t know about Big History until I got taught

**Aidan:**  (Threshold 1) would be important for us to know how it began so we can wonder more questions... and learn all the amazing discoveries
If we didn't have the Big Bang the earth wouldn't have been created and the sun and we wouldn't be here this day – humans wouldn't have existed or anything that lives... or you.

Goldilocks conditions ... it's just right ...

If it has conditions, it's just right, not too hot, too cold and Threshold means changing rules

[New learning...] How many years it took to build the world and how stars turn red and then explode and then the dust from that star makes a new star.

(First pedagogical interview, 1 August 2016)

Aaron’s one short sentence in the discussion may seem a simple obvious statement until it is seen in the light of his actually joining the discussion by using his new learning of ‘Big History’, to overcome his common difficulty in engaging with classroom learning. The other children’s responses show a greater depth of critically interpreting the learnt vocabulary, which is in keeping with UNESCO’s promotion of all learners having access to knowledge and innovation; UNESCO endorses them as major factors in worthwhile learning for a common quality future of our planet (2014).

Aidan was one student, whose comments from the first interview and throughout the pedagogical intervention, were imbued with previous knowledge, a sense of curiosity and a quest to interrelate and make connections to his new learning. His final sentence, in the second extract below, typifies his obvious critical, inquiry learning as he excitedly related new discoveries. Comparing Aaron’s simple comment in the previous extract to Aidan’s comment contrasts with Aaron’s limited ability to critically think about his learning:

Scientists can't really prove that (the universe never ends) because they don't have the long enough telescopes and they can't see that long away because it would take millions, billions, trillions of light years until you
can get to the end or maybe there might not be an end. Maybe it just keeps going on with black holes, stars and explosions. That's one of the biggest questions that the universe has.

(Second pedagogical interview, 29 August 2016)

Aidan uses technical vocabulary but now ably applies it to his own critical thinking and posing his own questions for future learning. The importance of examining the theme of knowledge within the research, addresses students’ varied learning journeys as evidenced in the comments and discussions. Students followed and contributed to the conversations at their own levels of understanding, using the specific vocabulary taught within a child-framed learning environment that was inclusive of students of differing academic abilities.

In interviews, children confidently added information from the previous speaker with minimal prompting because of their sound knowledge of the technical language. Georgia, Imogen and Charlie ably contributed to and built on the conversation below:

Georgia: ... we started off in the ocean.
Imogen: Yes and bacteria. And cells...started off as one cell - that surprised me. We started off as like one cell like bacteria in the deep oceans. I thought we started out as like animals. I didn't know.
Charlie: The lizards, I mean the reptiles... they had a soft shell and then when they went to land they had a hard shell.
MA: The lizards or their eggs?
Charlie: The eggs (others echo his answer).
Georgia: In the ocean they were soft and on land they were hard.
MA: ... Can you remember what we call that?
All students: Adaption
Charlie: Changes to suit the environment.

(Fourth pedagogical interview, 17 October 2016)
Building on the shared vocabulary was crucial to the evolving story to allow students to develop and relate this knowledge within a reformative and possible transformative process, through the lens of a values based framework. The structured and highly controlled space of the school can promote and encourage children to provide the ‘correct answer’ (Spyrou, 2011, p. 155) whereas the data I have analysed from the theme of knowledge they had learnt through the Big History story, allowed them to bypass this – no one else in the school had the expertise they were learning. Imogen expressed it simply in her last written reflection as: “I can tell my family things they don’t know - like all the 92 elements and supernovas. I’m a Big Historian now!”

The cyclical nature of ‘plan – act and observe – reflect – revise plan’ (Gordon, 2011; Sinek, 2009) was crucial to the development of the research data collected prior to, throughout and after the pedagogical intervention. As outlined in Chapter Four, the cyclical framing is in keeping with the significance of the knowledge concepts of Big History’s nine thresholds of increasing complexity and connectivity within an interdisciplinary, transdisciplinary approach. The following discussion is indicative of students’ growth in gaining knowledge and the ability to reference that knowledge to environmental matters:

**Jack:** They (animals) had to adapt with the environment so they had to adapt with the heat and with the cold.

**Gabby:** They had to change... to suit everything they needed to evolve into humans.

**Jack:** They had to move around to find the perfect environment with Goldilocks conditions. Then they could evolve into the humans. So the fish evolved into an animal that could walk on land. Then they evolved into dinosaurs, then they evolved into the animals we have now, and then after that we reach Threshold six because the monkeys evolved into humans.

**Joe:** A meteor hit the Earth and all the dinosaurs died and now they're extinct.

**Molly:** (The universe) gets more complex!

**Jack:** (Talking over others) Yeah. It's getting new complexities so life is evolving.
Because Earth has a core that has lots of heat, so it supports everything and it's got Goldilocks conditions with it while other planets, their core might be frozen... it might have half frozen half lava.
(Fourth pedagogical interview, 17 October 2016)

The fourth pedagogical interview extract exhibits students’ use of technical knowledge, gained through the pedagogical intervention. The cyclical nature of the building of increasing complexity of knowledge, supported by an increasing vocabulary base through the nine historical Big History thresholds, allowed students to conjecture and justify their explanations within a common, inclusive language framework. They ably provided a stronger inquiry-based argument, relevant to and in context with the language of the discussion, including ‘adapt, evolve, Goldilocks conditions, threshold, meteor, extinct’. This was in stark contrast to the limited knowledge and vocabulary base used during a pre-pedagogical interview, with evidence that many students had limited technical language or cohesive story to reference; Indi’s comment in an initial interview was representative of this where she referred to examples from a movie and a book in her everyday life to promote her reasoning. Although admirable, her referencing lacked the depth of understanding attributed to the previous quoted extract, which echoes Bezzina’s assertion (2014) that Catholic schools are called to empower students to engage with the world, with knowledge, skills and attitudes.

As the interviews progressed there was clear confirmation that students were using their new knowledge base to enquire and to critically evaluate their learning, as indicated below in a discussion about the significance of DNA to humans:

MA: Why don't you look exactly like your brothers and sisters?
Georgia: Because all DNA is different.
Charlie: Well if they look the same but they have different specialities.
Georgia: Different talents.
MA: And why is the important for us as humans ... Why is that part of our human story?
Charlie: It's like collective learning?... The scientist tells people and then they pass it on and pass it on and then pass it on.
Georgia: My mum tells me to do stuff and make me ... my granny tells my mum to do that and then it keeps on going.
Imogen: Like my grandmother, my great grandmother ...
Georgia: I used to wonder about stuff... now I know everything that I wondered about. I wondered when the world was created? 13.8 billion years ago.
Charlie: I didn't know that the stars gave elements to us... I thought...
Georgia: I didn't even know there were elements.
Charlie: ...meteors make elements to us (sic).

(Fourth pedagogical interview, 17 October 2016)

Imogen, Georgia and Charlie were able to use the learnt technical language of DNA and, through their conversation, extrapolate the definition to discussing different talents, collective learning and an enquiring sense of amazement at what they have learnt. Their common knowledge base referenced their conversation back to the technical language of the vital importance of meteors and elements. More generally, across the recorded interviews, students were echoing the sentiments of Georgia and Charlie, “I used to wonder … now I know… I didn’t know…” and increasingly felt empowered through a child-framed curriculum (Barratt Hacking et al., 2013) that incorporated a strong and visible knowledge-based component to empower their enquiring learning process (Hattie, 2012; Murdoch, 2015).

The following vignette typifies students’ comments and discussions in the final interviews, where they connected the themes of knowledge, Big History thresholds, inquiry learning and thinking of education and action to care for the environment. The theme of the importance of knowledge students gained from Big History is very pronounced:
MA: Big History is important for children in Year 3 because...

Molly: If we didn’t have Threshold 1, then there would be, we wouldn't have any of the start. We wouldn't have anything, because the world has started up as one little tiny cell. Then it became, and expanded into elements, and some elements and the gravity fused them together to make bigger even bigger elements, and then it grew even bigger.

Gabby: As Molly said, if we didn't have Threshold 1, there wouldn't be Threshold 2, 3, 4, 5, 6, 7, 8, 9. There would be no gravity, there would be no space, there would be no time. Nothing would be fusing, no stars, it would just be all dark, and nothing.

Jack: ...when you grow up, if there's a new Threshold you can study it and you can maybe add new information to the other Thresholds.

(Post-pedagogical interviews, 15 November 2016)

The student comments typify children’s integration of their new knowledge base, including ‘thresholds, elements, gravity, space, time, fused’. They expanded on their new knowledge of this cohesive and inclusive story from Threshold 1 of “one little tiny cell” to the conjecture of a new threshold “you can maybe add more information”.

In addressing the knowledge component as a cornerstone of the Big History pedagogical intervention, I believe the null curriculum, as defined by Eisner as what school do not teach (1979), has been addressed from the perspective of Big History; students were empowered with new knowledge that they had no prior idea existed, with eight to nine-year-old students even querying why they hadn’t been “told” about the universe story before.

As documented, the analysed data taken from student interviews verifies that students accessed increasingly complex knowledge and common vocabulary through successive Big History thresholds. Building knowledge within this cohesive universe history was then investigated in relationship to its benefits to encouraging inquiry learning and critical thinking. I now turn to substantiating the analysis of student
transcripts by reviewing teacher observations from a post-pedagogical intervention interview and referring to my research fieldwork journal.

d) Observations from the co-researcher teacher and my research journal of how Big History contributed to informing students’ knowledge of the universe.

The analysis of the data gathered on the theme of knowledge from the student interviews was analysed using the following extracts taken from the post-pedagogical interview with the students’ class teacher, Nadine and from entries from my research journal. Nadine emphasised the progression of students’ understanding through the teaching of Big History, where she noted they were, “...applying and using Big History ...”. She continued:

... I've seen, just in their writing and responses throughout the Thresholds and in their journals, ... the progression of their understanding and the concept of what they could record about things in Threshold 1, 2, and 3 ... they’ve got a much deeper understanding.

Nadine was impressed with students’ consolidation of their knowledge through adapting the religious education story telling strategy, with which students were familiar.

The story made sense, and revising the story through the storytelling and the use of visual images, that's helpful, definitely. Before they can read it and write it, they need to understand and talk it. Giving them the opportunity to use the vocabulary and to use the storytelling concept from Religion in the Big History lessons was really valuable, really important. It could help to give them more concrete examples and pictures, not just the words. Not just the text.
Nadine emphasised the importance of consolidation of vocabulary for the learning of students with a background of English as an additional language or dialect (EAL/D) at the school. She discussed the benefits of consolidation, particularly for those:

... They could then apply it more to their own situation or use it. I think that it was quite a deep learning experience for them ... They would make connections... The love of learning through questioning and deep thinking was very evident.

In discussing a particular EAL/D student with limited vocabulary and confidence, Nadine identified him as student who, “really embraced the use of the vocabulary and become a lot more confident in participating in class discussion”, adding that the rich text displays around the classroom, (see examples in Figure 5.2 below), supported such students to visualise the concepts they were learning. Inclusion of visual stimuli, as an example of good practice, was also a clear recommendation of the final report of the Education for Sustainability and the Australian Curriculum Project (2014) as a guide to integrating sustainability into all learning areas.

Stressing the significance of focusing on vocabulary for such students she added:

... we really need to consider the language background of the students and make them very familiar with the vocabulary before we take them further into the learning so that they can then articulate it.
As indicated in the abovementioned excerpts and Figure 5.2, Nadine as co-researcher identified vocabulary building as an ongoing crucial factor if students were to gain any insightful and meaningful knowledge. They could then apply those skills across transdisciplinary learning. Nadine reflected her amazement, "I really had to embrace [technical vocabulary] and the children now apply that language, especially
‘Goldilocks conditions’, to all sorts of different [learning] areas, which is amazing”. These observations were a clear link to the empowerment of transdisciplinary learning, as advocated in earlier literature by UNESCO (UNESCO, 1998) and more recent writing (Christian, 2017).

Nadine was supportive of the knowledge factor in the pedagogical information and continued to remind me of the need to consolidate the vocabulary and knowledge base of the Big History curriculum and the high ratio of students in the class with a home background with a language other than English. Although I was concerned that this took away from the tight time frame of the intervention, in hindsight I was pleased I followed her lead as the collected transcripts, containing the rich knowledge-based data is clearly evident.

My journal entry on 1 August 2016 indicates the need to concentrate on knowledge gathering, I was still concerned that, “children (would be) able to absorb information and apply it to activities later in class time”. Reflecting on this entry, I realise, with Nadine’s kindly reminders, I had become more conscious of the need to introduce fundamental knowledge and vocabulary associated with Big History. This aligned the pedagogical intervention to Cutter-Mackenzie et al. (2015) and Sterling’s (2011) call for active, informed participation in learning and a more conscious approach to informing the learners’ knowledge base; subsequently, students proceeded to communicate at deeper levels of reformatory and the possibility of transformative learning in the context of their common language paradigms.

Another two entries in my journal (8 August 2016) confirm my concern that initial grasp of concepts is the imperative to the early pedagogical intervention, which in
turn would enable richer data collection towards the end of the intervention. As part of the cyclical reviews with Nadine and myself reflecting and planning for the following threshold’s lessons, I recorded how we were planning to address the outcomes we had identified. Below is a table drawn up from the 8 August journal entry, identifying concerns from our reflections and strategies moving forward.

**Table 5.1 A cyclical review process - Reflecting and revising strategies to gain knowledge**

<table>
<thead>
<tr>
<th>Reflections on pedagogical program as at 8 August 2017</th>
<th>Revised strategies to address concerns</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concern children are not grasping the concepts and able to do the independent readings online -</td>
<td>Simplify and streamline the program – ‘Smart Notebook’ software [my shared teaching and learning program]</td>
</tr>
<tr>
<td>Exploring indicators of values as expressed by children not evident to date.</td>
<td>Decision that values indicators be addressed in later thresholds as learning in earlier thresholds needs to consolidate knowledge (conformative and reformative).</td>
</tr>
<tr>
<td>Lower group struggling - need more core vocabulary – EAL/D (English as an Additional Language or Dialect),</td>
<td>Introduce Bingo, matching games, picture/vocabulary matching, key word recording and current Threshold card is displayed by end of unit so children can see the increasing complexity of each Threshold.</td>
</tr>
<tr>
<td>Need to consolidate knowledge.</td>
<td>After watching a video clip children are to record visually or write notes on the topic then use notes to make presentation or write it up digitally to cover English component.</td>
</tr>
</tbody>
</table>

My journal reflections, along with the observations of the co-researcher teacher, emphasise the importance shared new knowledge played in the Big History pedagogical intervention. I was laying the foundations for a deeper understanding of the topic through shared knowledge, opening up the possibility of students to reflect on their reformative learning. My approach was in keeping with Kellett’s interpretation knowledge in action research projects (2011, p. 21), in that both action
and knowledge are reflected upon, leading to implementing further action. The reflection process described is further verified in my journal entry on 17 October 2016, where I noted that students were becoming familiar with Big History vocabulary and that the focus of interviews were redirected from knowledge based to a deeper learning where children were “interested in discussing how their thinking and feelings about the universe have changed during the pedagogical intervention”.

**Summary of the importance of knowledge to my research data**

Once students learning within the pedagogical intervention had begun, justification for emphasis on teaching the explicit knowledge and vocabulary of Big History was evident. The critical importance of informing students’ knowledge through a pedagogical framework created a meaningful platform for informed discussions in student interviews. As the teaching and learning program progressed students used their knowledge base to express their understanding of the evolving universe story. The synthesis of that knowledge into a wider worldview, leads to the possibility of transformative environmental education learning.

To situate these findings on children’s knowledge into the overall thematic framework of the thesis, I now turn to the second theme of my representation and analysis: the extent students’ knowledge of Catholic teaching helped them interpret the emerging Big History narrative.
THEME 2. CATHOLIC BELIEF: The extent that students transferred their prior knowledge of the Catholic teaching on God’s Creation to inform their emerging knowledge of the story of the universe.

Orientation to Theme 2

This section of the data analysis focuses on the significance of the extent students interpreted their prior knowledge and appreciation of God’s creation nested within their new knowledge of Big History learning. Theme 2 is structured under three subheadings, namely:

a) Exploring the connections of Big History and Catholic tradition within inquiry learning.

b) Exploring student understanding of God as creator in the context of the wider worldview that the Big History story presents.

c) Observations from the co-researcher teacher and my research journal of how students’ Catholic belief contributed to informing their understanding of the emerging story of the universe.

a) Exploring the connections of Big History and Catholic tradition within inquiry learning

In exploring the students’ Catholic belief and connections to their Big History learning, I sought to understand their initial pre-pedagogical interviews. The examples below indicate the children’s knowledge that God’s creation was at the centre of their learning:
... Do you know how the Earth began?
No. Jesus created it.

We’re all connected to nature?
Yeah, because everything is made up from God.

We were all made from God.

God gave us life and God chose that we should live our own life. We have to respect that God has given us that great gift... God gave us the environment to look after it.

(Pre-pedagogical interviews, 29-30 June 2016)

The vignette demonstrates how students relied on a fragmented and limited anthropocentric worldview of God’s creation, as described by McDonagh (2013) to help them explain their opinions, particularly in the statements where they had inadequate language to describe the relationship among humans and environment. This limited student perception is in contrast to Catholic literature (Australian Catholic Social Justice Council (ACSJC), 2002; Francis I, 2015; Sydney Catholic Education Office, 2012), which calls for the embracing of the interrelationship of the environment and humans.

In the following initial interview extract students debated whether they thought all people are connected:

All people aren't really connected because... some people don't know each other.

God created us so that we're all together and we're together because God made us out of the same thing. Some parts of us are different but most are same.

You think that all people are connected then?
Actually, I agree
**Imogen:** Yeah, I agree with her.

(Pre-pedagogical interviews, 29-30 June 2016)

When Gabby connected the issue with God, others then agreed with this stance because they have no informed interdisciplinary knowledge of a larger universe story for inquiry learning, which would then enable a richer worldview of the wonder of God’s creation.

When interconnecting discussions, from the preliminary interviews perspective, displayed a strong connectedness with students’ knowledge of the story of Creation from a religious education perspective where their principal learning and its attachment to values about the universe story had occurred. With no cohesive wider worldview available to students, their relationship with the environment was within an anthropological mind-frame as the following conversations continued to demonstrate:

**MA:** Can you explain why do you think animals are part of nature?
**Joe:** Because God's created them.
**MA:** Do you agree or disagree with that, Charlie?
**Charlie:** I don't know.

**Imogen:** Nature is like all the things that God created; nature is the whole world.
**MA:** Are humans part of nature?
**Imogen:** No.
**Gabby:** No.

(Pre-pedagogical interviews, 29-30 June 2016)

The conversations continued to place continuing emphasis from the children’s perspective that nature was not viewed as intrinsic and interconnected from our human understanding of the universe. There was strong evidence from the initial
interviews that students’ understanding of an ecocentric worldview attached to a sense of socioecological identity needed to be addressed. Appeals from some areas of the Australian Catholic Church also seek an ecological awareness and focus as outlined in previous chapters of this research (Brown, 2004; Catholic Earthcare Australia, 2010; Catholic Education: Sandhurst Diocese, 2014).

The turn away from students’ fragmented learning of the universe gradually became framed from within the unfolding and cohesive Big History story. In subsequent interviews students then felt very comfortable verifying their thinking through their Christian based knowledge of God and creation. An inquiry learning approach encouraged students to ask questions about the topic, as typified by Mia’s wondering, “… who made God and stuff? Or could it be from that one tiny cell?” (Fourth pedagogical interview, 17 October 2016). This was one demonstration that students were ready to incorporate the new learning into a wider worldview of God’s creation. Likewise, in the following post-pedagogical interview extract, Gabby has learnt to embrace local school values to contribute a richer worldview of God’s creation, that humans are interconnected with and responsible for the environment:

Gabby:  
It's disrespectful, because the trees are living like us, because they are living things. We should have compassion for nature. We should love nature, because God gave it to us.

(Post-pedagogical interviews, 15 November 2016)

Gabby’s comment typified a wider worldview from students’ learning that influenced their answers in the post-pedagogical interviews about what they initially knew about the universe. As students reflected on their initial knowledge, typical replies were, “I
used to know God created us and there were several million galaxies.” “We used to know God created us in seven days”. In using the words “used to know …” the students were identifying their previous knowledge as limited compared to their newly learnt critical knowledge of the origins of the universe (Post-pedagogical interviews, 15 November 2016). Their acknowledgement of newly discovered perceptions of an interrelated universe reflect the views of previously cited references (Spier, 2009; Tilbury, 2011; UNESCO-UNEP, 2012) and aptly articulated in both secular and Catholic Church documents. The 2007 Ahmedabad Declaration: A Call to Action (UNESCO-UNEP, 2008) states that education can support “ecological integrity … and respect for all life” (UNESCO-UNEP, 2008). Pope Francis I expressed “it cannot be emphasized enough how everything is interconnected” (Francis I, 2015, p. no. 138).

Once students had begun their learning of the Big History story they felt comfortable in subsequent interviews to wonder and ask questions that interrelated that learning to demonstrate the wider worldview of God’s creation that was being presented to them. When asked if there was something they wondered from their new learning, their new insights showed a deeper sense of the wonder of the universe, within their Catholic learning as evidenced by Indi and Gabby’s questions and learning below:

*Indi:*

> The question that I want to ask is, how did God get so much power and how come the world was so dark and why didn't he make the world earlier? How did he have such a good idea of building us?

> I learnt ... how God created us and the steps that he used to create us. I think (Threshold one – the big bang) is important to humans so they know who created them ... and they understand that God exists.

(First pedagogical interview 1 August 2016)
Gabby: I (was) thinking that when it was the beginning, it was just black and there was nothing there except God. Then, everything started to get more complex and then the stars came and then animals evolved and the planets came and then they were all orbiting the sun.

(Fourth pedagogical interview 17 October 2016)

The ideas projected in the student comments and typically framed in child-appropriate language, affirm my inquiry concerning Benjamin’s claim (2009) that Big History learning makes a significant contribution to both faith and logic. Gabby and Indi’s interpretations represented the comments of the majority of children who questioned their origins and increasing complexities of Big History. Their child-framed explanations mirror Pope Francis 1 (2015) and Tucker (2012) who advocate the deeper understanding that faith and knowledge can engender in environmental issues. Both Big History and Catholic teaching, enrich students’ critical knowledge and understanding of God’s creation.

Having explored the connections of Big History learning and Catholic tradition within critical learning, the message of the data is powerful: one of Big History’s influential contributions to deep inquiry learning is the reconciliation of both faith of the learner alongside the rationality of a multi-disciplinary exploration of the scientific origins of the universe. This finding is significant in that there has been no previous study at primary school level as to the extent that students’ faith values are influenced by Big History learning that both challenges and supports learning in Catholic schooling.

The data I have collected builds on Benjamin’s reflections from a tertiary level perspective that Big History induces a supportive atmosphere that taught students ‘how’ to think about the universe and not ‘what’ to think (Benjamin, 2009). To date,
due to this relatively new field of study, there is no data available on a particular faith stance from either a secondary or primary viewpoint. This research is therefore significant in that the findings my represented data suggest that Big History learning at primary school level also produced a positive outcome where students were empowered ‘how’ to think and incorporate their new knowledge into their existing knowledge of Catholic teaching on God’s creation.

I now turn to investigating relevant data pertaining to student understanding of God as creator in the context of the Big History knowledge and the local school’s values.

b) Exploring student understanding of God as creator in the context of the wider worldview that the Big History story presents

The unfolding of the Big History narrative enhanced students’ understanding of God as creator of the universe and the extent that it informed and enriched their understanding of an amazing, awesome universe story they had not been privy to before. More importantly they increasingly understood that the underpinning of this story required their personal involvement in questioning, testing and verifying their understanding from the foundations of a Catholic based local school’s values framework of PRhJECT LOVE.22

The below conversation reveals how Big History learning of ‘thresholds’ supported students learn about the environment. It demonstrates how students incorporated the understanding of God’s creation into their inquiry learning:

22 As already acknowledged, PRhJECT LOVE is and acronym for the local school values: Peace, Respect, hOnesty, Justice, Empathy, Compassion, Tolerance and LOVE.
Mia: (In threshold 5: life) when God made the creation, and he wanted to make people look after and not destroy it.

Molly: I used to think that God has created everything. He just somehow one day created this, and then the next day created a whole bunch of things. Then once I learnt ... He made all the elements but they did everything else, they fused themselves together (from the gravity), they made stars...

Imogen: I think Big History is a more amazing story (of God’s creation)...It says what was created, how it was created, all these big words like agriculture, dioxide ribonucleic acid and all of that.

Gabby: God's creation, it's not like it made itself. God made them, and it's like each of the Thresholds is each of the days. I'm saying that they're both like, both together...

Molly: I'm going on from Gabby’s (comment) ... I think they're completely different things... it took ... 13.8 billion years to make the universe...and I think that's a more interesting thing.

(Post-pedagogical interviews, 15 November 2016)

The way the conversation evolved is indicative that students are not being led to believe one point of view; rather, their unfolding discussion indicates that they listened closely to each other with respect and allowed each other the freedom of rich and diverse points of view. There is evidence in comments, including the use of Big History vocabulary of ‘thresholds’, ‘Big History’, ‘13.8 billion years’, ‘fuse’ that students have integrated the Big History teaching guide’s essential skills of thinking across scales, integrating multiple disciplines and making and testing claims skills advocate (2015), to verify their Catholic thinking on Creation. The fact that primary-aged students in this research were able to integrate the Big History and faith perspectives as complementing, not clashing with each other and therefore gain an in-depth appreciation of the 13.8-billion-year history of the universe, is an extrapolation of O’Connor’s broader viewpoint of Big History learning that complements faith, science and history (2014).
Critical inquiry learning is also evident in the following exchange where Aidan and Jack ably summarised their initial questions and consequent growth in understanding from learning Big History to ask bigger questions about their own thinking and God:

MA: Do you think Big History's been worth it?
Aidan: Yes. I really enjoyed. I thought it was amazing. When you first came in and you were like "We're going to learn about Big History" I was like "What's Big History?" Then you said "The Big Bang" and I was like "What's the Big Bang? Is it like a Big Bang went off and everyone woke up? Then they just thought I should build a building."

Jack: It's more complex. I've always been wondering how we were here, since I was really little, I've been wondering what will happen in the future? Will there be robots or something? How are we here? How were we made? Who is God?

(Post-pedagogical interviews, 15 November 2016)

The outlined Big History language of ‘Big Bang, complex, future’ gave them a platform for commentary. There is clear evidence that Big History was presented to children where they were empowered by the new language and knowledge to pursue their inquiry learning within a wider worldview of current Catholic teaching on the environment. This is particularly relevant to the call of Pope Francis 1 to all people, as cited earlier, for harmonious interaction with natural and social systems as part of our interconnection with the environment (2015).

Having related how students related Big History and their Catholic beliefs to express their understanding of God as Creator, I now verify my interpretation of student comments with observations from co research teacher and my research journal.
c) Observations from the co-researcher teacher and my research journal of how students’ Catholic belief contributed to informing their understanding of the emerging story of the universe

The pertinence of conducting my research within a Catholic school setting was not only conveyed in the students’ references to their expanding knowledge of the wider worldview Big History story of God’s creation, but also through Nadine’s observations in her post-pedagogical interview as the co-researcher teacher. She observed that students had begun the pedagogical intervention with a biblical understanding of the sequence of the universe as part of God’s creation, but by the completion of their inquiry learning, they understood the creation story, within the current scientific evidence of how the universe began and the ensuing knowledge of Big History Thresholds. She perceived that students were enriched with a deeper understanding of God's involvement in the evolving story of Big History. Nadine verified that once the children interrelated their religious knowledge with Big History knowledge of the recent introduction of humans in the vast 13.8-billion-year universe story, students emerged with a concept of the common good for all people, along with “a sense of wonder for the future, and that whole concept that they are the stewards of creation”. Nadine’s statements confirmed my directions to be inclusive of the research school’s Catholic knowledge in this research. It also corroborated my inclusion in my literature review of Benjamin’s call (2009) for Big History educators to empower students to make connections with whatever faith beliefs they may hold.

Nadine also addressed the issue of students’ anthropocentric leaning at the beginning of the pedagogical intervention where they did not see humans as part of nature but, “By the end (of the intervention), they were really tumbling their words out to talk
about everything. All creation's important, not just humans, and we can't do what we like … that it's all God's creation”. Her summation is in keeping with addressing the concerns, cited earlier in my research, that Catholic education continue to promote ecological awareness and conversion (Catholic Earthcare Australia, 2010, 2017). Nadine’s words also resonate with students thinking within a socioecological learning perspective and permeates Malone’s invitation for researchers and educators “to look at data differently and invite a new imagining for a ‘collective ecology’ of human and nonhuman for a future sustainability …” (Malone, 2016, p. 20).

I now summarise the implications of students incorporating their knowledge of the Catholic understanding of Creation.

**Summary of the importance of students incorporating their knowledge of Catholic teaching to my research data**

In this section I have built on my research story by analysing the data about students incorporating their perceived knowledge and understanding of Catholic teaching and beliefs to the increasingly complex and cohesive Big History story and their interpretation within local school values.

The connections of Big History to Catholic tradition were significant when students’ prior knowledge and appreciation of God’s creation were interpreted within their new knowledge of Big History learning and environmental education values. The growth in students’ understanding of God as creator was exponential when students were able to correlate their known biblical reference stories and local school’s values framework to the new learning context of the Big History story. It was reassuring to observe, as
the examples have demonstrated, that students were not disturbed by the scientific evidence they were presented with; rather they readily correlated the evidence into a greater sense of awe and wonder at the grander and more complex unfolding of God’s creation through the Big History story. As co-researcher teacher, Nadine commented on students’ ready acceptance of the Big History narrative within their Catholic understanding of God’s creation, that God is essential to the unfolding story.

In the first two themes I have analysed the extent that students aligned their new knowledge of Big History to their previous understanding of the Catholic creation perspective. I now turn to representing and analysing the data pertaining to the students’ environmental education values, particularly within the identified framework of the highly visible and articulated local school values.
THEME 3. VALUES: The extent that environmental education values, particularly in the context of local school values, were interpreted by students through the lenses of Big History and Catholic tradition

Orientation to Theme 3

For the purpose of this study, the extent that the students’ environmental values were informed and interpreted relied on children’s common understanding of the language of local school values. In keeping with the child-framed methodological basis of my research, I adapted the approach of Podger et al. (2013); they advocate that, by interpreting the particular values promoted in a local setting, those values play a significant contribution towards understanding them. The importance of analysing values at the local school level, as also discussed by Somekh and Zeichner (2009), was appropriate to apply to this research. It is set out below under the following subheadings:

a) Connecting the language of values to Big History knowledge during student discussions.

b) Importance of immersing students in the embedded local school values.

c) Observations from the co-researcher teacher and my research journal of how students’ knowledge of local school values contributed to informing their understanding of the emerging story of the universe.

I now turn to the first subheading.
a) Connecting the language of values to Big History knowledge during student discussion

Evidence of the cyclical nature of the increasingly complex knowledge that children accessed, through both the Big History story and its related vocabulary, as discussed above, was a vital component of this research, enabling students, the teacher and myself to then meaningfully apply the local values in post-pedagogical interviews. Through the shared knowledge, students confidently used critical thinking skills to relate values to their observations as represented in the interaction among Aidan, Jack and Indi:

MA: Why are the stars important for our human story?
Aidan: Because they create hydrogen, helium atoms and we need hydrogen and helium to stay alive and to make the planets. If there wasn’t there, time might not be here today. Then it would just be nothing. Nothing may be invented.
Jack: They (stars) gave us elements ... They're the building blocks of our universe and they might tell origin stories even if you look closer to them like, how old are they.
Indi: (Threshold Four’s) important because if we didn't have the sun, everything would be just cold and black.

(Second pedagogical interview 29 August 2016)

Aidan, Jack and Indi relied on their learnt technical knowledge to verify their thinking; they could then justifiably apply the value of the scientific universe story to the origin of humans. When discussing their learning about the most important knowledge they had gained, students’ familiarity with specific and relevant vocabulary of ‘oxygen, helium, hydrogen’ allowed them to clarify their thinking as they discussed the value of the combination of elements to form essential water. In doing so they addressed the need for sustainability within the worldview of ecological
systems, echoing Gough (2011) and Barry (2010) who both upheld the importance of the understanding of ecological systems in student learning. Students’ connections to valuing the environment are typified in Aidan’s comment that the environment “needs to be sustainable so we have enough for ourselves and enough for the environment to grow. If we take too much we could run out of everything”.

Likewise, in the discussion below Aidan, Jack and Theo mused on their learnt knowledge of the thresholds of Big Bang and agriculture and civilisation alongside the technical terms ‘complex, evolving humans,’ to deduce their value in the emergence of humans:

Aidan: If we didn't have the Big Bang, we wouldn't be alive. The Earth wouldn't be here, the stars wouldn't be here. There would be no elements and the universe, everything ... Nothing would be here.

Jack: Civilisation and agriculture... If it didn't happen we would still be living in caves and hunting for food. We wouldn't have farms and all those things we need.

Theo: Evolving humans. If the humans wouldn't have evolved ... no humans.

(Post-pedagogical interviews, 15 November 2016):

Aidan, Jack and Theo’s conversation further demonstrates how children’s values surfaced in their discussions where they linked their Big History knowledge base to an emerging reformative consciousness as acknowledged in Catholic education documents (Catholic Earthcare Australia, 2010, 2017) and the concepts of Sterling’s levels of learning (2003). There was a general understanding and consensus in discussions that empowered students to articulate their knowledge of the Big Bang, elements and various thresholds, including ‘civilisation and agriculture’; therefore, they ably expressed the development of the human story and survival that was essential to their interpretation of the values aligned to sustainability.
It was important for this research to investigate evidence that students aligned their Big History knowledge and vocabulary of increasingly complex thresholds to inform their discussions into sustainability from a deep time perspective as identified by Cheek (2012) and Delgado (2014). The represented data adds credence to the available literature on the need for evidence based critical learning within a child-framed appropriate language, previously discussed, with reference to Barratt-Hacking et al. (2013) and Spyrou (2011). I now turn to investigating the importance of embedding local school values to my research.

**b) Importance of immersing students in the embedded local school values**

Students’ embedded knowledge and understanding of the local school values were of immense significance. As documented earlier, the local school values of the chosen research site were of high priority throughout the school. It will be recalled that the values are taught, and students prompted, with the acronym, PRhOJECT LOVE:

- Peace
- Respect
- hOnesty
- Justice
- Empathy
- Compassion
- Tolerance
- LOVE

As referred to in the methodology section of my research, students had been previously exposed to the local school values in all areas of their school life since Kindergarten, which gave a deeper meaning to the connection of values to this research. Students’ understanding of local school values was therefore easily
transferred into their emerging and cyclical understanding of Big History. This connection of values to student perceptions was recognisable from the initial interviews, as exemplified by Charlie using some of the school values to explain his feelings about the environment as, “happy and sad at the same time … because it's sad that people like not having peace and love and respect, and the happy thing is that some people do respect, love and other good things” (Pre-pedagogical interviews, 29-30 June 2016).

In the post-pedagogical interview, it was observably more transparent that students generally were now referencing knowledge of Big History alongside local school values as they discussed the most important thing they had learnt about the environment. They began by raising the need for a sustainable environment and easily segued into related local school values with Indi citing, “Respect, honest [sic], peace, tolerance … compassion”. When queried why compassion was important, Indi referred to her own child appropriate recall of the collection of ‘nuts’ used to manufacture an unnecessary rejuvenating cream she had heard about, empathetically concluding, “It gives them [people] some nerve to go and get all nuts just for (the) cream, like if it was something important!” (Post-pedagogical interviews, 15 November 2016). The ongoing child-framed connection, observed in Indi’s comment, was apparent in most interviews, particularly once students’ knowledge had become proficient and their reflections displayed compatible values related to their learning as documented:

Gabby: We need a sustainable future, and we need all the (local school) values. Big History helped me think about the future and people.
Gabby’s intuitive knowledge of local school values, when combined with confidence in her Big History learning, led her to an insightful understanding of where those values are implicit to environmental education which can be related to the writing of Podger et al. (2010), who advocate that values need to be challenged at a local level by society’s institutions to empower them to examine the values dimensions of sustainability projects.

When students were asked what local school values they believed were needed for a sustainable future, they comfortably answered using child appropriate language while also choosing appropriate school values, as exemplified below:

Charlie: Mostly justice- you have to fight for something... like Pollution.
Georgia: I would probably have respect because if no one in the universe had respect, everyone would be greedy and take too much. And then people would get mad and then might start another war.
Charlie: And they might not be peaceful.
Georgia: Because in the war, everything gets destroyed.
Charlie: Especially nuclear bombs that kill people.
Georgia: And animals.

(Post-pedagogical interviews, 15 November 2016)

The extract is again a validation of Scott’s call (2009) that students gain a critical knowledge, they could then relate personally to local school values of justice, respect and peace. It is also worthy of note that Charlie speaks of bombs that kill people and Georgia, uses her knowledge to include animals which displays Big History’s stance of a more cohesive and ecocentric attitude to values.

My theoretical framework, as previously illustrated in Figure 3.9, is nested in Big History participative learning praxis (Christian, 2011a), which leads to the possibility
of an affective and transformative educational paradigm (Sterling, 2003, p. 205). The following excerpt continues to extrapolate on children’s understanding of values, referring to a storybook Just a Dream read in class. I was initially tempted to group student comments under individual values, but this would do a disservice to their discussion interactions as their articulation of their understanding of the issues grew as the conversations progressed; rather, I have highlighted the local school values raised in bold/italics:

Amy:  *If we don't have love in our world, everybody will hate each other and they will be selfish to each other.*

Joe:  *I would choose tolerance because if there was (sic) people who didn't have tolerance and they took too much it won't be a sustainable future.*

Gabby:  *It's disrespectful, because the trees are living like us. We should have compassion for nature. We should love nature, because God gave it to us*

Gabby:  *We need justice. We have to be fair to nature...We have to equally share it.*

Molly:  *(The fishermen) need to have justice, because they need to be fair... You can't just go out and fish all of them.*

Molly:  *Respect. We need to respect the world, because they're just polluting everything. It's not good.*

Molly:  *(Walter) needed to have honesty, because he wasn't putting rubbish in the right trash bins.*

Gabby:  *(Walter) was tolerant and he planted a tree. He said that was his best (birthday) present.*

Imogen:  *I was going to say empathy because of the tree.*

(Post-pedagogical intervention 15 November, 2016)

Amy, Joe, Gabby, Molly and Imogen identified strongly with the sustainability theme of the book Just a Dream (Van Allsburg, 1990), often relying on it to stress or to illustrate their points of view on the values displayed. The students’ reliance on their comprehension of Big History knowledge and local school values, aligns with Wattchow et al.’s view (2014) that knowledge of sustainability, viewed within a
values framework, helps to meet the complex challenges that face the socioecological learner.

In the following vignette, students continued to build on the discussion, using the book *Just a Dream* (Van Allsburg, 1990) to apply critical thinking skills and explain their points of view through a school values lens:

Gabby:  *I think sustainable is also part of our values, because sustainable, we have to be fair, justice, and it could be like ... It's like sustainable means like all of our (local school) values.*

Jack: *You might need PRhOJECT LOVE - Love because you need love to take care, you need to respect everyone's ways.*

Aidan: *I think all of the values because if you have all of them you have a stronger heart and you can help the environment ... you should only use what you need. I would like to make the world sustainable.*

(Post-pedagogical interviews, 15 November 2016)

The vignette was typical of student’s referral to their deep learning by the post-pedagogical interviews, where they applied their knowledge to name and explain local school values from a sustainability perspective. Evidence of this deeper learning was noted in their application of critical thinking skills to actually use child-appropriate language and references to incorporate the word ‘sustainable’ into the framework of all the school values.

As discussed in my theoretical framework, the findings of this research needed to consider the importance of immersing students in the embedded local school values. The analysed data adds credibility to the available research of Podger et al. to embrace values, within the local context, (2010; 2013) if they are to be measured within an action research methodology. I now turn to analysing the importance of
embedded local school values from the perspectives of the co research teacher and my research journal notes.

c) Observations from the co-researcher teacher and my research journal of how students’ knowledge of local school values contributed to informing their understanding of the emerging story of the universe

The co-researcher teacher contributed valuable feedback in the area of local school values. I outline a selection of her observations below. We discussed the relevance of students’ knowledge of local school values in the context of my overarching research question, of investigating the extent their environmental education values could be informed:

*Nadine: I think that the students of (our school) are very articulate and confident in the areas of our mission statement, which is PRhOJECT LOVE. The values have been built since they were in kindergarten. The values have been adopted by all staff and all students and all parents... now through the Big History programme, they're more articulate and they're more able to see that PRhOJECT LOVE values apply to the world and the universe, and that they can see how something that happened so long ago is still something to respect and to value and to love ... something that's going to happen in the future.*

Nadine’s comment validates the relevance of Dahl’s appeal (2012) to incorporate local indicators of values, where the local vocabulary is embedded to articulate those values. The students’ familiarity with the values deepened from initially applying them to personal relationships and then incorporating them into their Big History learning as it evolved. It was also valuable for my research findings that Nadine linked the important learning of the children and the crucial aspect of applying values to the past, present and future to my choice of teaching Big History as a cohesive universe story.
In my research journal I noted a need to broaden the perspective of the school values as I prepared to analyse the data I had collected to date. On Friday 11 November 2016 I had written in my journal the concern that I “need EXTRA INDICATORS to place across appropriate values- awe and wonder, love of learning, critical thinking”. This concern arose from the students’ broader framing of values as they began to relate their knowledge learnt to the values they were associating with Big History. After due consideration I added these indicators under the value of ‘Love’, as explicitly identified in my literature review through Catholic school values (Bezzina, 2014; Sydney Catholic Education Office, 2012) and acknowledged in my methodology section as one of the students’ local school values. Students’ use of the term ‘love’ was becoming increasingly evident as they validated their comments and feedback, as exemplified in this current section.

I now summarise the implications of local school values to this research.

**Summary of the importance of local school values to my research data**

I began the construction of my research story, building on the importance of teaching a cohesive story with accompanying vocabulary, and in this section I have added the richness of local school values. When representing the values theme for the purposes of this research the data analysis needed to be linked to the growth in students’ knowledge base where they connected the importance of embedded local school values in their interview discussions. As recognised in the data representation, the local school values were a pivotal point around which students could centre their discussions because the values were already so deeply embedded in all classes’ daily
routines. The examples I have documented represent students’ immersion in appropriate rich knowledge within the context of local school values. Both co-researcher teacher’s observations and my journal notes concur with the advantage of students’ previous knowledge of local school values and the ensuing enrichment of interpreting of those values through the lens of the Big History universe story.

The data pertaining to the students’ environmental education values have been particularly investigated within the framework of the highly visible and articulated local school values. The nesting of the three themes of knowledge, student understanding of God’s creation and values has been analysed within the context of student appropriate understanding, relevant to their age.

I now add the next layer to my analysis: the extent that transdisciplinary learning enriched students’ understanding of environmental education values through the emerging Big History narrative, their Catholic understanding of God’s Creation and local school values.
THEME 4. TRANSDISCIPLINARY LEARNING - The extent of impacts on students’ environmental education values

Orientation to Theme 4

This fourth theme encompasses the analysis of students’ perceptions from teaching a whole-systems, transdisciplinary 17-week pedagogical intervention through the lens of the emerging story of the universe. The significant data analysed for this fourth theme are particularly referenced to students and teacher’s last interviews, as that is when their comments on transdisciplinary skills across subject areas became particularly obvious to them in their group-interview discussions. The theme will be discussed under following subheadings:

a) Significance of the Big History cohesive story within a transdisciplinary framework.

b) The importance of story, language and Big History learning framework.

c) Influence of the Big History story and local school values to enrich student observations from a transdisciplinary perspective.

d) Observations from the co-researcher teacher and my research journal of how transdisciplinary learning contributed to informing students’ understanding of the emerging story of the universe.

I now address the first subheading.
a) Significance of the Big History cohesive story within a transdisciplinary framework

Nesting of the Big History narrative around students’ own voices was essential to allow students to articulate their own inquiry thinking and critical learning within a transdisciplinary structure. The power of story, skills and concepts, alongside the use of visual resources were important learning tools to enable meaningful student understanding and participation in dialogues, using age-appropriate language (Scott, 2009).

Students’ growth in inquiry learning and age appropriate understanding of the Big History narrative as a cohesive and evolving story was at times a reminder for the teacher/researcher of the importance of not fragmenting that story; rather, students needed age appropriate understanding and learning involving a vast interconnected and complex creation story where thresholds connect and inform critical inquiry. As discussed in my literature review, the choice of Big History as the learning platform fulfilled the named criteria (Big History Project, 2015). Aiden and Mia’s comments below demonstrate the point:

**Aidan:** If we did not know how old humans started, we could just be thinking how was the first writing done and we couldn't research that because the people...

**MA:** Aidan ... before you go on we're still talking about Threshold five (Life evolving). I know we've moved (on in class lessons) and started learning about humans.

**Aidan:** It's really hard ... because life and humans are connected and when you're talking about joining them together the more we talk about life, but sometimes it just goes (intertwines his hands to express the connection between life and humans)...

**Mia:** It's one of the most important Thresholds... because if we never had life, we wouldn't be here
Aidan’s opinion and Mia’s following comment demonstrated that they understood the sequence of historical Big History thresholds. Aidan also acknowledged that he no longer viewed his learning as fragmented but within a cohesive and valuable interconnected story. This finding relates to the evidence of Wattchow et al. (2014), who advocate the complex synthesis of interdisciplinary fields, discussed in the justification of my theoretical framework, that empowers students to integrate their learning and gain, as previously quoted from Stein et al, “a higher-order knowledge that is more than the sum of its parts” (2008, p. 402). This view is also a validation of the relevance of imbuing Sterling’s whole systems thinking into my theoretical framework and relates directly to the interdisciplinary, critical inquiry approach of Big History (2015).

Following the transdisciplinary skills approach to the structure of the pedagogical intervention, students did not limit their discussions of their learning to single disciplines, concepts and skills; rather, they ably included the complexity of different points of view.

The class excursion to Sydney Observatory, with its varied subject emphases on history, science and geography, provided such a catalyst for insightful discussion. Aiden’s observation, when speaking to the Sydney Observatory guide, included the core skill of Big History claim testing to verify the group discussion on weather: while completing a geography focused weather task the guide asked why scientists study weather. Aidan transferred his initial Big History learning skill to geography to
suggest the need for claim testers (Big History Project, 2015). The guide was impressed and agreed that scientists do test claims. The melding of Big History skills and knowledge across subjects encouraged students to refer to a variety of learning experiences and link multi-faceted experiences to articulate their new learning, as promoted by Department of Education and Training (2009) and Lundy et al. (2011).

Having analysed the significance of Big History to integrate a cohesive story within a transdisciplinary framework I now turn to the importance of story and language to transdisciplinary learning.

b) The importance of story, language and Big History learning framework

The enriching power of age-appropriate resources, in conjunction with the structured learning sequence of the increasing complexity of the Big History narrative, gave students a firm basis to express their understanding of their critical inquiry findings. There was rich data collected to identify that students were to be able to meaningfully discuss their thinking, according to their personal ability. Individual student understanding and their suggestions for future action highlighted the importance of a story, language and learning framework to engage and to cater for each student. A physical rope timeline of the universe history was an example of a resource that introduced students to the immense timeframe needed. It became a continual reference point for most students, as observed in Molly’s explanation of what Big History had taught her. “We now know … when the Earth and something else was being made – it took a very long time, there was a very big gap between (thresholds) on the rope” (First pedagogical interview, 1 August 2016).
The ensuing ability of students to synthesise the familiar local school’s values framework to their new Big History learning produced clear evidence of independent student articulation of their inquiry-learning journey. Aaron is an example of how his new Big History learning, albeit limited, gave him confidence that he had previously lacked to contribute to discussion:

*MA:* Can you explain why you think Threshold four (life emerges) is important  
*Aaron:* Because it's a part of our universe.  
*MA:* It's a part of our universe. Is it important for humans?  
*Aaron:* Yeah.

(Third pedagogical interview 14 September 2016)

Although Aaron’s comments appear limited to an outside observer, the fact that he answered the question is a definite sign that he now grasped a basic understanding of learning about the universe; up until this time he had generally answered that he didn’t know or “no”, when asked if he had any comment. Aaron’s perspective is important in this study in that it highlights the issues raised in earlier chapters from the writings of Kellett (2010) and Spyrou (2011) relating to the power of knowledge to researching with children. I needed to ensure I heeded the reminders of Kellett (2010) and Spyrou (2011) by keeping Aaron’s voice in the data analysis to demonstrate his limited linguistic skills are as relevant to the shape of the research findings as those demonstrated by the more articulate learners. Reformative learning promoted by Sterling (2011) can occur at differing levels of understanding, yet still has the ability to empower all learners.
The provision of visual, interactive activities, involving team skills, movement and opportunity for student-chosen inquiry research, sparked student conversation that related to earlier thresholds of learning and high interest in their learning, as identified in the following:

**MA:** *Why do you think (Big History) is important for humans?... we played that game where I was the sun and you were all particles of dust and no planets formed, you just kept circling around me as the sun and... planets (began to form).*

**Molly:** *That you need Hydrogen, Helium, and lots of other elements to make the universe and the sun took 99.9% of every element into it to make it. I was surprised how the dust and the elements could make this big planet because they're so small, I was surprised that they could make such a big thing.*

(Third pedagogical interview, 14 September 2016)

From Molly’s comment referring to the class solar system activity, other students then continued a shared conversation about the differences in planets in our Solar systems from their findings from individual research. Their knowledge was not limited or fragmented but belonged to building a cohesive story in which they could all share.

The transdisciplinary skills and concepts of Big History empowered students’ reformative learning and addressed the issue of the null curriculum (Eisner, 1979; Sterling, 2003) in my development of my theoretical framework.

The importance of story, language and Big History learning in presenting a cohesive and interconnecting history of the universe to Year 3 students now leads to analysing how students’ observations, conversations and comments were enriched by this rich knowledge.
c) Influence of the Big History story and local school values to enrich student observations from a transdisciplinary perspective

Group discussions during interviews revolved around students’ sound knowledge of local school values, where they acknowledged, encouraged, built on, and at times disagreed, with each others’ thinking, recommendations and observations. From this perspective, students’ dialogue revolved around consideration of what they currently noticed being implemented and their suggestions for future action, hence highlighting the importance of a cohesive universe history, language and transdisciplinary learning skills framework. It is worthwhile noting that students were aware of values in the pre-pedagogical interviews, but hadn’t linked their perceptions to local school values terminology they were familiar with, as evidenced by Jack, Theo and Aidan:

Jack:  (Humans) sometimes step on plants or they pluck out plants and then they sometimes ...
Theo:  Cut down trees.
Aidan:  It’s sad for the little animals that live there. (empathy)
Jack:  Yeah.
Theo:  They (animals) have a really nice house and someone is destroying it.

(Pre-pedagogical interviews, 29-30 June 2016)

As the initial comments indicated, the students had not connected the concepts and language of their local school values, with which they had been familiar since Kindergarten; this indicated the need for students to perceive that their existing knowledge of values was not isolated from cross-disciplinary learning and, in fact, would add to their use of a shared language around values, Big History and environmental education inquiry, as implied by Bowers (2010).

The following extract, taken from the pedagogical interview after Big History had
been introduced, shows the shift to deeper inquiry learning. Here, the same students were discussing the importance of learning appropriate technical vocabulary to encourage them to speak with more authority across a range of disciplines and skills:

Jack:  (We are learning Big History) new words... So we can speak more like scientists and astronomers

Aidan: You can learn lots more and it’s part of different subjects – like religion, maths, history, science and all the other subjects that we know.

MA: Is that important Aidan? Do you think it’s important we learn with other subjects as well?

Aidan: Yes because you can’t just learn one subject because if you just learn one subject, when you do a test or when something comes to life (sic), that you need to do with other subjects, you won’t know it and so you should know lots of subjects so then you’ll be ready for life’s challenges.

Theo: If you would know any subject then you won’t be that smart to do anything in science or history or any subject.

(First pedagogical interview, 1 August 2016)

Jack, Theo and Aidan’s conversation validated the significance of Big History learning through students’ explanations of the transdisciplinary skills that they had built on to understand and to articulate a wider worldview. Through authentic understanding of what that entailed for current and future learning, they realised the worth of their learning in terms of relating that learning in discussions with others. Aiden commented, “we need to know the vocabulary before we do the work so we know what it means … and it would be easier for us – if anyone comes in and says what does this word mean we can say this word means this or that”. (First pedagogical interview, 1 August 2016). Without any prompting the students had come to the realisation and, importantly, were able to articulate their observations that transdisciplinary learning needs to be applied for richer learning environments.
The whole systems, transdisciplinary framing of the pedagogical intervention encouraged deep and meaningful discussion of their learning as observed in the following excerpt discussing elements. Imogen’s final comment of the excerpt is particularly insightful, in that she displays an enriched understanding of increasing complexity, which is one of the major transdisciplinary concepts of Big History learning:

Gabby: (Elements) are the building blocks of the universe... It's the building blocks of us going further, and to the Big Bang, and the...
Imogen: Thresholds.
Gabby: Yes. Into different Thresholds.
Imogen: It's getting more complex. I think it's like building blocks. Sometimes if they're really tall, it's really hard to try and reach it, so it's like the building blocks of the universe, because it keeps going on, it keeps getting more complex. It's like if you were trying to reach it, you wouldn't be able to because it just kept on going and getting complex.

(Second pedagogical interview, 29 August 2016)

The ability of students to interpret meaning, as observed in their child-appropriate led discussion on increasing complexity is exemplified further below. Their continuing enthusiasm for deep learning (Fullan & Langworthy, 2013; Victorian Department of Education, 2017) engaged the students in a sense of awe and wonder at their new learning and access to the transdisciplinary Big History curriculum led to them overcoming the barrier of null curriculum (Eisner, 1979; Sterling, 2003).

Students expressed a sense of awe and wonder as they expanded their knowledge and surprised themselves with their capabilities for deep learning:

Molly: I’m surprised that we have learnt all these difficult science things that a lot of us didn’t really know at the beginning...
**Gabby:** I’m wondering why we are learning, doing this – shouldn’t we do it at Year 6 or university because it’s really hard stuff to do and maybe we can’t get it all – **but we can!**

(First pedagogical interview, 1 August 2016)

**Aidan:** That's the amazing thing about planets because you never know what it's going to be like. You never know if there could be life on it, if it could be water, if it could be full of fire, or if it could just be plain rock and dust.

(Third pedagogical interview, 14 September 2016)

Aidan, Molly and Gabby’s interest and engagement in their views, verify the importance of a sense of awe and wonder to environmental education values. This particular point was discussed earlier in this research, including Stone’s claim that children’s need to be empowered with a sense of wonder at the natural world with the possibility of gaining emotional connections that may determine how deeply they will care about the fate of nature (Stone, 2010). Linking a sense of awe and wonder to this analysis is also validated by Sydney Catholic Education Office as one of the essential Catholic values to consider to be integrated into the curriculum (Catholic Education Office: Sydney, 2013b).

As students developed their knowledge of the unfolding universe story, through Big History thresholds, they then confidently applied this to their learning in the use of reasoned argument as did Jack and Aidan in their discussion transcribed below:

**Jack:** If Threshold 4 didn't happen, then Earth wouldn't have been made and our Solar System wouldn't have been...Goldilocks Conditions, they would be destroyed or they wouldn't have existed if the Sun had taken more elements than it should have.

**Jack:** Our human story is important because if our human story didn't happen, then Earth would just be like Mercury ... or... the dinosaurs would still be on Earth.
Aidan: I have something to say. Dinosaurs needed air to survive. If Earth didn't have any air or anything, dinosaurs wouldn't survive ... Maybe nothing would be created yet because there's no living being. That's one of the greatest mysteries I've ever thought (appears amazed at his thinking).

(Third pedagogical interview, 14 September 2016)

Jack and Aidan linked the formation of our solar system to subsequent increasing complexity of human life and the awe and wonder it inspired, as observed in Aidan’s concluding remark emphasised in bold. Their eager approach to engage in inquiry learning in the dialogue below demonstrates students’ willingness to explore a wider worldview to answer their wondering. Jack and Aidan contemplated their sense of awe and related it to a Big History core transdisciplinary skill of evidence–based, informed learning. The inquiry and critical thinking skills built into the Big History curriculum also encouraged students to use skills to think across disciplines.

There have been various critiques of Big History, since its recent inception at a secondary school level, that attempt to dismiss it as another closed grand narrative to present to students (Fleming, 2015; Jackson & Finn, 2015). In addressing these criticisms, I reiterate a summary of Big History from Chapters Two and Three of this thesis: Big History adopts an open, critical inquiry approach as a project-based transdisciplinary course. It relies on the teacher as lead-learner and is evidence-based, relying on authoritative sources, students’ intuitive learning and logic (Big History Project, 2015). The diverse knowledge content and transdisciplinary skills of the Big History course therefore empowered students to interconnect and to apply their understanding of Big History thresholds to the wonder of the universe’s increasing complexity:
Molly and Gabby were typical of the majority of students who used learnt terms to discuss the evolution of human life, particularly in terms of ‘Goldilocks conditions’, which will be recalled is one of the Big History terms to explain increasing complexity of our universe (Christian, 2017).

When combined with local school values, the Big History course gave students the ability to recall and to apply that content in a broader context of sustainability. The following examples display children’s innate familiarisation with, and understanding of local school values, in conjunction with a picture book resource introduced in Threshold 9 (the Future). When the local value ‘tolerance’ was mooted by students as important for future living Joe used the example of the fishermen in the story; if “They just kept on fishing and didn't save some for other people. …It’s a bit selfish” (Post-pedagogical interviews, 15 November 2016). The rich language Joe employed from the values perspective of the book, was taken up generally by students in post-pedagogical intervention interviews. The child-appropriate scenarios in the book, allowed students to identify, explore and articulate the importance of sustainability. This concept of child accessibility and empowerment is in keeping with Spyrou’s research (2011), as cited earlier. Here it became obvious that children were transferring concepts and skills into a cross-disciplinary broader worldview.
When discussing students’ impressions of the Big History learning they had experienced, the picture book *Just a Dream* (Van Allsburg, 1990) and local school values were springboards from which students based much of their reasoning to apply skills learnt to the broader understanding of sustainability for the future. The shift in interview conversations through the Big History lens of Threshold 9: The Future, gave students the ability to transfer the shared language of Big History skills and understanding, book discussions and local school values to infer about sustainability for the future. When referring to love and peace being needed for future sustainability the conversation continued with Charlie and Amy offering the example of the fish in the story to demonstrate the worth of local school values to environmental education:

Charlie: Walter said, what's going (on) and then they (the fishermen) just ignored it... They need a (local school) value, two values ... respect... and peace
Amy: Loving. Because if they didn't love animals, they can just kill the animals and eat it.

(Post-pedagogical interviews, 15 November 2016)

Charlie’s and Amy’s remarks validate that students’ broader vision of local school values, through the teaching of Big History core concepts and essential skills, engaged them in whole-system observations, including the understanding that care of the universe is ecocentric, not anthropocentric as many of them had initially understood. This broader vision of environmental education resonates with me as a teacher committed to environmental education. In contrast to the initial interviews where children’s comments reflected an anthropocentric, fragmented knowledge and an environmental disconnect with the environment (Leiserowitz & Fernandez, 2008; Leiserowitz, Kates, & Parris, 2006), it was becoming obvious that children were now
relating to an interdisciplinary and wider worldview, inclusive of local school values.

The following excerpt from post-pedagogical interviews, show students’ critical inquiry thinking with their responses indicating the conveyance of transdisciplinary skills to empower whole systems thinking away from anthropocentric worldviews:

**MA:** What does sustainable mean?
**Joe:** Enough for everyone.

**MA:** Enough for everyone. Is that just everyone?
**Georgia:** Everything. (everyone else agrees)

**MA:** What does everything include, Joe?
**Joe:** Plants, animals, all living things.

**Charlie:** Rubbish... because you need to recycle.

**Amy:** If you don't follow the rules, like putting the rubbish in the wrong bin, it can just ruin our environment.

(Post-pedagogical interviews, 15 November 2016)

**MA:** Can you think of some values ... that would help people like Walter and Rose think about the future environment?

**Emma:** Respect and justice. You should respect animals and plants and things like that to make a better future. Justice is to be fair, so in the future a lot of people will have the same thing that you have. If you're not fair, and you take a lot of things, in the future there will be nothing left.

**Emma:** Sustainability.

**MA:** Sustainability. ... who is sustainability for?

**Jack:** Everyone?

**Emma:** Everything.

**MA:** Why did you say (that) differently? Jack said everyone, you're saying everything, Emma...?

**Emma:** If it's just everyone, it means every one of us, but we need to look at the plants and animals as well. If there's a lot for us and nothing for the plants and animals, they'll be ... If the plants and animals help us to stay alive, and there's nothing left for them, then we won't be alive anymore.

(Post-pedagogical interviews, 15 November 2016)

**Jack:** Love, because he's caring for the environment.

**Theo:** Peace... When they plant a tree they have to wait until it grows...They need to give it peace to wait and watch it grow

**Respect** because you need respect for everything, really.

**Aidan:** You need respect for the animals, environment, plants, people.

**Jack:** He (Walter) learned ... He learned to not tease someone who is trying to
care for the environment and think about what he's doing first and then act.

MA: What value would that be?

Jack: All of them.

Theo: He wasn't giving respect to the environment and he just shoved everything in the same bin just to watch the TV show.

MA: Was there anyone who needed to show or showed empathy in this book?

Jack: Only Rosie... By taking care of Walter at the end because he felt what the plants felt when... Before he went back home he saw toothpick men and felt sad, he felt just like how the trees felt, so when he went back home, he fixed the future by planting a tree and cleaning everything he's done.

Jack: Honesty ... Maybe because after they realised it they might have told the government or something that they chopped down all the trees?

(Post-pedagogical interviews, 15 November 2016):

Jack: I would think the fishermen (show tolerance)... They're supposed to throw away the little ones and catch the big ones so the little ones make more fish... They just caught a lot and they started celebrating that they caught a little fish.

Aidan: Two new fish in one whole week!

(Post-pedagogical interviews, 15 November 2016)

The knowledge students had gained allowed them to critique the environmental actions being discussed through examples from the picture book they had shared in class (Van Allsburg, 1990). They were empowered to relate known school values to help them articulate underlying, joint responsibility to take care of the earth and to understand that everything and everyone is interconnected from that perspective. In investigating transdisciplinary and systemic thinking through the Big History curriculum, students ably transferred knowledge and understanding. I now address the stance of myself as researcher and the co-researcher teacher.
d) Observations from the co-researcher teacher and my research journal of how transdisciplinary learning contributed to informing students’ understanding of the emerging story of the universe

It became discernible from my shared teaching in the classroom that the class co-researcher teacher was implementing Big History skills and concepts across disciplines. When I discussed this with her in the post-pedagogical interview she agreed that Big History was conducive to English in the forms of personal responses, talking and listening, reading, factual and fictional texts and visual literacy.

_Nadine:_ ‘Mother Nature’ (Conservation International, 2017) … was part of our responding to texts in English and looking at personal responses … It’s probably not a clip or a series of clips designed for children (but) they certainly grasped the concept given their prior knowledge from Big History.

Nadine’s comment, demonstrated that a deeper learning had taken place, where students had been presented with the Big History critical knowledge base across skills and subject areas. Her observation gives credence to the calls from Christian (2012), Wattchow et al. (2014) and Sterling (2016) to not isolate learning into silos. Her remark that Big History had introduced her to new resources allowed her to explore and integrate deeper knowledge with her students across discipline areas. A sample of one of the rich resources she referred to is displayed in Figure 5.3.
Figure 5.3 Photo taken from the student Newsela website (2017) as an example of reading content offered at differentiated reading levels and using a cross-disciplinary platform and complementing transdisciplinary learning

When I asked Nadine if there was anything else that she used to extend Big History learning across any other subject areas Nadine’s reply is also validated by examples of students’ artwork in Figure 5.4:

*It's such a rich topic that we've been able to either integrate or at least complement Big History in almost every area. Of course, the Creation unit, we studied in Religion integrated into the programme, and Creative Arts... I think the children have really benefited from that.*
Nadine explained further that Big History skills and concepts crossed discipline boundaries:

_A mathematics task that I can think of now is the beaks experiment ... we looked at some graphing and data analysis, which was amazing. We've integrated science broadly, and geography has complemented it, and we've got the History side of it as well. Our excursion to The Observatory really consolidated the prior work we had done, and then we were able to take that further, especially matching it with the weather at The Observatory and looking at weather inside geography and science._

It is important to emphasise Nadine’s naming of so many disciplines in her comment and the many authentic tasks introduced in the teaching and learning program that crossed the silos boundary allowing for empowered inquiry learning and reformative thinking (Sterling, 2011). Likewise, in my research journal I also regularly reviewed and adjusted the cycle of the learning program as illustrated in my 12 September entry.
where I mentioned the need to incorporate drama-based (learning using flashcards and resources to further investigate Big History across the disciplines.

Furthermore, Nadine commented on the suitability of teaching Big History to engage students of varying abilities. She validated the positive effects of Big History learning that engaged Aaron, who I have highlighted in this data analysis. He generally struggled to engage in learning, articulate his thinking and follow class discussions across different subject areas. Nadine noted that she could see a shift in his learning where he joined in class discussions and brought in relevant literature from home. She added, “Even though his writing was limited compared to other children, it actually extended (it) beyond what he had previously been doing”. This is in keeping with my research journal entry where I acknowledged, “Children (are) very enthusiastic and I can see, although learning at various levels, (they) are taking the overall ‘story’ on board” (Research journal, 12 August 2016).

Nadine also remarked on the more capable students’ engagement with the Big History topic where they were provided with a variety of activities across disciplines, including an online learning portal where, “there were still further tasks to look at different perspectives.”

Nadine verified my research journal entry note below, in that visual resources (see Figure 5.5) added to the rich learning environment of inquiry learning and “really brought their learning to life and it gave them a lot more creativity and thinking”. The reliance on resources to transfer knowledge was recorded in my journal and on 12 September, after my co-researcher teacher and myself had hung up models of our
solar system. It was beneficial in that it helped students cross reference their learning in lesson time across subject areas, including spontaneous use of learnt vocabulary when discussing and transferring Big History learnt terms, such as ‘goldilocks conditions’.

**Figure 5.5 A sample of the classroom vocabulary wall**

One further observation Nadine referred to, validates the transference of skills that she and other teachers associated with the class, where students transferred their inquiry learning to ably working not only in groups, but to view teachers as co-learners with them, evidenced in her comment, “They've seen Big History as a shared learning for me and for you and for them, and they really do get involved in it”. Children became confident in articulating their opinions, verified by facts they had learnt. She noted that their growth in their ability to work in groups was amazing:
They can use these group skills in other areas too. They're so much more confident to talk and share their own ideas in a small group and in a large group. The progress in that area has been amazing.

This notion of children being empowered by their sense of being co-learners and researchers is given credibility from the research of Kellett, (2005, 2010, 2011) and Barratt Hacking et al. (2013). In the methodology section of my thesis I discussed the importance of children having their own voice to add their valuable contributions in understanding their worldviews and the extent those views can be transformed. In this study, through the pedagogical intervention of critically studying the Big History story through cross-disciplinary learning. I will therefore discuss, in the conclusion chapter of this paper, the students’ growing sense of ownership and their child-framed contributions as co researchers to the overall directions and future implications.

I now turn to summarising the implications of transdisciplinary learning on students’ environmental education values.

**Summary of Transdisciplinary learning - The extent it impacts on students’ environmental education values**

In this section I have continued to build on my research story by representing the data gathered about students transferring transdisciplinary skills and concepts of the increasingly complex and the cohesive Big History story within local school values.

This fourth theme of transdisciplinary learning has analysed students’ perceptions and their broader worldview away from anthropocentric thinking, unfolded through the teaching of a whole-systems, transdisciplinary, emerging story of the universe. The
story, language and Big History learning framework were transparent components of student interview comments as they discussed the need for the interconnection of subjects to enable a deep understanding across subject areas. Without using the actual words, they had discovered and articulated in child-friendly language, what I had discussed in depth in my literature review, that the isolation of teaching subjects in ‘silos’ is limiting for learning and the expansion of their understanding away from an anthropocentric worldview. The extent of the impacts on students’ environmental education values was discernible in students’ enriched observations, their use of their newly learnt knowledge from Big History and their known local school values and Catholic teaching. Nadine as co-researcher teacher, remarked on the learning across disciplines and the opportunities for children of varying academic abilities to engage in inquiry learning at their own level of understanding, where they were empowered to see themselves as co-learners with teachers. Likewise, in my journal I noted that, as part of my cyclical reflection on the need to change direction or add to the plan, I needed to add richer tasks that would further embrace transdisciplinary learning skills and concepts of Big History. This is in keeping with cyclical and reflective components of action research as “part of the joy is in the doing” McNiff (2002, p. 17) and Mertler (2002, p. 25).

I now turn to the fifth theme of my analysis: the socioecological learner and the evidence from the collected data that demonstrated the extent that students’ values were informed within the conformative, reformatory and transformative socioecological learning process of the emerging Big History narrative. I continue to emphasise that, the four themes I have analysed to date should be not seen as merely linear, but as nested in each other; the same concept will be applied to the fifth theme.
THEME 5. SOCIOECOLOGICAL LEARNER - The evidence for conformative, reformatory and transformative socioecological learning process

Orientation to Theme 5

To investigate my data further I now turn to the final theme: the socioecological learner. The possibilities for socioecological learning, within the evolving scientific origin story, began to emerge during the research interviews, once students had begun to nest their knowledge of Big History, through the lenses of local school values, their learnt Catholic traditions and transdisciplinary skills and concepts aligned to Big History. As discussed in those themes, the growth in students’ critical knowledge base aided the deepening of student learning, where they applied that knowledge to express emotional intelligence (Mertler, 2008, pp. 13-17) and a systemic worldview from a socioecological perspective (Morgan, 2002).

As noted in the theoretical framework for this research, deep learning (2011a, 2011; IBHA, 2012) resonates in Sterling’s model of conformative, reformatory and transformative learning; this scaffold is echoed in Catholic education documents as ecological awareness, ecological consciousness and the possibility of ecological conversion. This theme will be expanded through the following subheadings:

a) The scope of Big History and local school values for the socioecological learner.

b) Research interviews, values and the emergence of informed socioecological learning opportunities.
c) Students’ growth in values learning from the socioecological learning perspective.

d) Co-researcher teacher and research journal observations to verify above points.

a) The scope of Big History and local school values for the socioecological learner

Evidence that students’ values have been informed, in the context of their conformative, reformative and transformative learning, converges within the socioecological learning process. I begin with a reminder of how students generally relied on fragmented prior knowledge with little evidence of informed learning in their pre-pedagogical interviews:

*MA:* ...do we know why the universe is important? Is that something else you need to learn?

*Georgia:* No.

*MA:* ...What do you think is important about the environment?...

*Georgia:* That we don't chop the trees down because boats live there.

(Pre-pedagogical interviews, 29-30 June 2016)

*MA:* Do you know what the Earth's made of?

*Amy:* Air.

*Amy:* Woods, air, I think.

*Georgia:* I think it would be made of dirt, stone, water, stuff like that.

*MA:* You (can) go anywhere in the universe, what do you imagine you would see?

*Georgia:* Water. House. Technology

*MA:* What kind of technology?

*Georgia:* Electricity.

(Pre-pedagogical interviews, 29-30 June 2016)
As can be inferred in the pre-pedagogical interview excerpts, most students displayed little knowledge or curiosity about the universe. Their initial quotes are in contrast to the second pedagogical interview where students were discussing, not only knowledge but also the essential learning skill of claim testers as testing for evidence. This was indicative of the reformatory learning that was taking place within the inquiry learning process:

MA: (Any) words that you've learnt that you think are important for Big History?
Mia: Claim testers like authority and intuition.
MA: Do you know why we need those claim testers?
Mia: Because if people don't agree with you, you have to show them evidence so they can believe.
MA: Okay so is it just other people or do we need the evidence so we can believe?
Mia: We need the evidence to believe. Like, different elements can do different stuff.
MA: Can you think of any particular elements?
Mia: Hydrogen and helium?
Georgia: Gravity?

(Second pedagogical interview, 29 August 2016)

Mia and Georgia demonstrated the children’s growth into a reformatory wider worldview and possibility of transforming how they traditionally see, think and act is central to socioecological learning. The comments, seen in this light, waylay any criticism of Big History as a closed narrative by its emphasis on the need to incorporate whole systems worldview through any new authenticated evidence (Bai, 2012; Goleman, 2012; MCEETYA, 2008). Transience is a necessary underpinning of the interdisciplinary Big History Project (Fleming, 2015; Jackson & Finn, 2015).

I continued to follow Aaron’s progress, as a student who struggled generally in his
class work:

Amy: If we didn't have life we wouldn't be here.
MA: Can you explain that a little bit more? If we didn't have life we wouldn't be here?
Aaron: If we didn't have life we wouldn't have human.

(Fourth pedagogical interview, 17 October 2016)

The differentiated learning opportunities, as represented in the appendices of this research, contributed to Aaron’s socioecological learning. The following conversation indicated his shift from having nothing to contribute, to following the basic ideas of a group interview discussion and displaying some limited reformative thinking.

The possibility of reforming and transforming how we traditionally see, think and act is central to socioecological learning. The ‘big’ story of Big History provided students with the springboard for understanding the interconnectedness of the evolution of human life within the history of the universe. This knowledge allowed them to critique environmental actions being discussed and that they may have seen implemented, within an underlying, joint responsibility to take care of the earth.

Through the learning process of Big History, students’ perspective changed from an anthropocentric to a broader worldview that encompassed discussions that everything and everyone is interconnected. This perspective, with its investigation of interdisciplinary and systemic thinking in education, links well with Pinar’s claim, referred to in an earlier chapter, that the present … found in remembering the past, in turn will help locate the future (IBHA, 2012. p. 6).

Mia and Jack’s following comments represent evidence of the foundations from
which students’ broader worldview towards socioecological learning had developed.

When asked about the importance of Big History to their learning, replies included:

*Mia:* Claim testers like authority and intuition.
*MA:* Do you know why we need those claim testers?
*Mia:* Because if people don't agree with you, you have to show them evidence so they can believe.

(First pedagogical interview, 1 August 2016)

*Mia:* (We're building up a story of our universe) but we don't know. Sometimes scientists say that a volcano erupted, so we don't even actually know.

(Third pedagogical interview, 14 September 2016)

*MA:* ... were there people back in Threshold Five?
*Students:* Yes. No. Yes. (disagreement)
*MA:* Jack, why are you saying no? What was in Threshold Five?
*Jack:* In Threshold Five there was only learning about life like trees, bacteria, stuff like that. Not the early humans.

(Fourth pedagogical interview, 17 October 2016)

Critical inquiry necessarily places values in environmental education within a broader holistic educational framing. Big History locates the individual’s values within a worldview of the 13.8-billion-year-old narrative. This wider worldview allowed students, during the research phase, to reflect on framing the past, present, and future (Fullan & Langworthy, 2013; Sterling, 2003, 2008) that encompasses both human and nonhuman history, within thresholds of increasing complexity as Charlie’s contribution to a group conversation on water reflected.

*Charlie:* If the water was polluted, with oil or other kinds of stuff which ships...  
*Georgia:* You wouldn't be able to drink it and shower...  
*Charlie:* And you would just get dirtier when you have a shower.  
*MA:* What (local school) value... wouldn't people be showing?  
*Charlie:* Respect and empathy.  
*MA:* Empathy? Why empathy, Charlie?  
*Charlie:* You don't feel what the water is feeling...  
*Amy:* It would be sad?
Charlie: Yeah.
MA: Do you think water might have feelings?
Amy: Yeah. I think so.
Charlie: Other people would get feelings about it.
MA: It's the feelings of other people? If we polluted the water, how would other people feel?
Georgia: No one else would be able to have it. People would feel really sick and really dirty and sad.
MA: What value wouldn’t that be showing - if we allowed the water to get dirty?
Amy: Tolerance.
Georgia: Peace.
Joe: Respect.
Georgia: Love.
Charlie: Compassion.

(Post-pedagogical interview, 15 November 2015)

Through this enhanced worldview of the socioecological learner, students critically examined values within the inclusiveness of human and nonhuman in our universe.

I now address the important role that group discussions, as opposed to student comments, informed socioecological learning.

b) Research interviews, values and the emergence of informed socioecological learning opportunities

As noted in the previous sections, I believe it is essential to the authenticity of the data representation that I particularly reference the contributions that group discussions informed my research in the area of socioecological learning for the students.

Big History learning gave students confidence to discuss the environment as in Joe’s confident explanation of DNA. His learning gave him the confidence and enthusiasm to speak up and add meaningful information to a group discussion, which had not
been obvious in earlier interviews:

Molly: Yeah. We started off with a little cell like this, like a tiny cell... and then it kept on getting bigger. (Gabby & Jack agree)
Jack: ...Then it separated
MA: Can anyone explain how that one cell separated?
Joe: DNA?
MA: Can you explain what DNA is? ...
Students: Zipper (calling out together)
Joe: It was like a zipper, it zipped up then it broke into two parts of DNA.
MA: Okay, did it always copy itself exactly?
Joe: No.
MA: What did that mean for life then?
Joe: That people will come different.

(Fourth pedagogical interview, 17 October 2016)

As a result of students being attentive to and sharing in others new learning, there was an obvious shift to inquiry learning beyond their previous anthropocentric, fragmented understanding of the universe. They were free to formulate a more complex understanding of the universe as Molly and Gabby demonstrated below:

Molly: I was surprised about today when Gabby told me light travels 7.5km around the earth's equator in 1 second.
MA: So we can travel 7.5 times around the earth in 1 second?
Molly & Gabby: No light can travel.

(First pedagogical interview, 1 August 2016)

When students were asked how Big History helped them change their ideas or their feelings, their answers encompassed a much wider perspective than that of humans; rather, they were able to incorporate the technical language of ‘thresholds’ that they had learnt in Big History. When explaining the unfolding universe story, Gabby and Molly in the following example use their Big History understanding to explain their
new thinking, that humans became a part of, not the centre of the unfolding universe.

Gabby: It makes me feel like when I started I was like what's going to happen? How am I going to know? Then sooner or later, it went really fast and it was like, now I know about the Thresholds because I've went through Threshold one all the way up to Threshold five and soon we're going to be doing Threshold six.

Molly: I used to think that everything was already made, like space was already made, the stars were already made, all the planets were already made - just already made. I used to think that all of Earth was already made. I used to think that humans were made and then the humans just started off really tiny and then once it got into a future, they (would) just somehow grow. Now, since I've been learning about Big History, it's made me learn that that's not what happened. Space was made, it started off like a speck of dust and then it was…made.

(Fourth pedagogical interview, 17 October 2016)

Georgia, Amy, Aiden, Aaron and Mia described fragmented and conformative knowledge within initial group discussion time. Aaron’s reply in particular, shows his inability to contribute in the pre-pedagogical interview:

MA: Where do you think we learn about the environment?

Georgia: In books.
Georgia: Maybe in the classroom.
Amy: I think...church.
Aiden: I watch videos

Mia: I'd want to learn about, earth is a small planet but with other planets if we think dwarf planets, how are they dwarf.
MA: Aaron. Is there anything special you would like to learn?
Aaron: Not really.

(Pre-pedagogical interviews, 29-30 June 2016)

When the samples are compared to ensuing interviews, there is evidence of students’ use of their increasing reformative learning. Their learnt vocabulary and knowledge of Big History learning gave them the confidence to contribute to group discussions and to articulate the possibility of transformative socioecological learning. I
emphasise here the limits of this research, that its framing is restricted to the extent Big History can **inform transformative learning**, as opposed to evidence for **transformative action**. Jack, Aidan and Theo, by the third pedagogical interview, had gained an informed understanding of a whole-system view of Earth as essential to its survival, as opposed to the worldview of the anthropocene:

Jack: *Our Earth changed when our core, our planet’s core is hotter and hotter and changed our crust. The core keeps our planet from freezing into an icy planet like Uranus so that’s why life is on Earth. If we didn’t have our core, we wouldn’t be here.*

Aidan: *We are perfect. If our planet gets moved we either freeze or burn, so that’s why we need to be the third planet from the sun.*

Theo: *If the Earth was like really far away (from the sun) it would be really cold and the core would be frozen and if the core is frozen then we will die by freezing to death.*

Aidan: *Too hot, too cold. Like the Goldilocks story.*

(Third pedagogical interview, 14 September 2016)

The group discussion style of research interviews also encouraged the students with a more limited understanding of whole systems to still contribute within the sharing of knowledge, as corroborated by Aaron’s comments below, after participating in learning activities and then listening to another student’s comments:

Jack: *I didn’t know that the sun was the only hottest star. How long will our sun live and how long will our galaxy last?*

Aaron: *Is a star a star shape or is it just a circle?*

Aidan: *That’s a great question.*

(Second pedagogical interview, 29 August 2016)

In the second example, Aaron used basic language to express his reformative learning:
Aaron, although using basic language displayed evidence that he followed a student’s more technical answers, demonstrating he was understood the conversation. Socioecological learning was happening within differing learning abilities. I now turn to addressing values learning from the socioecological perspective.

c) Students’ growth in values learning from the socioecological learning perspective

For the purposes of this research students’ growth in values learning needs to be analysed within the socioecological learning process, building on findings where relevant, to Sterling’s whole system thinking and the Catholic environmental education framing of ecological awareness, consciousness and conversion.

As will be recalled form the theoretical framing of this research, the stance of Big History relates directly to preparing students, through interdisciplinary, critical inquiry to deal with unknown futures of greater complexity and most importantly, as new and better evidence is found, the story will need to be updated. The socioecological learner, with a wider, whole-system post humanist understanding is ready to tackle the many possibilities for future new learning and innovation.
Students’ capabilities for critical inquiry, based on the teaching of a coherent universe story, were evident in their new learning. In the first, second and third interviews students were using their shared knowledge learnt to think critically and query a wider worldview as table 5.2 indicates.

**Table 5.2 Applying new learning to query a wider worldview**

<table>
<thead>
<tr>
<th>New shared learning</th>
<th>Applying new learning to query a wider worldview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tectonic plates</td>
<td>Causes earthquakes and changes earth's surface</td>
</tr>
<tr>
<td>Elements</td>
<td>Helium and nitrogen important to form the sun our earth</td>
</tr>
<tr>
<td></td>
<td>Oxygen needed to breath</td>
</tr>
<tr>
<td></td>
<td><em>How did scientist find all the elements?</em> (Gabby, 29 August, 2016)</td>
</tr>
<tr>
<td></td>
<td><em>I wonder if there are lost elements</em> (Imogen, 29 August, 2016)</td>
</tr>
<tr>
<td>Meteors and asteroids</td>
<td>Extinction of the dinosaurs and humans wouldn’t be here (discussing evolution)</td>
</tr>
<tr>
<td>Formation of our solar system</td>
<td><em>That's one of the mysteries. Why isn't there only one planet and the sun? They'll all be on the exact same line connected to one</em> (Aidan 14 September 2106)</td>
</tr>
<tr>
<td>Scales of space</td>
<td>How do scientists know how big the universe is, how many galaxies there are?</td>
</tr>
<tr>
<td></td>
<td><em>If we could go any further into space and find more planets can we claim them for Australia?</em> (Jack, 1 August, 2016)</td>
</tr>
</tbody>
</table>

Table 5.2 summarises some of the students’ deeper enquiry learning from their learning the cohesive deep time and space story of Big History that embraces past, present and future. Within the shared language and critical enquiry evaluation
techniques, they began to query the implications of our past, present and future to critically examine the inclusiveness of all that is human and nonhuman in our universe.

When students were asked the importance of Big History to the future they responded with a variety of explanations. I return to Aaron with a simple, yet reformative response and an example of transformative thinking where he is showing respect and empathy, two of the local school values. Mia then refers to one of the picture books, discussed in English, to verify her opinion about honesty as an important value for a sustainable future:

Aaron: Because like if you didn't know the future, you wouldn't know what you are going to do... It tells you what the future is going to be like when you're older, and like Big History tells us about stuff that we can't see

MA: So do we need nature?
Aaron: We need nature, but nature doesn't need us.
MA: Did you understand why we need nature but nature doesn't need us?
Aaron: Yeah, because if nature faults we fault, and if it all collapsed we collapse.

(Post-pedagogical interviews, 15 November 2016)

MA: Do you think (honesty is) important for a sustainable future?
All together: Yes.
MA: Why do you think it is important, Mia?
Mia: Well, with the 'Just a Dream' book - the fisherman - and this was like the worst part, this was the part I hated - what I didn't like is they caught a fish, but it was small, and they didn't let it go. They just kept on fishing. Then there will be no more fish. They sent it to the market, and they said, "Why is this so small?" And they go, "I don't know, it's not my fault".
Aaron: Not showing love.
Jemma: Tolerance.
Aaron: Caring.

(Post-pedagogical interviews, 15 November 2016)
The disparity and contradictions evident in the pre-pedagogical intervention where there was no coherent narrative to relate to was evident in student thinking in first interviews:

*MA:* All people are connected. Is that important to our environment? What do you think?
*Theo:* We’re connected to our family.
*MA:* Are we connected to everyone?
*Jack:* No, not really.
*Theo:* Not everyone.

(Pre-pedagogical interviews, 29-30 June 2016)

As students grasped the interconnection and complexity of the universe story demonstrated a greater assurance and certainty was evident in their comments:

*Imogen:* Imagine if you were nature, and people were building things on you, and cutting you down. How would you feel if, yeah.
*MA:* Does that mean do you think that we're part of nature? Humans are part of nature?
*Molly:* Yeah, humans are.

(Post-pedagogical interviews, 15 November 2016)

During further discussions in the post-pedagogical interviews students articulated their thinking about sustainability to verify the aforementioned claims about the interconnection of, and need to care for, all the earth. I particularly noted their confidence in using references from resources built into the Big History program, which is a strong indication of their shared inquiry learning and their understanding that to be critical learners they needed evidence as taught through the skills of Big History claim testing. Although their discussion below does involve humans’ needs, there is also a strong indication of a whole-systems perspective towards a value
enriched socio ecological learning stance:

**Gabby:** I think we should treat the earth as what we want to be treated because if we treat the earth what (sic) we want to be treated then we can help the earth and all the animals because the earth is like a human being, it's like us except it doesn't walk. We want to keep the Earth safe so we have to treat the earth how we want to be treated as well.

**Aidan:** We need to be sustainable because people are building so many roads in the forests and that means for these tiny little possums, I forgot what they are called - it just destroys their homes and if you destroy their homes they can get extinct really easily. Another thing, if you litter it can go down the drain and then a turtle will think it's a jellyfish and eat it. It's pretty much sad and then pretty much all the animals could get extinct from just one tiny thing that we do that we think is "Oh I don't care!" But, it can destroy it all.

**Molly:** We need to be fair. We need to be sustainable in the world because if we're not, for example, if we take too many creatures out of the sea or take too many creatures out of the jungle or cut down any of their trees where they live, then it's not fair for all the animals that live there 'cause then they can't live there anymore because we've just destroyed their homes.

**Georgia:** We need to keep the world sustainable even with all our cars and our lights. With our cars and stuff like that we're polluting the air and all the birds, they're gonna (sic) be very sick and birds are the closest things to dinosaurs so we need to keep them in our world.

**Jack:** The way I'm thinking of keeping our earth safe is by buying more electrical cars by making them more cheap or thinking of a new way of transport that everyone can use that everyone likes. If we don't care about our precious Earth we won't have anything to live with.

(Class post-pedagogical discussions, 16 December, 2015)

Once students had discussed the local school values within the contexts of Big History learning and sustainability, I asked them to consider what part local school values could play in their thinking about possible involvement in a sustainable future.

I have highlighted in bold the definitive transformative thinking in some of the replies below, where students’ language now included the terms **everything and everyone**, as well as **all nature and all humans**.

**Mia:** Peace ... Because you need to be friendly to the rain forest and not ...

Well, then the animals wouldn't have a shelter to live in.
Indi: (Big History) Could make us learn the future ...
Imogen: I'm going to be a marine biologist.
MA: If that's your dream what do you have to do now to get towards that dream in Year 3?
Imogen: ...I could study all the animals and see what's bad for them and good for them?
Molly: You could hold on to what you really want to be, and then you get older, you could actually become it.
Gabby: I would want to have everybody to be sustainable and everything sustainable, and everything's fair, and everybody's happy, and there's part of Imogen's, and Molly's ideas.
Gabby: Every value (is important).
Imogen: I'm saying love...Because if everyone hated each other it would be a bad world, but if everyone loved each other and loved the environment and everything, the world would be happy.
Molly: Respect as you need to respect all nature. You need to respect also all humans, because you could destroy their land.

(Post-pedagogical interviews, 15 November 2016)

In the first interviews students’ understanding of the need for values for both the human and non-human was not visible, yet this is clear evidence that by the post-pedagogical interviews, there was an assumption that the local school values applied to both. I believe that the cohesive and interconnected Big History universe story provided students with a significant breakthrough in their understanding of sustainability within a socioecological learning context.

As a final comment on representation of data collected, I refer to the following extract, which I believe indicates a caveat for educators; we may think we are teaching the value of sustainability through action and example but the question we need to ask ourselves returns to Sinek’s directions for authentic learning: ‘first ask why’. The conversation is an example of what adults can assume: that children will understand and value if we just tell them it’s important to recycle. Without providing them with an opportunity to gain knowledge of the broad story and context and then
to apply that knowledge critically to their actions, the sustainability focus we hope for
may fall short of socioecological learning, that encompasses reformed knowledge and
critical inquiry learning, with the possibility of an individual’s transformative thinking
and a call to action. Charlie’s observation on recycling bins and plastics is an example
of that concern – luckily he had been given the interconnecting story and time for
critical inquiry to find his answer of how he can authentically respect the
environment, not just pay ‘lip-service’ to sustainability.

*Amy:* I think that you need learn to Big History in Year 3 because... you need
to know more about the environment, so that you can respect your
environment and tell others about it.

*Charlie:* I was saying, what Amy said. I was going to say .... So people don't put
their recycling in the waste and don't pollute too much.

*MA:* Can you explain ... How has Big History helped you learn that better?

*Charlie:* It helps me because I didn't know about plastics, I kind of put them in
the wrong one. I thought it was recyclable ... I didn't know where to
put the plastics and the... other ones.

*Amy:* I think he learned to put the right rubbish in the right bin.

The direction of Amy and Charlie’s conversation demonstrates the need to provide
students with an opportunity to gain knowledge of the broad story and context and
then to apply that knowledge critically to their actions; otherwise, any sustainability
focus may fall short of socioecological learning, encompassing reformed knowledge
and critical enquiry learning, with the possibility of an individual’s transformative
thinking and a call to action. Charlie’s observation on recycling bins and plastics is an
example of that concern – luckily, he had been given the interconnecting story and
time for critical enquiry to find his answer of how he can authentically respect the
environment, not just pay ‘lip-service’ to sustainability. Without a Big History
cohesive story and enquiry learning focus ‘sustainababble’ may have continued as
part of Charlie’s thinking (Engelman, 2013, pp.3-15.). Previous findings cited in my
research, support the growing concern that informed and critical inquiry education is
an essential component to validify environmental education, as opposed to the uncritical promotion of sustainability issues (Department of the Environment, 2010; Hungerford & Volk, 1990; Jickling & Spork, 1998; Scott, 2009; Tilbury, 1995). Two particular references I relied on, as a catalyst within the Australian context, were the *National Australian Curriculum* (ACARA, 2014; NSW Board of Studies, 2014), strongly supported by Sydney Catholic Schools (2013a), where sustainability was elevated to one of the three cross-curriculum priorities; in turn the *Australian Curriculum* cites the Australian values named in the *Melbourne Declaration* (MCEETYA, 2008) as its foundation. Charlie’s comments reflected the majority of children’s reformed wider worldview, through the lens of Big History, familiar local values and sustainability.

Without providing students an opportunity to gain knowledge of the broad story and context and then to apply that knowledge critically to their actions, any planned sustainability focus may fall short of socioecological learning, and the need to encompass reformed knowledge and critical enquiry learning, along with the possibility of individual transformative thinking and a call to action. Charlie’s observation on recycling bins and plastics is an example of that concern. Providentially, he had been empowered with the interconnecting story and time for critical enquiry to find his answer of how he can authentically respect the environment, not just pay ‘lip-service’ to sustainability.

Having analysed students’ growth in values’ learning from the socioecological learning perspective I now turn to analysing the data from co-researcher teacher
observations and my research journal to clarify students’ perspective on the socioecological learner.

d) Observations from the co-researcher teacher and my research journal of the importance of socioecological learning in informing students’ understanding of the emerging story of the universe

Students’ understanding of where they fitted into the environment and into the universe, needed to be seen through the lens of their growth in critical knowledge of deep time in relation to the past, present and future, as cited by Pinar (2012). Nadine, as co-researcher teacher, observed that children had a greater perspective of the time frame of almost fourteen-billion-years of universe history, where humans fitted into this time frame and the future that needs to be considered.

She also commented that knowledge impacted on students’ values for the environment. It is important to note that Nadine has commented that the children saw her as lead-learner as opposed to her usual teaching, in that she was learning the evidence along with the students and the program and then, like the students in their explanations, used it to validate her claims.

Nadine’s observations were significant in her use of Big History terminology and local school values. I have highlighted her relevant use of Big History wording, along with the correlation of local school values, to express her opinion:

(Students developed) a very good understanding of - you just can't get some more oxygen, you can't get more helium or hydrogen. What happened in the beginning created what we have now, and that if we don't care for it now, and
if it's not just and fair, and if we don't respect the environment, then it's going to be gone for the people in the future. They've got a good sense of sustainability, and it's their job and it's the job of all people to look after creation and to look after the planet Earth...there's enough for everybody, forever, and that if they take too much of it, then that's not fair and that's not just.... If we don't respect each other and respect the environment, then parts of the environment will disappear.

Nadine was also impressed how the multidisciplinary approach to student learning gave children a more powerful voice to articulate the socioecological aspect of learning in their own child-appropriate language, that humans’ relationship with the environment is fragile and as such humans need to play our part for future sustainability. She referred to texts *Just a Dream* and the *Nature is Speaking* series (Conservation International, 2017) as child-appropriate visual literacy to engage children in the sustainability cross curriculum focus. The conclusions of Reid et al. (2010) support this conclusion, where they describe literature as a valid gateway to child-framed learning, not only of the children’s own worldview of life, but also a wider worldview of socioecological learning. Children are therefore empowered to value environmental education through transdisciplinary learning within a unified story of wholeness (p. 455).

Likewise, my journal entries reflect my concerns as to how I could accurately record my observations of student values within conformative, reformativa and transformative socioecological learning (Monday 8 August 2016).

On Friday 12 August, my journal notes confirmed my ongoing action research cyclical reflections to ensure that authentic planning needed revision, with the intention to continue to include class teachers. I planned for a meeting to listen to and to discuss any changes needed for inclusive and authentic inquiry learning. I was
aware that there was a growing feedback from students of the awe and wonder inspired by the Big History narrative. This entry also showed the cyclical nature of the planning further, in that my reflections on the teaching and learning to date suggested a need to incorporate levelled Big History reading material to the Reading program. I was also evaluating where in the pedagogical intervention I was now expecting to obtain the most pertinent data. By this stage of the intervention it was becoming more obvious to me of the crucial part the building up of the interconnected story played to enable students to then nest this story within a whole systems socioecological understanding.

On Monday 26 September 2016, after viewing a few of my student interviews with my supervisors they reminded me I needed to be aware of the rich data collected from the interviews, keeping in mind the stage of children’s conceptual development, including temporal and scientific concepts.

*My co-supervisor commented that it isn’t so much that they are getting all facts right but that they are beginning to see the relationship between Big History concepts and that this expands on their previous knowledge of how they saw the world working.*

The above points were an important refocusing of my data representation to looking at the children’s discussions from their current conceptual framing. This rethinking led me to journaling the following insight on 13 October 2016, where I was confirming the worth of a thematic methods approach that would be in keeping with my transdisciplinary focus on skills and concepts, rather than silos of subjects and individual values.

**Insight:** Thinking I need to add life-long learning/critical/inquiry learning, awe and wonder of the environment and appreciate the environment to encapsulate values at Local school - these themes coming up frequently in
children interviews but I’m finding it difficult to file them under any indicator/value in NVivo.

By 11 November the rich cross-disciplinary learning data was apparent. In the transcript below I was initially concerned that children were not writing rich information but, after reading through their written comments I noted that I was actually quite amazed at how children had taken on local school values and (were) able to relate them to Just a Dream picture book dilemmas and that gave them a solid foundation to be able to give reasons for choosing values within a practical, child-framed understanding. A sample of children’s comments is provided below, showing evidence of children empowered to relate their rich learning within a socioecological thinking frame.

Figure 5.6 An example of collated written information referred to in the above extract
Again, on 16 November, I verified the increasingly rich student data I have represented in this chapter by commenting on the following significant issue that children had become very confident about relating values to Big History and a sustainable future. I had also written that there was the Big History scaffold had allowed significant progress in students’ ability to articulate their thinking and learning about values and use their knowledge of thresholds to back up their insights.

My last school research visit on 15 December produced some final rich data for socioecological learning. On that date I had recorded the following in my research journal that had arisen from observations from general class conversation.

*As Aidan was packing up his school books (last day of school year), and chatting to me voluntarily (he) said as he packed his Big History journal*’ “Oh, my Big History journal: Big History was my most favourite subject this year. It was awesome and my Mum is going to be amazed at what I have learnt when I show her this book. She’s going to say, “Good job Aidan. You’ve learnt so much”. I’ve already told her so much about Big History.”

The observation Aidan had made displayed his understanding of Big History as a shared learning where he had a proficient knowledge that he could confidently discuss with adults. It was interesting to observe that by the end of the pedagogical intervention Aidan had embraced Big History as a ‘subject’, thereby displaying he had transcended the majority of traditional curriculum silos to embrace his Big History learning with socioecological learning. His comments are in keeping with literature from my research, citing curriculum theory as interdisciplinary (Bonnett, 2013; Payne, 2006; Stein et al., 2008). Bonnett (2013) aptly calls for a transcendence of both the “culture and the curriculum of the school if we are to have environmental education worthy of the name” (2013, p. 194).
Jack and Aidan continued to talk to me on the same day about their favourite subject this year. I believe the following dialogue I recorded in my journal, displays the worth of Big History in socioecological transformative thinking, where their love of enquiry learning led them to embrace the cohesive and emerging Big History story.

**Aidan:** I loved Big History. I learnt so much because I didn’t know anything about how the world was created and how it was so complex. We did so many interesting things too.

**Jack:** Yeah, Big History was my favourite too...oh, no actually my most favourite thing this year was the beak activity where we had to pretend to be birds with different beaks and try to pick up food, then we had to do graphs and things to work out how different beaks worked. (that activity was a Big History activity)

In the dialogue both Aidan and Jack referred to the interesting activities that aided them to grasp the breadth of the universe story within a critical enquiry based pedagogical intervention. Even in these few sentences they referred to the knowledge, the love of learning and the seamless transdisciplinary child-appropriate learning, exemplified in Jack’s explanation above, of the Maths activity. I found Aidan and Jack’s comments to be particularly significant in that they were not sought by me but instigated by themselves. The learning journey may have started as teacher initiated but by the end of the intervention children had taken ownership as active learners with numerous references to themselves as ‘big historians’ during interviews and class activities. Their learning had become increasingly child-framed during the data collection period which is in keeping with my earlier referencing to Spyrou (2011) and Kellett (2010) who promote the place of children in education as critical reflective thinkers.
On 1 January 2017 I had noted in my research journal the following quote from a radio interview with David Suzuki (ABC Radio National, 2016).

**David Suzuki (at 39:00min):** I've been an atheist all my life ... *Laudato Si* (Francis I, 2015) is a magnificent document and I regret that 'we' (environmentalists) didn't write it first, but what he has done is take issues of social justice, hunger and poverty and the environment and he's never split them into silos - they're all together and his statement is we've spent a lot of time trying to work on a relationship with each other and with God but we've spent no time on a relationship with creation and I think *Laudato Si* is a magnificent document that allows us to get at that.

I believe it is an important statement, linking Catholic socioecological thinking with the stance of a prominent world-renowned environmentalist. Suzuki’s statement is a call for environmental education research to embrace the many possibilities promoted by socioecological learning that empowers transformation of the learner, within whole systems thinking. As advocated by Suzuki, ‘seeing our worldview’ empowers a whole systems approach that embraces social justice, hunger, poverty and the environment, rather than seeing ‘with our worldview’ in silos (Sterling, 2011). Snaza and Weaver (2015, p. 5) tackle the problem of achieving sustainable futures and disciplinary silos by specifically linking education to “call into question the entirety of the discipline structure” and to cut across the divisions (disciplines) “all constructed around the human” (2015, p. 5). The impressions of both Suzuki and Snaza and Weaver add weight to the findings of this research, that anthropocentric thinking needs to be transcended by a broader, transdisciplinary socioecological thinking to empower students with whole systems worldview.

I now summarise the evidence for the socioecological learning process.
Summary of the Socioecological Learner theme: The evidence for conformative, reformatory and transformative socioecological learning process

The data representation I have collated as central to my research revolved around the nesting of the first four themes within this final theme of the socioecological learner. The significance of socioecological learning within the evolving scientific origin story began to emerge during the research interviews as students intertwined their knowledge of Big History through the lenses of local school values, their learnt Catholic traditions and transdisciplinary skills and concepts aligned to Big History.

The emerging wider worldview, noted in my analysis of my data and in my earlier discussion on Snaza and Weaver (2015), calls into question limited learning that is structured around the human. The evidence I have collected is in keeping with the stance Big History Project promotes (2018), which empowered children to integrate a wide range of academic disciplines that aligns with socioecological learning (Gruenewald, 2004; Hart, 2012; Kyburz-Graber, 2012).

The aspect of the socioecological learner that became increasingly evident in student interviews, is consistent with the report of the Australian Education for Sustainability Alliance Project (2014), which calls for learning that embraces comprehension, complexity, uncertainty and risk that can be applied to future sustainability. An overall finding from the analysis of this theme is that when students were taught a cohesive deep time story that embraces past, present and future, within a shared language and critical inquiry evaluation techniques, it helped them evaluate the implications of our past, present and future and to move away from anthropocentric
thinking to critically examine the inclusiveness of all that is human and nonhuman in our universe.

The analysis of my research data, from the perspective of the socioecological learner, was imperative to complete the thematic nesting of my analysis of student learning within a wider worldview and a dynamic and broader perspective of curriculum theory. The pedagogical intervention of a course in Big History provided students with an even stronger sense of the interconnectedness of all things in space and time. The open and critical learning they encountered from Big History demonstrates Sterling’s call for ongoing critical analysis. This allowed for changing paradigms to occur from conformative to reformative learning, with the possibility of transforming how we perceive whole systems and worldviews.

In this section I have brought my research story to a close in the analysis of data collected about students transferring and interrelating their learnt knowledge of the interconnection and increasing complexity of the Big History universe story, local school values, Catholic education learning, transdisciplinary skills and concepts within the possibilities of transformative socioecological learning. As the culminating piece of the story, the socioecological learner theme analysed the extent that students’ values were informed within the conformative, reformative and transformative socioecological learning process of the emerging Big History narrative. As will be recalled, I correlated Catholic education understanding of ecological awareness, ecological consciousness and the possibility of ecological conversion with socioecological learning and Sterling’s model of transformative learning.
This section therefore gave evidence that students’ values were informed through the interplay of conformative, reformatory and transformative socioecological learning. Through Big History they articulated their enquiries and critical thinking (2012, p. 6) as evidenced in the represented data examples that embraced reformatory learning and the possibility, for many students, of transformative thinking.

The final rich data feedback from both co-researcher teacher and students was affirmation for the rich and emerging Big History story that encouraged socioecological learners to be informed, and in turn to interpret, local school environmental education values within a Catholic school setting. The students made the connections and their enthusiasm for learning through questioning and deep thinking was clearly evident. Their personal responses demonstrated that they could make the connection between their learning in Big History and caring for the environment. My findings from my data analysis verified that environmental education was all the richer when teachers and students were empowered with a narrative that embraces a wider worldview of socioecological learning. The cohesive Big History story enabled students to understand the interconnectedness of the evolution of human life within the history of the universe. This knowledge allowed them to critique the environmental actions being discussed and implemented within an underlying, joint responsibility to take care of the earth and to understand that everything and everyone is interconnected from a rich values perspective.

I now turn to concluding this chapter by summarising the analysed evidence from the nesting of the five themes; in turn they have informed my directions for my final
chapter, addressing my research questions and my theoretical framework developed in Chapter Four.

**Chapter Five conclusion**

This chapter has analysed data within a nesting of five themes collected from pre-pedagogical student interviews, a 17-week pedagogical intervention with accompanying student interviews and final post-pedagogical interviews with students and teacher as co-researchers. The overarching themes were:

1. Knowledge gained through Big History.
2. Values interpreted, in the context of local school values.
3. Catholic teaching and the emerging story of the universe.
4. Transdisciplinary learning and the emerging story of the universe.
5. Socioecological learning perspective viewed from conformative, reformatory and transformative learning platforms.

As discussed in Theme 5, socioecological learning, the teaching of the evolving scientific origin story empowered students to think beyond their conformative knowledge to a reformatory and, at times, transformative thinking about environmental education. This critical learning emerged through ensuing student interviews and they intertwined knowledge of Big History through the lenses of local school values, their learnt Catholic traditions and transdisciplinary skills and concepts aligned to the Big History Project.
Summaries at the conclusion of each theme outlined important stances, uncovered from student and teacher interviews, towards answering my overarching research question:

\textit{To what extent can the emerging scientific story of the universe inform children’s environmental knowledge and values through Catholic education?}

Directions for my final chapter, Chapter Six, were derived from the findings of the analysis in this current chapter and aligned to my subsidiary questions, as explained further in Chapter Six. The students’ immersion in the cohesive story of Big History learning enabled them to express confidence in their new, shared knowledge where they articulated a growing sensitivity to their own interconnection and interdependence as socioecological learners.

In Chapter Six I will address the major finding that intertwined the significance of all five themes, empowering students to interpret and inform their environmental education values from both a Catholic and local school values’ stance.
CHAPTER SIX

THE FUTURE STORY: SYNTHESIS OF THEMES, LIMITATIONS AND IMPLICATIONS FOR FUTURE RESEARCH

Introduction

This final chapter returns to my overarching research question and its accompanying subsidiary questions directing this thesis. It will be recalled in the personal orientation of my thesis (Chapter One), my initial inquiry stemmed from my subjective perspective as an experienced primary school teacher, within the Catholic school system. I was concerned that there is a need in environmental education research to address an all-embracing environmental story that incorporates much of the existing wide body of literature. I speculated that a scientifically based history of the universe would enable children to access a cohesive story, with the possibility of informing children’s environmental education knowledge and values.

My overarching research question therefore was:

To what extent can the emerging scientific story of the universe inform children’s environmental knowledge and values through Catholic education?

The subsidiary questions that guided the directions of my research were:

23 Please note in this final chapter I intersperse the following interchangeable terms, previously identified and cited in earlier chapters, as the ‘emerging scientific history of the universe’: ‘interconnected story’, ‘cohesive story’, ‘universe story’, ‘Big History’ and ‘the story of the universe’.
1. To what extent can teaching children critical knowledge of the emerging scientific origin story help them to interpret environmental education values within their knowledge of local school values and the Catholic education curriculum?

2. To what extent can the transdisciplinary nature of the emerging scientific story of the universe inform children’s environmental values as socioecological learners?

The above overarching research question and subsidiary questions provided the basis to research the extent children’s environmental education values can be informed through the lenses of a cohesive universe story, Catholic education curriculum, local school values, transdisciplinary learning and socioecological learning. The importance of these concepts was developed through my literature review and consequent theoretical framing and methodology, culminating in their emergence as five significant and nested themes in which to analyse my collected data. This chapter is framed around the following headings:

6.1 Summation of my thesis chapters;
6.2 Synthesis of the findings of the study in relation to research questions and theoretical framework;
6.3 Limitations of this study;
6.4 Possible future directions for further research in this area; and
6.5 Conclusion to this study.
I now turn to synthesise the evidence from my literature review, theoretical framework and research. I begin the task by providing a summation of my thesis chapters.

**6.1 Summation of my thesis chapters**

**Chapter One**

I introduced my thesis with an adapted summary of the Big History ‘universe story’ (2011a), to ensure the reader was familiar with the cohesive storyline that underpinned my personal orientation to my research. It is crucial that the conclusions in this chapter be understood in terms of the centrality of the history of the universe story; it underpins my justification of, and significance for further investigation beyond the extensive body of existing environmental education research. From my anecdotal experience as an environmental education coordinator in a Catholic primary school I saw that school environmental education was actively promoted within the philosophy of the Catholic primary school with the ‘what to do’ and ‘how to’ being addressed, but with only fragmented stories of ‘why’. In combining my new knowledge of an interconnected, evidence-based universe story with prior environmental education research, the directions for further research became apparent. My focus for my research therefore was querying the extent that a values-based and interdisciplinary curriculum in Catholic primary education could inform students’ environmental education values.

**Chapter Two**

In my literature review I collated the historical relevance of environmental education documents and polices from international, Australian and Catholic education
perspectives. In varying degrees across all platforms of research, there were contradictions regarding the anthropocentric viewpoint rating from major concern, disregard or ambivalence. This was a clear gap in environmental education research involving primary school education that needed to be addressed.

It was also evident that the acquisition of knowledge values and the current, popular term ‘sustainability’ have broad reaching significance for this study, especially in context of the cross-curriculum Australian Curriculum’s ‘sustainability’ priority. The curriculum’s acknowledgement to integrate sustainability within and across subjects, gave further credence for me to use an interdisciplinary focus for an evidence-based cohesive story that could potentially connect students meaningfully with the environment.

Two other factors added to the significance of the Australian Curriculum in this study, and hence the directions for my research. Firstly, the curriculum was underpinned by the values outlined in the Melbourne Declaration (MCEETYA, 2008) and secondly, that Catholic education is based on that curriculum (Sydney Catholic Education Office, 2017). When examining calls from both the wider body of environmental education literature (Earth Charter Commission, 2000) and Catholic environmental literature (Francis I, 2015) to integrate fragments of knowledge from the environmental story, there is clear evidence for a deeper examination of an interconnected emerging scientific story (Christian, 2017; Leiserowitz & Fernandez, 2008).
Chapter Three

I framed the third chapter for my thesis story by establishing links between the major concepts of values, curriculum, and whole systems theory, resulting in my theoretical framework. I adapted and linked Sterling’s nested levels of learning to the Catholic Church levels of ecological learning as previously summarised in Figure 3.10. This provided evidence of the significance for converging knowledge within the nested learning models of Sterling (2003) and Wattchow et al. (2014), alongside referenced Catholic Church ecological awareness, ecological consciousness and ecological conversion environmental education models. Catholic and secular primary education, environmental education, interdisciplinary whole systems theory and curriculum theory provided a multi-layered context to acquire the knowledge to address my research question.

A particular point that emerged from the development of my theoretical framework was the necessity to emphasise nesting in the importance of any data to be collected and analysed. The research I was to carry out therefore applied to examples in primary education that interacted within ontological, epistemological and methodological learning levels (Lewis, Mansfield, & Baudains, 2008; Sterling, 2016). It was vital that my research findings were to be examined through this nested lens, as opposed to being viewed within the light of a hierarchical structure. Big History was a significant factor in the contributions of my research to environmental education as it addresses the whole cohesive story of the universe history, as opposed to random and fragmented chapters traditionally taught in primary schools; an allegory to this is that educators do not read unrelated chapters of any other story to students at random.
intervals over the course of seven years of primary schooling therefore addressing my overarching question:

*To what extent can the emerging scientific story of the universe inform children’s environmental knowledge and values through Catholic education?*

**Chapter Four**

In Chapter Four I introduced the qualitative-based methodological design utilised to investigate the extent the emerging scientific story of the universe informed children’s environmental values through Catholic education. The chosen cyclical action research model was conducive to an ethnographic approach in investigating knowledge and values, as indicated in the local school environmental education context (Podger, Velasco, Luna, Burford, & Harder, 2013). The methodological design also embraced child-framed participatory research (Dickinson, 2013) where the child engaged in the research from both the prevailing cultural and Catholic tradition contexts, with the possibility that the pedagogical intervention would connect them to a wider, whole systems worldview (Sterling, 2003) of interrelationships as socioecological learners (Payne, 2015; Wattchow et al., 2014). My adaptation of the Big History Project (2015) for primary students addressed all of the above criteria, including the need for collecting data from observations, documentations and semi-structured interviews on the basis of shared knowledge involving critical enquiry-based learning.

**Chapter Five**

In Chapter Five I represented and analysed the data collected from six cyclical student interviews, recorded before, during and after a 17-week pedagogical intervention
along with one class teacher interview at the conclusion of the intervention. As I analysed the data a clear pattern of five nested themes emerged, consistent with my literature review findings and also addressing both my theoretical framing and grounding my research questions.

I expand on each of the two subsidiary questions below. I summarise the significant findings from the perspective of each question, within the analysis of my data and their consequential implications to add to the existing significant body of research within environmental education scholarship.

It will be recalled that the first subsidiary question is:

To what extent can teaching children critical knowledge of the emerging scientific origin story help them to interpret environmental education values within their knowledge of local school values and the Catholic education curriculum?

This question revolves around, and is nested in, the first three themes discussed in this chapter, which acknowledge the need for both informed, critical knowledge and students' knowledge of their Catholic understanding of God's creation, aligned to local school values. My conclusions in this final chapter address the following significant findings from Chapter Five analysis, through the lenses of the first subsidiary question and my developed theoretical framework:

- An overall need to view student learning as nesting of Ontological, epistemological and methodological learning where they could freely move from
one learning style to another, without it being seen as an hierarchical method. This became increasingly apparent from analysing student comments where they needed to refer to conformative, reformative and at times transformative learning to express their points of view and discuss views within a common learning and understanding. This nesting of conformative, reformative and transformative learning (Sterling, 2003, 2011) aligns with Catholic education documents and the call for ecological awareness, consciousness and conversion. Figure 3.5, illustrates this point and the importance of learning beginning with asking ‘why’ before asking ‘what’ and ‘how’ to teach.

- The growth in student interpretation and critical thinking about environmental education became clearer as the Big History pedagogical teaching intervention progressed through its 17-week cyclical learning process. Students increasingly articulated their understanding through the Big History cohesive story, vocabulary and essential skills and concepts.

- The awe and wonder of student learning presented a significant insight into students’ ability to think critically beyond the facts presented to them. Their critical thinking addressed the relevance of a curriculum theory that opened up the null curriculum of an emerging scientific origin story. It empowered students to gain critical knowledge and then apply that knowledge within a critical inquiry approach. The child-framed, critical enquiry learning methodology was critical to student responses in that they were not asked to ‘start over’ with new learning; rather, the evidence from their comments demonstrated that they were enabled to build on their previous knowledge of local school values and Catholic knowledge.
of Creation. Meeting the child “in the middle” became a crucial factor to children’s insightful comments in interpreting environmental education.

- Following on from the above point, embedding students’ new learning within the children’s existing familiarity and understanding of their own local school values and Catholic knowledge of Creation grounded their responses and interpretation of their new learning for this research.

The second subsidiary question it will be recalled is:

*To what extent can the transdisciplinary nature of the emerging scientific story of the universe inform children’s environmental knowledge and values as socioecological learners?*

In addressing this question, I expanded on the evidence, as outlined above from the first question, particularly the importance of teaching a cohesive Big History story, nested in familiar local school values, students’ Catholic understanding of Creation and child-framed critical enquiry learning. I predominantly focus on the last two themes of my data analysis: transdisciplinary learning and the socioecological learner to further extrapolate on:

- The students’ understanding and use of transdisciplinary concepts and skills in demonstrating their transformative thinking and possibility of transformative action or as stated in Catholic documents, ecological conversion.
- The significance of students’ indications that, during the pedagogical intervention they had developed a wider worldview, moving away from an anthropocentric stance, towards an understanding of whole-systems thinking. This is consistent
with socioecological learning that embraces a social ecological understanding of nature, sustainability of societies and wellbeing of the planet.

- The students’ broad and interactive discussions involving shared learning and vocabulary, indicating that Big History communicates to the learner how to think, not what to think (Baker, 2015; Benjamin, 2009; Blanks, 2016; Hawkey, 2014; Rogers, 2010).

I extrapolate on the above themes within the context of my overall synthesis of findings in the following section.

6.2 Synthesis of the findings of the study in relation to research findings and theoretical framework

The significant contributions of this research to environmental education address the theoretical research question rearticulated in Chapter Three of my research, namely:

*How does the emerging scientific story of the universe inform children’s socioecological values through the principles of whole-systems learning?*

Answering the above question requires the merging of my original theoretical framework (see Figure 3.10) with the identified themes from Chapter Five findings. Both the framework and themes are incorporated into Figure 6.1, representing the cyclical nested underpinning of my investigation, where, in answering questions, they also intertwine with the other themes and findings of the research.
Figure 6.1 helps explain the first three themes, critical knowledge, Catholic education tradition and environmental education values, nested in with the transdisciplinary and socioecological themes. They add noteworthy observations to both the first and second subsidiary questions.
The importance of student identified critical knowledge to my research data

It is clear from the data that students began the pedagogical intervention with fragmented knowledge and vocabulary related to the universe. In fact, pre-pedagogical interview excerpts show little interest from students in learning more, yet as they increasingly accessed complex knowledge of Big History they became engaged in their learning and were proud to see themselves as ‘experts’ in Big History. In developing a common vocabulary, within a cohesive deep timeline, students thrived in their enquiry, learning and knowledge of thresholds and increasing complexity to display critical thinking skills. The comments from Nadine, the co-researcher teacher verified the above points, as did my journal notes, about the importance of building the knowledge to then enable students to use technical language and informed viewpoints to discuss Big History.

In one of my journal entries as the pedagogical intervention had progressed I reflected on how children’s learnt knowledge was beginning to inform deep, enquiry learning. In that entry I had observed the possibilities for children to:

- Articulate how everything is interconnected;
- Display incredulity of increasing complexity;
- To be empowered in environmental agency and/or major philosophical environmental shifts; and
- Refer to environmental values, as encompassed in their school values displayed in the classroom.

In building on the field of a cohesive and shared language framework, the evidence emphasised the vital importance knowledge played in underpinning my research to a
deep-enquiry learning approach. This approach led to the possibility of addressing the second subsidiary research question from the viewpoint of a transformative wider worldview for the socioecological learner, including a deep sense of awe and wonder, as advocated by Ashley (2006), and connecting that same value to Catholic education, identified in my literature review (Catholic Education Office: Sydney, 2013b; Francis I, 2015).

My theoretical framework, which relied on Sterling’s (2003) emphasis on an interconnecting relationship among ontology, epistemology and methodology to create a systemic, wider worldview, in turn informed my data analysis, to critically reflect on how students articulated the shared new knowledge. There has been no previous analysis of using a shared child-framed knowledge base, from the perspective of Big History learning in the primary school; therefore, the findings are significant for future research. This aspect is especially relevant in light of Scott’s assertion (2009) that critical knowledge needs to be taught to reduce any concern that moral values could be simply ‘given’ to students, in contrast to students critically exploring and validating those values within a child-framed pedagogy (Hart, 2013; Kellett, 2011).

The foundations to observe and evaluate any reformative learning were underpinned by students’ Big History learning; any moves away from an anthropocentric epistemological worldview to an enquiry values based wider worldview were then appraised within the further themes analysed in the following sections.
The importance of students’ incorporating their Catholic viewpoint to my research data

In this second theme I investigated the extent students were empowered to transfer their previous knowledge of Creation from within the Catholic tradition with their emerging deeper knowledge of Big History.

Students’ growing knowledge of the interconnected Big History story is particularly relevant to providing evidence of the important contribution nesting of themes provided for this particular cohort of students. From my data analysis I ascertained that children readily moved between their previous conformative learning of the stories they related in initial interviews of how the universe came to be; in those interviews, although some students ably related some scientific knowledge of space and the universe, it was clear it was fragmented with no cohesive structure; all students therefore fell back to the default conformative, Christian story of the ‘seven days of creation’ because they had no interrelated storyline to connect their fragmented scientific knowledge to the origins of the universe. This is in spite of evidence from my literature review that both official Catholic documents and Catholic education documents, relating to environmental education promote the stance of the Catholic Church acknowledging science’s contributions to knowledge of the history of the universe, evolution and environment. It was actually reformative learning, as advocated by Sterling’s model of learning (2003, 2011), that connected student understanding with God as creator in the context of the wider worldview that the Big History story presented to them. Both co-researcher teacher interview comments and my research journal observations verified the above points.
The reformative learning was valuable in linking students’ interview comments of an understanding of a wider worldview to a richer sense of awe and wonder that transcended both their perceptions that the Big History story related of the field of science and importantly a deeper appreciation of the mystery and magnificence of God. They were very proud of their new learning and ‘how amazing God is to think all this up’.

**The importance of local school values to my research data**

The context of analysing values within a local school values’ framing emphasised the part that deep critical knowledge of Big History played in empowering children to explore and to analyse the crucial role of local school values. Through the agency of an embedded localised values system students ably used their familiar language of values to link their enquiry based learning of a cohesive Big History knowledge, which became increasingly evident during the cyclical student interviews.

The immersion of students’ understanding in local school values allowed students to think across silos of learning, in keeping with the advocacy of Wattchow et al. (2014) and Christian (2011), to ensure a deeper sense of environment and voluntary introduction of applying those values to the term sustainability as described above. The evidence found in analysing student interview transcripts of clear examples of reference to local values needed is in accord with Leiserowitz and Fernandez’ call to promote a new worldview and deeper connection of environmental education values (2008). Students were beginning to express that wider worldview, exemplified in Jemma’s written comment at the conclusion of the pedagogical intervention, about how attitudes and values could affect our sustainable future environment: “If we only
think about people we will have a terrible future. If we think about EVERYTHING (sic as written) we will have an amazing and sustainable future”. The significance of the nesting of themes is evident in the context of embedding local school values across subject disciplines (Catholic Education Office: Sydney, 2013a). This research contributes to the dilemma investigated by Gough (2011) of how to put sustainability education into a cross-disciplinary curriculum.

The integration of local school values into the Big History knowledge, concepts and skills (2015) was clearly identified by the co-researcher teacher, who had a thorough understanding of the local context and place the school values played in the everyday lives of the school community. This was invaluable to my research findings in that, although I spent periods of time over 17 weeks in the classroom, I did not possess the ‘insider’ knowledge and understanding of the permanent class teacher; her informed perspective was therefore vital to my understanding and subsequent interpretation that local school values’ language was indeed embedded, allowing students’ to critically interpret the knowledge learnt from a child-framed and deep learning standpoint (Kopelke, 2012).

In conclusion, I again return to my values-centred theoretical framework that relied on Sterling’s model of interrelating conformative, reformative and the possibility of a transformative worldview of learning (Sterling, 2003). In my data analysis I have continued to critically reflect on how students interconnected their shared Big History knowledge with the language of their familiar school values. From the perspective of Big History learning in the primary school, this aspect is especially relevant alongside Elliott’s stance (2007, p. 107) where a pedagogical intervention allowed for the
opportunity for values to be comprehended by students within the learning process, rather than as a product of the teaching intervention.

Synthesis of findings incorporating first three themes of knowledge,

Catholic teaching and values

The above three themes nested in the first subsidiary question where the data verified that the ethnographic and child-framed nature of the research produced concise evidence that all children gained critical knowledge of the emerging scientific origin story. The learnt shared critical knowledge and shared vocabulary that students gained from Big History, alongside its skills and concepts, encouraged child-framed discussion. This common knowledge enabled students of varying academic abilities to engage and to interpret environmental education values within their knowledge of their local school values of peace, respect, honesty, empathy, compassion, tolerance and love. Big History gave them the confidence to view both the classroom teacher and myself as ‘lead learners’ rather than ‘expert teachers’; this was clearly evident in the later recorded student interviews where they referred to themselves as ‘Big Historians’ who could tell others about the universe story.

Children’s Catholic stance on converging their critical knowledge of the universe story with Catholic teaching on that subject produced an unexpected student-initiated insight for this research. As interviews progressed the majority of children articulated, in varying degrees, transformative understanding of a deeper worldview where, of their own accord they had merged richer learning that enhanced their previous learnt Catholic tradition.
Transdisciplinary and socioecological learning

The last two themes of transdisciplinary and socioecological learning particularly address the second subsidiary question and, as previously stated, build upon the conclusions drawn from the first subsidiary question, incorporating the nesting of all themes within socioecological learning. The second subsidiary question is:

*To what extent can the transdisciplinary nature of the emerging scientific story of the universe inform children’s environmental values as socioecological learners?*

I now address the importance of the nesting of transdisciplinary learning to my research conclusions.

The importance of transdisciplinary learning to my research data

At the core of Big History learning is the students’ understanding and use of transdisciplinary concepts and skills in demonstrating their transformative thinking and possibility of transformative action/ ecological conversion. Students’ transdisciplinary skill of evidence–based, informed learning highlights the importance of a cohesive universe history, language and transdisciplinary learning skills framework.

There was strong evidence from students’ comments that they embraced the evolving universe story through the increasing complexity of Big History thresholds and came to realise that learning does not take place in silos; rather, they displayed evidence, within child-framed discussions, of their own increasing understanding of the importance of not fragmenting that story; hence they used their age-appropriate understanding and learning to interrelate a vast interconnected and complex creation
story where the Big History historical thresholds connected and informed their critical inquiry. This conclusion is in keeping with the assertions of Christian (2012), Leiserowtiz and Fernandez (2008) and Wattchow et al. (2014), that sustainable education is transdisciplinary and requires a socioecological framework that encourages collaboration of learning across academic disciplines, skills and concepts.

The crucial elements of embedding the Big History story into familiar local school values, including a particular Catholic perspective of the school community (Podger et al., 2010), led to a significant increase of child-appropriate led discussion. Their confidence gained momentum during the latter stages of Big History intervention interviews where students clearly articulated their personal connection with the shared story, and at times corrected others, in their descriptions of environmental issues. In doing so, there was an answer to my overall research question that the emerging scientific story of the universe had indeed impacted and informed children’s environmental values. Students articulated this point of view voluntarily on numerous occasions as they adjusted their own child-appropriate language to a post-humanist perspective of the environment in ‘needing to look after everyone … not just everyone… everything’. The evidence clearly showed there was a dramatic shift of consciousness from ‘seeing with their worldview’ to seeing ‘their worldview’. Although students differed in their understanding and knowledge of the universe at the pre-pedagogical interviews, it was evident that knowledge was fragmented, and no student had an evidence-based coherent story of the history of the universe. They all referred to the biblical version of the seven days of creation which displayed they drew upon personal and local cultural values to explain their understanding. Although there was concern from some teachers, that children’s Catholic values could be
interrupted by Big History teaching, the opposite was evident; in fact, children’s critical enquiry learning resulted in ecological consciousness, reformative learning and at times evidence of transformative thinking that embraced a greater awe and wonder of 13.8 billion years of God’s creation, as opposed to seven days. As I conclude my summation of the significance of this thesis, Benjamin’s words resonate once more, that the work of Big History education is to teach students ‘how’ to think, not ‘what’ to think (Benjamin, 2009). Students themselves articulated that the ‘bigger’ story amazed and surprised them, demonstrating their capabilities for deep learning at the ages of eight and nine. Their continuing enthusiasm of deep learning (Fullan & Langworthy, 2013; Kellett, 2010, pp. 91-92) led to them overcoming the barrier of null curriculum (Eisner, 1979; Sterling, 2003) and addressing the ontological and epistemological aspects of learning.

The importance of the socioecological learner to my research data

I contend that from both socioecological and whole systems approaches discussed in my literature review my research has empowered primary students to envisage a broader worldview of environmental education, situated within an inclusive educational model that Big History provides. Entwining the findings from the above four themes and taking into account the varying academic abilities of students, the holistic framework of those themes has produced evidence that students had become informed to enable them to critique their own thinking and new knowledge. Children’s participation and deep engagement in their enquiry learning, as evidenced in interview transcripts, transcended the conformative and reformative nested learning levels and leads to the ‘possibility’ of underpinning student socioecological learning for critical thinkers for the future as advocated in my theoretical framework (see Figure 3.9).
The place of socioecological learning within the evolving scientific origin story was central to culminating my research analysis as students aligned their knowledge of Big History, local school values, Catholic traditions and transdisciplinary skills and concepts.

One important acknowledgement of a change to socioecological understanding of values was evident in students’ language when they changed from their initial focus on human and the environment to a deliberate move in their vocabulary away from ‘everyone’ to an inclusive ‘everything’ and ‘everyone’; through the deep learning of time scales and the increasing complexity and interconnection concepts of Big History learning students generally changed their anthropocentric language to that of post-humanism, incorporating an inclusiveness of values for both human and non-human in our universe.

One other pertinent observation was that students acknowledged their initial limited understanding of the interconnection of the universe, which raises a concern for educators, that students need to understand the ‘why’ of sustainability and not become lost in the ‘doing’ without understanding the reasons for any action first. This reflection relates particularly to the need for educators not to be presumptuous in their thinking that children are disconnected from nature; rather, they need to meet children in the middle, as observed earlier (Deleuze & Guattari, 1988; Dickinson, 2013; Malone, 2016) within a child framed, ethnographical action research approach.
Synthesis of findings incorporating all five themes nesting in transdisciplinary and socioecological learning

In the preceding sections of this chapter I have correlated the five interdependent themes to synthesise my research. To this end, the conclusions of this thesis cannot be seen in isolation but within the combined findings from teaching children critical knowledge of the emerging scientific origin story help them interpret environmental education values within their knowledge of local school values and the Catholic education curriculum. Only then can the significance of the last two themes of transdisciplinary nature of the emerging scientific story of the universe inform children’s environmental values as socioecological learners.

I therefore propose that insights were significant in that they were viewed from within a child-framed pedagogical intervention. Children were thus empowered with a common learning platform to connect the new knowledge they had gained from Big History within the lenses of their embedded Catholic traditions and local school values. Building on this foundation the transdisciplinary and socioecological learning inspired students to critically reflect on their environmental values and query their previous assumptions of sustainability. This thesis is therefore valuable for educators and students in the primary education field where they can reflect on our common evidence-based universe (hi)story that is true to the heart of education as highlighted by Scott (2009), who contends that education needs to be at the heart of schooling; he poses the question that educators not only ask what can sustainability do for education but that the question also needs reciprocal rights of what can education do for
sustainability. In light of the findings presented, there is clear evidence of this reciprocity in children’s interview comments, where they used their common knowledge of the universe, shared story to critically enquire and evaluate that knowledge, not merely promote a cause, but to analyse their learning, nested within the three perspectives of conformative, reformative and transformative thinking paradigms. The evidence presented is heartening at a crucial time when we need our students’ learning to incorporate informed and shared values within a post-humanist environment.

Based on the findings of this study, Sterling’s writing resonates (2016) in that all learners need encouragement to develop informed engagement, agency and empowerment for sustainable change to occur. This view is also a validation of the relevance of imbuing Sterling’s whole systems thinking into my theoretical framework and relates directly to the interdisciplinary, critical inquiry approach of Big History (2015).

### 6.3 Limitations of this study

The results of my research addressed the extent that children’s values were informed by the coherent evidence-based Big History story in environmental education within a local school Catholic setting, the following limitations need to be addressed.

One limitation of the project was the restricted time available as the end of school year approached, swimming lessons and end-of-year school function rehearsals being two such examples. Students were therefore unable to share their learning and
reflections on environmental education values through a planned forum involving families and the larger school community. The co-researcher teacher and I decided any future teaching would need to begin earlier in the school year to avoid similar interruptions.

My decision to use a qualitative framework using a child-framed methodology was based on empowering students to voice their learning and to be heard as socioecological learners. In making this decision I also recognise the subjective nature of the data analysed and the limitations of data collection from such a small database. However, I believe the individual comments of students, alongside the interactive student-led discussions gave valuable insight to the changes in informed values added valuable insights at this emerging stage of the significance of Big History research in primary education.

My lonely journey into this emerging area of research was another area needing acknowledgement where it was necessary for me to grasp that I had gained expertise in the area of Big History in the primary school and that it was a little known topic where others actually looking to me to ‘produce’ rather than ‘collaborate’ as I had been expecting. Due to the lack of widespread knowledge and affirmation of Big History as a valued learning framework, it was difficult for me to have my intended research acknowledged by both Catholic education and state education authorities and individual schools; in fact, I approached many schools before my research and resulting pedagogical intervention were seen in the light of authentic and relevant education. The lack of a recognised, evidence-based and systemic educational framework became increasingly obvious as the research progressed.
The reticence of Catholic schools in particular was articulated as not wanting to counter the beliefs of parents and some staff and parish priests associated with the school, even though I had produced official Catholic documentation, particularly Pope Francis I’s latest official document on caring for our earth (Francis I, 2015). This limitation continued to be articulated by some members of staff where my actual research took place. I was very appreciative that I had a supportive co-researcher teacher and principal who collaborated with me. In hindsight I may have overcome the disinterest and concerns of some staff by holding a pre-research discussion to validate the educational worth of my project. Regarding parents, there were no objections to teaching the Big History course to the class before or during the intervention, which was a positive sign.

A limitation for my data collection was that, although I had planned for my co-researcher teacher to use the research journal as a joint project, in reality her days were so busy that there was no time for this to happen. In order to compromise, we would meet most days I visited the classroom, and I would subsequently document any findings from that meeting in the journal. We would also email regularly, and, with her consent, any relevant comments were pasted into the electronic journal, including both of us addressing her concern that the program needed to cater for children whose first language was not English.

I believe that the research program would have run more smoothly if I had been conducting my research within the wider parameters of a regular class teacher practising action research as such. Although I had produced an evolving Big History
electronic curriculum, which the co-researcher teacher and I adapted as the project progressed, I was aware of the valuable student observations I may have missed on days I was not present in the classroom.

### 6.4 Possible future directions for further research in this area

The findings of this thesis suggest further research paths, particularly in view of the knowledge that this is the initial study at PhD level into teaching the cohesive Big History story in primary education. The holistic and nested nature of the inquiry, allude to a breadth of future directions; however, I outline below the areas that I have identified as significant.

**Implications for future classroom practice and research**

The findings from my research validate that teaching Big History not only promotes academic knowledge of the emerging story of the universe. Through the power of socioecological learning Big History informs the values of primary-aged students to invite the possibility of transforming their worldviews from a narrow anthropocentric view to an understanding of human and nonhuman interrelationships and interdependence. The child-framed interviews and written reflections from students, at the conclusion of the project, further demonstrated the significance of their learning at all levels of the learning continuum, including both academically challenged and gifted students. My data analysis in Chapter Five was inclusive of students with a broad range of learning abilities who all took pride in their Big History learning within a transdisciplinary perspective and transferred the implications for their learning across the disciplinary silos. This was particularly significant in its
implications for meaningfully addressing environmental education through the child-framed lens of school-based values and the transdisciplinary framework of Big History. I include the following extracts to demonstrate the children’s conclusions noting their newfound sense of empowerment through Big History:

*Imogen:* I can tell my family things they didn’t know … I’m a Big Historian now! :) [sic]… It’s fun and interesting! We need to know about evolution and elements because we need to know where we came from.

*Gabby:* I know all the thresholds now and some people can’t learn Big History so I am very grateful; and I think we should now teach everyone … and we should use these thresholds to care for our future environment to make a better universe.

(Post-pedagogical written evaluation, 16 November, 2016)

Teaching Big History to primary students provided effective experiential learning across multiple discipline areas, particularly when related to local school values and environmental education. However, implications from this research indicate that researchers and educators in primary schooling need to be provided with educational models and empowered with more training to effectively use Big History as a teaching tool. They require embedded support mechanisms that are authentic to critical enquiry learning, ensuring the socioecological learner, not the anthropocene, is at the heart of the teaching and learning and that Big History is embedded into a transdisciplinary curriculum, not merely as an add-on. Although beyond the current parameters of my research findings, an important element emerges for teacher training. Teacher education needs to empower both pre-service and qualified teachers with the knowledge and confidence to apply transdisciplinary learning, already embedded in contemporary curricula, to the emerging scientific history of the universe in the primary school classroom.
In addressing the above and following implications for future classroom practice and research, Macquarie University Big History Schools Project (2018) is worthy of ongoing research as it promotes a supportive and holistic primary education curriculum as part of its K-12 coverage. This project is particularly relevant to future research following on from some major conclusions from my research, including multidisciplinary, cross-curriculum, interdisciplinary and transdisciplinary curricula, alongside an inclusive platform that supports local, national and global education systems. Future research requires further qualitative and quantitative studies into teaching the universe story that examine how success is managed and maintained throughout a student’s primary schooling years. Follow up studies would be valuable as to the extent that children’s values in environmental education are transient or long lasting through the possibility of transformative action in environmental education. These studies would necessarily address any further action needed.

An added implication from this present study is that it focused on the extent that primary-aged students’ ecological awareness could grow into a consciousness and possibility of conversion to transformation in putting values into action. By conducting my research in a Catholic primary school I was therefore able to address concerns from some schools I had approached, as outlined in Chapter Four, that Catholic schools may not be mandated to teach within a Big History-based scientific model. The interviews, as discussed in the analysis, provide evidence that students were empowered through the knowledge gained from evidence-based scientific history of the universe; they used this knowledge to embrace their understanding of sustainability and religious education and articulate an enriched worldview,
encompassing an amazing awe and wonder of what God has created, alongside the values needed for a sustainable world.

Although Catholic education validifies this stance from official documents cited in my literature review, it is hoped that the positive findings of this study at a primary school level may add credence to encourage Catholic educators that they continue to address ongoing concerns of some staff, parents and wider community on this issue. One line of inquiry, in addressing this issue, would be for Catholic Education universities and systems to conduct research into the understanding that pre-service and qualified teachers have of confidently teaching religious education within a transdisciplinary, socioecological framework. Such a framework has the potential to empower students to make connections with their current beliefs and values, at the same time allowing for a possible correlation with a post anthropocentric wider worldview.

One final but substantial implication for future investigation is that this current thesis has broken new ground into adding original, significant literature to environmental education research beyond Catholic education. As emphasised throughout the theoretical framework, primary-based Catholic education is mandated to teach the Australian curriculum. Therefore, in referring to the previous paragraph my research relates to all Australian primary schools. This initial pedagogical intervention involving one class of Year Three students has the possibility for further study, immersing all primary aged children in the emerging story of the universe and planting a seed, beyond the anthropocene. Further inquiries need to critically evaluate and broaden further implications of studying Big History in primary school, district and systemic education systems.
6.5 Conclusion to this study

There is clear evidence that this research raises significant innovative issues, requiring address by all primary schooling systems, if environmental education is to be viewed from both the wider shared universe story and inclusive, transdisciplinary socioecological learning perspectives.

The emerging scientific story of the universe is a story of the past and present informing the future through socioecological learning where action requires love, understanding and, equally as important, cohesively taught critical knowledge as emphasised in the following quote:

> It is essential to seek comprehensive solutions which consider the interactions within natural systems themselves and with social systems … We lack an awareness of our common origin, of our mutual belonging, and of a future to be shared…. A great cultural, spiritual and educational challenge stands before us, and it will demand that we set out on the long path of renewal.

(Francis I, 2015, pp. 139 - 202)

The quote from Pope Francis I summarises my new-found hopes stemming from this research: that Catholic primary school education systems and education broadly take up the challenge to critically evaluate the teaching of a cohesive and interconnected (his)story of our universe that challenges the socioecological learner to critically inquire beyond anthropocentric models of learning and to embrace interrelated critical knowledge, local and systemic values alongside transdisciplinary concepts and skills.

The wider implications from this research provide evidence that the deep time
learning of Big History is accessible and relevant to primary-aged students within a child-framed deep learning pedagogy that informs environmental values for current and future learning. This is the essence of the ‘why’ of environmental education; if educators are to truly comprehend the values of the socioecological learner, education needs to be embedded in sustainability whilst also embedding sustainability in education.
REFERENCES


Board of Studies, N. (2014). *Geography K–10 draft syllabus for consultation: July – August 2014*. Sydney, NSW: Board of Studies, Teaching and Educational Standards NSW.


Henderson, R., & Danaher, A. (2011). Chapter 1: Contemporary educational research: Selected tactics and tools for traversing and transforming the terrains *Troubling terrains: tactics for traversing and transforming contemporary educational research* (pp. 1-15). Teneriffe, Qld, Australia.


Radio Vaticana (Writer). (2014). Pope at Audience: If we destroy Creation, it will destroy us [radio transcript].


Victorian Department pf Education.

Vygotski, L. (1972). *Thought and language: revised and expanded edition*

Wallette, A., & Edgren, L. (2013). *Postmodernism, globalization and the*
metanarratives of global-world-transnational and Big History. Retrieved from
https://lup.lub.lu.se/student-papers/search/publication/3810823

http://watersfoundation.org/


Cutter-Mackenzie, & J. O'Connor (Eds.), *The Socioecological Educator: A*
21st Century Renewal of Physical, Health, Environment and Outdoor
*Education* (pp. i-vi). Dordrecht: Springer Netherlands: Springer.

Wattchow, B., Jeanes, R., Alfrey, L., Brown, T., Cutter-Mackenzie, A., & O'Connor,
J. (Eds.) (2014). *The socioecological educator: a 21st century renewal of*
physical, health, environment and outdoor education. New York: Springer

*155*.(3767), 1203-1207.

places, spaces and nature connections. Southern Cross University, Lismore.

Qualitative Research: Interpretive and Critical Approaches. New York:
SAGE Publications.

Wooden, C. (2014). Pope says schools must show connection of truth, goodness,
http://www.catholicnews.com/data/stories/cns/1401937.htm

Wraga, W., & Hlebowitsh, P. (2003). Toward a renaissance in curriculum theory and


APPENDICES

APPENDIX A:

Phases of the research: pre and post-pedagogy intervention, including semi-structured interview prompts

NB: the following are possible prompt questions to draw on student responses. *Black italic print is actual wording and blue print is prompts for the researcher.*

**Phase 1: Pre-pedagogy intervention student semi structured interview**

*Introduction*

Thank you for agreeing to take part in this survey *(child’s name)*. I’m studying about our universe at university and this interview is for you to share your ideas about the universe. Remember, if at any time you feel you don’t want to be part of this research about the universe please come and talk to me, or your teacher, or ask your parents to speak to one of us.

*Introductory questions to set student at ease e.g.:*
1. How old are you?
2. How many people in your family?
3. Tell me about your favourite things you like to do at home/at school.

*Research activities:*

1. **Tell me:**
   *Tell me what you know about our universe.*

2. **Mind map activity:**
   *Have you drawn mind maps before? This is a mind map of what I have learnt about your school.*

   (display and explain the format of a mind map if the student does not know what a mind map is.)

   *Can you draw a mind map (or a picture with labels if student seems confused with the request) showing everything you know about our universe? Remember this is not a test – it’s to give your teachers an idea of what you already know so we know where to start our unit of work about the universe.*

   *(Example probing starters/prompts:)*

   *You could add:*

   *I know; I would like to know; How I feel when I think about the universe; How others may feel when they think about the universe; What is important to humans in our universe; Why it is important “)*
3. **Compass activity for 'My compass for my future'.** Use a page of Jeannie Baker’s picture book ‘Belonging’. Can you tell me about this picture? What would it be like for you to live here? Prompt examples: “home, school and community” for each compass point (Nature, Economic, Social, Well being). Invite the student to choose and overhead transparency picture of a modern development that he/she could overlay onto the bushland picture. What would happen to the bushland if you were to add this building/road etc.? Prompt examples: Do you think there would be any problems for the home/community? Would it affect Nature, Economic (money needed), you socially, your well being? Record child’s answers on a compass proforma, as appropriate.

4. **Universe Hero Badge activity**

   Example probing questions/discussion points:

   - Do you know any heroes?
   - What attitudes do heroes need?
   - What qualities/values do they need?
   - What choices do they need to make?
   - Can you use this circle to create/complete a hero badge for a universe hero? Can you draw your hero showing the most important thing he is doing? What important words would you include?

   Thank you for sharing your ideas. I really appreciate your willingness to share your ideas about the universe. Remember, if at any time you feel you don’t want to be part of this research about the universe please come and talk to me, or your teacher, or ask your parents to speak to one of us. Even though I am using your ideas for my university study, your name, other students’ names and the name of your teacher and the school remains a secret.
1.1: Pre-pedagogical group interview sheets
### 1.2: Values cards for pre-pedagogical interviews

<table>
<thead>
<tr>
<th>Share</th>
<th>Speak and act honestly.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peace</td>
<td>Celebrate our world</td>
</tr>
<tr>
<td><strong>Respect our environment</strong></td>
<td>Choose wisely to keep everyone safe.</td>
</tr>
<tr>
<td><strong>Speak out when something is unfair.</strong></td>
<td>Respect other people.</td>
</tr>
<tr>
<td><strong>Understand other people better.</strong></td>
<td>Treat each other fairly.</td>
</tr>
<tr>
<td>Love</td>
<td>Care for others.</td>
</tr>
<tr>
<td>Wonder</td>
<td>Problem Solving</td>
</tr>
<tr>
<td><strong>Care responsibly for all creatures</strong></td>
<td>How humans live is important for our earth.</td>
</tr>
<tr>
<td><strong>We are related to all of creation.</strong></td>
<td>Spend time in our environment.</td>
</tr>
<tr>
<td><strong>Reduce, reuse, recycle</strong></td>
<td><strong>Everyone needs to cooperate.</strong></td>
</tr>
<tr>
<td>----------------------------</td>
<td>---------------------------------</td>
</tr>
<tr>
<td><strong>How our world works.</strong></td>
<td><strong>Appreciate our Environment</strong></td>
</tr>
<tr>
<td><strong>Future inventions are important.</strong></td>
<td><strong>Our health is affected by our environment.</strong></td>
</tr>
<tr>
<td><strong>Humans help save our environment.</strong></td>
<td><strong>Humans can damage our environment.</strong></td>
</tr>
<tr>
<td><strong>Understand our world.</strong></td>
<td><strong>All people are connected.</strong></td>
</tr>
<tr>
<td><strong>We are connected to nature</strong></td>
<td><strong>Tolerate other people</strong></td>
</tr>
</tbody>
</table>

**Phase 2:** Ongoing observation of student learning through discussions, student journals and activities to be recorded in participant-researcher and teacher field study journals.
Phase 3: Post evaluation, semi-structured interview

Use of Pre and Post-assessment Mind map, Compass activities; Use Big History journals in individual Semi-structured interview questions, as a guide for researcher and student.

Thank you for agreeing to take part in this survey __ (child’s name)__. Remember I told you that I’m studying about our universe at university and this interview is for you to share your ideas again about the universe. Remember, if at any time you feel you don’t want to be part in this interview about the universe tell me, or your teacher, or ask your parents to speak to one of us.

Introductory questions to set student at ease e.g.:

Research activities:
1. **Tell me:**
   
   Tell me what you’ve learnt about our universe.

Prompt examples.

- What have you learnt about the universe from Big History?
- Can you describe your feelings about learning Big History/about the universe?
- Can you tell me more about what you learnt?
- Tell me about the important words you have learnt in Big History. Can you explain why those words are important to you?
- How would you describe Big History to your parents/the school principal?
- Would you recommend Big History be taught to primary school children?... What are your reasons?
- Can you explain how your universe Mind map has changed?
- Can you explain your sustainability compass for your future? How has it changed? Why?
- Draw me a picture to show what you have learnt in BH.

Have picture books read during pedagogical intervention, on display copies of school value posters, original universe and environment forms children filled in at pre interviews: discuss in context of following questions and allow children to refer to any of the above materials to explain their thinking and opinions.

1. Now we have learnt Big History:
   a. What is the most important thing you have learnt about the universe? What does 13.8 billion years of Big History tell you about yourself/about us?
   b. What else have you learnt about the universe?

2. Now we have learnt Big History:
   a. What is the most important thing you have learnt about the environment? How does knowing so much about the past change the way you think about the future?
   b. What else have you learnt about the environment?

3. Remember the book called ‘Just a Dream’ that we shared in class? (show book).
   a. Can you tell me how the children in the story showed how they valued/didn’t value, the importance of caring for our future sustainable environment?
Prompt examples:

1. Walter tossing a wrapper on the ground
2. Walter making fun of Rosie
3. Rosie planting a tree
4. Different places Walter flew to in his bed
5. Walter’s birthday party

b. How can our school values help us decide how we think about a sustainable future environment?

4. Can you tell me how Big History learning is important for you when you think about the future?

Big History is important for children in Year 3 to learn because… I wonder what the next Big History threshold could be…. What role could you/children your age play in the future?

5. Universe Hero Badge questioning

When I interviewed you, before we started our Big History learning, we talked about what a universe hero would value and what choices they would make. I want you to imagine now you are a Universe hero. Now you have learnt about Big History:

- What do you now think about:
  The values you need?

  The choices you need to make?

  Words to describe you as a universe hero?

- What is the most important thing you would do as a universe hero to help our sustainable future? … Why?..

Thank you for sharing your ideas. I really appreciate your willingness to share your learning about the universe. Remember, if you feel you don’t want to be part of this research about the universe please come and talk to me, or your teacher, or ask your parents to speak to one of us. Even though I am using your ideas for my university study, your name, other students’ names and the name of your teacher and the school remains a secret.
APPENDIX B:
Participant information, consent forms and withdrawal of participation forms

Participant Information Sheet and Consent Form
(For students and parents)

Research Project Title: An Tairseach (Threshold): An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education.

Principal Investigators: A/Prof Amy Cutter-Mackenzie and Ms Marilyn Ahearn

| Invitation to Year 3 students to participate in this university research project |

Year 3 students are invited to participate in the above classroom-based research project. The students are invited to be research participants on this project, which is aimed at assessing the extent to which students’ values in environmental education can be informed by explicitly teaching them the emerging scientific story of the universe. The ten-week unit of work will be taught to the students in their normal classroom setting by their class teacher and myself and complies with the content and skills requirements of the NSW Board of Studies Australian Curriculum for Year 3. I will gather data from students’ journals, teacher and student observations and two semi-structured individual interviews I will conduct with each student. Analysis of data will centre on gaining students’ views and ideas, noting any perceived changes in their environmental education values over the ten-week unit of teaching.

This research project has been considered important by a university review panel in the light of the new Australian Curriculum emphasis on values education and its call for a wider worldview and integrating student learning that can inform other relevant subject areas. Catholic primary schools’ values are
particularly relevant for this study because the Religious Education curriculum specifically teaches about God’s creation of the universe and promotes the call of the Catholic Church for environmental/ecological consciousness and conversion; a unified, cohesive scientific account of the universe can therefore enhance student learning in this area.

The research project will be investigated in three phases:

Research Phase 1 – before teaching the unit of work:

- Individual student, semi-structured videoed interviews with prior to teaching the emerging history of the universe unit using:
  - Individual student mind maps prior to the teaching of the unit to establish student thinking and attitudes about the universe.
  - Student drawings showing what they know about the universe. This task takes into account students who find it difficult to respond verbally or in writing.
  - The making of a “hero badge”.

Research Phase 2 – during the teaching of the ten-week unit of work:

- Ongoing class teacher and researcher observations of student activities during teaching of the unit to be recorded in the researcher’s journal.
- Observations of student individual “Universe journals”. The recording of individual students’ perspectives and interpretations will be monitored by the class teacher and researcher as the unit progresses.

Research Phase 3:

- A repetition of phase 1: individual student, semi-structured videoed interviews with the researcher after completion of the teaching of the ten-week unit of work to establish primary students’ environmental and ethical values.
  - Individual student mind maps after completion of the teaching of the unit to establish student thinking and attitudes about the universe.
  - Student drawing showing what they know about the universe. This task takes into account students who find it difficult to respond verbally or in writing.
  - The making of a second “hero badge”.

There are no costs associated with participating in this project, nor will you or your child be paid.

Participating students will be requested not to share personal information or photos of others as part of their role of research participants in this project to protect people’s privacy. They will be expected to interact with the research team (other students from the class and the university researchers) in a respectful manner. If a student does not wish to answer a question or respond to a comment, either in an interview or during class observations, they may decline and continue with other aspects of the research, or they may stop their participation in the project immediately. If your child becomes upset or distressed as a result of their participation in the study, you should contact the class teacher and university researchers.
Participation in any research project is voluntary. No student will be disadvantaged by not participating in the project. It is up to you and your child to decide whether or not they will take part in this project. If you do decide that your child can take part, then you and your child need to complete the Consent Form attached. Students and parents can decide to stop participation in the project at any stage and will not be disadvantaged by withdrawal from the project.

If you wish to withdraw your child from this study please advise the study team. If you decide to withdraw your child from the project, the researchers would like to keep the information your child has contributed (photos, commentary and discussion responses). If you do not want them to do this, you must tell them before you withdraw from the research project. However it may not be possible to remove some material once recorded (group meeting recordings, etc.).

The material collected in the study will be used to develop a PhD thesis about the project. Extracts from the thesis may be used to produce journal articles and presentations about this project for the Australian and international education community. The School Principal will be presented with a copy of the project thesis when completed. In any publication and/or presentation, information will be provided in such a way that your child cannot be identified. No images of persons will appear in any reports or presentations (pictures or video footage) if they have not given prior consent. The results for this particular project may also be used in other research projects and/or publications. Any information obtained in connection with this study project that can identify your child will remain confidential. Only the research team will have access to this data, which will be securely stored for at least 7 years. All data will be destroyed after this period. Your child’s information will only be used for the purpose of this study project and it will only be disclosed with your permission, except as required by law.

Contact for further information:
If you would like any further information on this study you may contact Marilyn Ahearn or Amy Cutter-Mackenzie at: marilyn.ahearn1@scu.edu.au or amy.cutterm@scu.edu.au

All research in Australia involving humans is reviewed by an independent group of people, called a Human Research Ethics Committee (HREC). This research has been approved by the Southern Cross University, Human Research Ethics Committee (HREC). The approval number is _______. The School
Principal has also reviewed and approved the project.

Complaints about the ethical conduct of this research should be addressed in writing to the following:

Ethics Complaints Officer
HREC
Southern Cross University
PO Box 157
Lismore, NSW, 2480
Email: ethics.lismore@scu.edu.au

All complaints are investigated fully and according to due process under the National Statement on Ethical Conduct in Human Research and this University. Any complaint you make will be treated in confidence and you will be informed of the outcome.
Research Project Title: *An Tairseach (Threshold): An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education.*

Principal Investigators: A/Prof Amy Cutter-Mackenzie and Ms Marilyn Ahearn

NOTE: This consent form will remain with the Southern Cross University researchers for their records

I agree to participate in the following areas of the research project:

- An individual videoed interview with Ms Ahearn, the researcher
- To allow my class teacher and Ms Ahearn to observe my learning in the ten-week unit of work about the history of the universe.
- A second individual videoed interview with Ms Ahearn, the researcher

I understand that participation is voluntary and that I can choose to withdraw from the study at any stage of the project without being disadvantaged in any way.

I understand that any material that the researchers use from the project for use in reports or published findings will not, under any circumstances, identify me. No images will be used unless a photo release form has been completed.

I understand that any information I provide is confidential, and that no information that could lead to people knowing who I am will be disclosed in any reports on the project, or to any other party.

**Student Consent**

I agree to take part in the Southern Cross University research project

Student’s Name: ________________________________
Signature: __________________ Date: ____________

Parent/Guardian Consent

I freely consent for my child to take part in the Southern Cross University research project specified above. I have (please tick off each item to indicate your agreement):

☐ I/we have read the attached Participant Information Sheet outlining the nature and purpose of the research study and I understand what my child is being asked to do.

☐ I/we have discussed the project with our child and she/he is happy to participate.

☐ I/we have been informed about the possible risks of my child taking part in this study.

☐ I/we have returned the Photo, Video and Work Samples Release Form with signatures completed.

☐ I/we have retained the Participant Information Sheet for my/our records.

☐ I/we understand I/we may withdraw my/our child form participating in the research at any time.

Parent/Guardian’s Name:

Signature: __________________ Date: ____________

Two copies provided for each participant - researcher keeps the signed copy and parent/s, guardian/s keep a copy of this letter for follow up if needed.
I grant permission to Southern Cross University researchers, Amy Cutter-Mackenzie and Marilyn Ahearn to use the digital photographs and/or videos taken of my child, or of my child’s written work, in the course of the classroom Research Project titled: An Tairseach (threshold): An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education. I understand that these images may be reproduced in publications generated from this research (report or conference presentation for example). No participant will be identified.
If you agree to us using your images in this way, please sign below where indicated.

__________________________
Student Consent

☐ I agree to Southern Cross University researchers, Amy Cutter-Mackenzie and Marilyn Ahearn using and reproducing photos and images of me and of my written work as explained above.

☐ I do not agree to Southern Cross University researchers, Amy Cutter-Mackenzie and Marilyn Ahearn using and reproducing photos and images of me and of my written work as explained above.

Signature: ______________________________________

Name: ______________________________________

School: ______________________________________

Date: ______________________
Parental/Guardian Consent

☐ I/we agree to Southern Cross University researchers, Amy Cutter-Mackenzie and Marilyn Ahearn using and reproducing photos and images of my/our child and of his/her written work as explained above.

☐ I/we do not agree to Southern Cross University researchers, Amy Cutter-Mackenzie and Marilyn Ahearn using and reproducing photos and images of my/our child and of his/her written work as explained above.

Signature: ______________________________________________________________
Name: _________________________________________________________________
School: _______________________________________________________________
Date: __________________________
WITHDRAWAL OF PARTICIPATION

Research Project Title: An Tairseach (Threshold): An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education.

Principal Investigators: A/Prof Amy Cutter-Mackenzie and Ms Marilyn Ahearn

I hereby wish to WITHDRAW my intent for my child ____________________________ to participate further in the above research project.

Child’s Name: ____________________________
(printed)

Parent/Guardian Name: ____________________________
(printed)

Signature of Parent/Guardian: ____________________________ Date: __________

If a verbal withdrawal:

In the event the participant decided to withdraw verbally, please give a description of the circumstances.

Coordinating Investigator to provide further information here

Participant’s name (printed):
Letter to School Principal:

(Date)

Principal/Chairperson
[School address]
Dear [name of Principal/Chairperson]

Research Project Title: An Tairseach (Threshold): An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education.

I am a PhD candidate, attached to the Education faculty at Southern Cross University, Lismore and am seeking your assistance for a research project exploring the connection of the emerging scientific story of the universe to values in authentic Catholic primary school environmental education. I have committed support from my SCU supervisors, Associate Professor Amy Cutter-Mackenzie and Dr Bradley Shipway, who regard my research as highly significant for environmental education and Catholic primary education.

My research is based on Environmental Education, Religious Education and the ground-breaking, interdisciplinary Big History Project, which explores the emerging scientific history of the universe. Macquarie University has pioneered this project at both university and secondary levels and is committed to promoting it in primary education in 2015. I have a good working relationship with the Big History Institute at Macquarie and they assure me that they are very excited that I am undertaking practical classroom research. My research will evaluate the extent to which students’ values can be transformed through teaching a wider worldview of the history of our universe, creating the possibility of interrelationship and connectivity with all creation.

This research project has been considered important by a university review panel in the light of the new
Australian Curriculum emphasis on values education and its call for a wider worldview and integrating student learning that can inform other relevant subject areas. Catholic primary schools’ values are particularly relevant for this study because the Religious Education curriculum specifically teaches about God’s creation of the universe and promotes the call of the Catholic Church for environmental/ecological consciousness and conversion; a unified, cohesive scientific account of the universe can therefore enhance student learning in this area. My review of current literature clearly identifies a mandate, from official teachings and documents of the Catholic Church, for Catholic schools to foster ecological consciousness and conversion.

My intended research outline is classroom-based, child-centred and participatory, with the classroom teacher, students and myself all being participants. My project is specifically oriented to integrating your school’s values. I would appreciate initial collaborative meetings and planning, to discuss school values and indicators relevant to those values, with school executive and class teacher, at whatever level the school management and teacher decide would be needed.

The ten-week unit of work would be taught to the students in their normal classroom setting by the class teacher with support by myself and complies with the content and skills requirements of the NSW Board of Studies Australian Curriculum for Year 3. I will gather data from students’ journals, from the class teacher, student observations and from two semi-structured individual interviews I will conduct with each student. Analysis of data will centre on gaining students’ views and ideas, noting any perceived changes in their environmental education values over the ten-week unit of teaching.

The research project will be therefore be investigated in three phases:

Research Phase 1 – before teaching the unit of work:
- Individual student, semi-structured videoed interviews with prior to teaching the emerging history of the universe unit

Research Phase 2 – during the teaching of the ten-week unit of work:
- Ongoing class teacher and researcher observations of student activities during teaching of the unit to be recorded in the researcher’s journal.

Research Phase 3:
• A repetition of phase 1: individual student, semi-structured videoed interviews with the researcher after completion of the teaching of the ten-week unit of work to establish primary students’ environmental values.

There are no costs associated with participating in this project.

Participating students will be requested not to share personal information or photos of others as part of their role of research participants in this project to protect people’s privacy. They will be expected to interact with the research team (other students from the class and university researcher) in a respectful manner. If a student does not wish to answer a question or respond to a comment, either in an interview or during class observations, they may decline and continue with other aspects of the research, or they may stop their participation in the project immediately. If a child becomes upset or distressed as a result of their participation in the study, parents should contact the class teacher and the university researchers.

Participation in any research project is voluntary. No student will be disadvantaged by not participating in the project. It is up to parents and their child to decide whether or not they will take part in this project. If they do decide that their child can take part, then they need to complete and return a Consent Form. Students and parents can decide to stop participation in the project at any stage and will not be disadvantaged by withdrawal from the project. If they wish to withdraw their child from this study they are asked to advise the study team using the Withdrawal of Participation form. If they do decide to withdraw their child from the project, the researchers would like to keep the information the child has contributed (photos, commentary and discussion responses). If the parents do not want this, they must tell the researcher or class teacher before withdrawing heir child from the research project. However it may not be possible to remove some material once recorded (group meeting recordings, etc.).

The material collected in the study will be used to develop a PhD thesis about the project. Extracts from the thesis may be used to produce journal articles and presentations about this project for the Australian and international education community. The School Principal will be presented with a copy of the project thesis when completed. In any publication and/or presentation, information will be provided in such a way that children cannot be identified. No images of persons will appear in any reports or presentations (pictures or video footage) if they have not given prior consent. The results for this particular project may also be used in other research projects and/or publications. Any information
obtained in connection with this study project that can identify a child will remain confidential. Only
the research team will have access to this data, which will be securely stored for at least 7 years. All
data will be destroyed after this period. A child’s information will only be used for the purpose of this
study project and it will only be disclosed with parental permission, except as required by law.

Contact for further information:
If you would like any further information on this study you may contact Marilyn Ahearn or Amy
Cutter-Mackenzie at: m.ahearn.10@student.scu.edu.au or amy.cutterm@scu.edu.au

All research in Australia involving humans is reviewed by an independent group of people, called a
Human Research Ethics Committee (HREC). This research has been approved by the Southern Cross
University, Human Research Ethics Committee (HREC). The approval number is _______.

Complaints about the ethical conduct of this research should be addressed in writing to the following:
Ethics Complaints Officer
HREC
Southern Cross University
PO Box 157
Lismore, NSW, 2480
Email: ethics.lismore@scu.edu.au

All complaints are investigated fully and according to due process under the National Statement on
Ethical Conduct in Human Research and this University. Any complaint you make will be treated in
confidence and you will be informed of the outcome.

Through participation in this research, it is hoped that the school will gain new and specific
information about issues involved in values education, with specific emphasis on Religious Education
and environmental education. The class teacher’s ongoing feedback on the study will be welcomed,
with opportunities provided for her/him to read all researcher observations during the ten-week
teaching unit, any draft reports and to contribute impressions of any observations of students. As such,
for the purpose of this research, the teacher would be seen as a teacher, research participant.

If you have any questions regarding the project please feel free to contact me.
Thank you for taking the time to read this letter and your anticipated support for this research project.

Thank you for considering my research plan,

Yours sincerely,

Marilyn Ahearn

Principal/school consent form

I, ______________________________________ have read the information above.

Any questions I have asked have been answered to my satisfaction. I agree to the research being conducted at this school. However, I understand that I may change my mind and withdraw at any time.

I understand that all information provided is treated as confidential and will not be released by the investigator unless required to do so by law.

I agree that research data gathered for this study may be published, provided names of participants or other information, which might identify them is not used.

Signed: ___________________________________ Date: ___________________

Two copies provided - researcher keeps the signed copy and Principal keeps a copy of this letter for follow up if needed.
Letter to Year 3 classroom teacher

Date
[School address]

Dear [name of classroom teacher]

Research Project Title: *An Tairseach (Threshold): An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education.*

I am a PhD candidate at Southern Cross University and I am seeking your assistance for a research project about values in environmental education with your Year 3 class. My research is under the supervision of Associate professor Amy Cutter Mackenzie and Dr Bradley Shipway. The purpose of this study is aimed at assessing the extent to which students’ values in environmental education can be informed by explicitly teaching them the emerging scientific story of the universe. The ten-week unit of work will be taught to the students in their normal classroom setting by you as the class teacher and myself and complies with the content and skills requirements of the NSW Board of Studies Australian Curriculum for Year 3. I will gather data from students’ journals, from yours and student observations and from two semi-structured individual interviews I will conduct with each student. Analysis of data will centre on gaining students’ views and ideas, noting any perceived changes in their environmental education values over the ten-week unit of teaching.

This research project has been considered groundbreaking by a university review panel in the light of the new Australian Curriculum emphasis on values education and its call for a wider worldview and integrating student learning that can inform other relevant subject areas. Catholic primary schools’ values are particularly relevant for this study because the Religious Education curriculum specifically teaches about God’s creation of the universe and promotes the call of the Catholic Church for environmental/ecological consciousness and conversion; a unified, cohesive scientific account of the universe can therefore enhance student learning in this area.

The research project will be investigated in three phases:
Research Phase 1 – before teaching the unit of work:

- Individual student, semi-structured videoed interviews with prior to teaching the emerging history of the universe unit using:
  - Individual student mind maps prior to the teaching of the unit to establish student thinking and attitudes about the universe.
  - Student drawings showing what they know about the universe. This task takes into account students who find it difficult to respond verbally or in writing.
  - The making of a “hero badge”.

Research Phase 2 – during the teaching of the ten-week unit of work:

- Ongoing class teacher and researcher observations of student activities during teaching of the unit to be recorded in the researcher’s journal.
- Observations of student individual “Universe journals”. The recording of individual students’ perspectives and interpretations will be monitored by the class teacher and researcher as the unit progresses.

Research Phase 3:

- A repetition of phase 1: individual student, semi-structured videoed interviews with the researcher after completion of the teaching of the ten-week unit of work to establish primary students’ environmental and ethical values.
  - Individual student mind maps after completion of the teaching of the unit to establish student thinking and attitudes about the universe.
  - Student drawing showing what they know about the universe. This task takes into account students who find it difficult to respond verbally or in writing.
  - The making of a second “hero badge”.

There are no costs associated with participating in this project.

Participating students will be requested not to share personal information or photos of others as part of their role of research participants in this project to protect people’s privacy. They will be expected to interact with the research team (other students from the class and the university researchers) in a respectful manner. If a student does not wish to answer a question or respond to a comment, either in an interview or during class observations, they may decline and continue with other aspects of the research, or they may stop their participation in the project immediately. If a child becomes upset or distressed as a result of their participation in the study, parents should contact you as the class teacher and the university researchers.

Participation in any research project is voluntary. No student will be disadvantaged by not participating in the project. It is up to parents and their child to decide whether or not they will take part in this project. If they do decide that their child can take part, then they need to complete and return a Consent Form. Students and parents can decide to stop participation in the project at any stage and will not be disadvantaged by withdrawal from the project.
If they wish to withdraw their child from this study they are asked to advise the study team using the Withdrawal of Participation form. If they do decide to withdraw their child from the project, the researchers would like to keep the information the child has contributed (photos, commentary and discussion responses). If the parents do not want this, they must tell the researchers before withdrawing heir child from the research project. However it may not be possible to remove some material once recorded (group meeting recordings, etc.).

The material collected in the study will be used to develop a PhD thesis about the project. Extracts from the thesis may be used to produce journal articles and presentations about this project for the Australian and international education community. The School Principal will be presented with a copy of the project thesis when completed. In any publication and/or presentation, information will be provided in such a way that children cannot be identified. No images of persons will appear in any reports or presentations (pictures or video footage) if they have not given prior consent. The results for this particular project may also be used in other research projects and/or publications. Any information obtained in connection with this study project that can identify a child will remain confidential. Only the research team will have access to this data, which will be securely stored for at least 7 years. All data will be destroyed after this period. A child’s information will only be used for the purpose of this study project and it will only be disclosed with parental permission, except as required by law.

Contact for further information:
If you would like any further information on this study you may contact Marilyn Ahearn or Amy Cutter-Mackenzie at: marilyn.ahearn1@scu.edu.au or amycutterm@scu.edu.au

All research in Australia involving humans is reviewed by an independent group of people, called a Human Research Ethics Committee (HREC). This research has been approved by the Southern Cross University, Human Research Ethics Committee (HREC). The approval number is _______. The School Principal has also reviewed and approved the project.

Complaints about the ethical conduct of this research should be addressed in writing to the following:
Ethics Complaints Officer
HREC
Southern Cross University
PO Box 157
Lismore, NSW, 2480

Email: ethics.lismore@scu.edu.au

All complaints are investigated fully and according to due process under the National Statement on Ethical Conduct in Human Research and this University. Any complaint you make will be treated in confidence and you will be informed of the outcome.

Through participation in this research, it is hoped that you will be able to gain new and specific information about issues involved in values education, with specific emphasis on environmental education. Your ongoing feedback on the study will be welcomed, with opportunities provided for you to read all researcher observations during the ten-week teaching unit, any draft reports and asking you to contribute your impressions of any observations of students. As such, for the purpose of this research, you would be seen as a teacher, research participant.

If you have any questions regarding the project please feel free to contact me.
Thank you for taking the time to read this letter and your anticipated support for this research project.

Yours sincerely,

Marilyn Ahearn

______________________________
Classroom teacher research participant consent form

I, __________________________________________ have read the information above.

Any questions I have asked have been answered to my satisfaction. I agree to take part in this research as a teacher, research participant. However, I understand that I may change my mind and withdraw at any time.

I understand that all information provided is treated as confidential and will not be released by the investigator unless required to do so by law.

I agree that research data gathered for this study may be published, provided my name or other information, which might identify me is not used.

Signed: __________________________ Date: __________________

Two copies provided - researcher keeps the signed copy + and participant keeps a copy of this letter for follow up if needed.
APPENDIX C:
Samples of Pedagogical Intervention Program: Introduction – What is Big History and Threshold 1 – The Big Bang, adapted for primary education from the Big History Project (Big History Project, 2014).
### Success Criteria:

**I have:**
- Discussed and displayed Big History project: *Champions for Big History* banner and Big History vocabulary on our pin board.
- Written some threshold moments in my life on post it notes and displayed on poster.
- Discussed our Catholic origin story and displayed our school values on our pin board.
- Use ideas from 'Our Place in Space' and vocabulary cards to design front page of my Big History journal.
- Completed front page of my Big History passport and placed it securely in my journal.
- Completed a self pre-assessment about what I know and would like to know about Big History.

### Teaching, learning and assessment and resources

**Teacher note:** reinforce what students have learned: break students into small groups and ask them to list the eight thresholds on a couple of consecutive days, before asking them to do it on their own. Students name a different threshold (in the correct order, of course!). Although these are low-stakes assessments, this knowledge will help them understand how the course is organised; give them insight into how the disciplines and content for each unit were chosen; and help them keep in mind where we’ve come from and where we’re going in the course.

### Welcome to the Big History Project

**VALUES AT St ______**
- Explicit teaching revising School Values: class or group brainstorm on Y chart – see like, feel like, sound like – Use post-it notes and display on pin board. Introduce and discuss indicators listed on St ______ Values posters – display posters.
- Explicit teaching: on texts to be covered this term: what do we know about the structure of narrative and information texts? Display structures on pinboard during the discussion.

**Vocabulary we need to understand Big History**

**BH vocabulary for pinboards**

### LEARNING ABOUT BIG HISTORY

This term we are learning about a very big history - the story of our universe! (refer to display title)

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*Adapted from *Big History Project for secondary schools (https://www.bighistoryproject.com) by Marilyn Ahearn towards current PhD research Page 14

Updated 15/07/2016*
Watch David Christian explain Big History. Big history of everything (Play 1st 2 mins only) or read Then There Was You And then there was you

- Introduce picture book: Born with a bang: The Universe tells our cosmic story (Jennifer Morgan, Dawn Publications) – Read ‘Letter from the universe’ (1st page)

- **A. Pre assessment** class task sheet on Big History BH pre and post assessment Fill in as a class or group.
- Decorate front cover of Big History journal (or take home to cover) using art worksheet as a stimulus. Space art journal cover stimulus or free choice of students’ own ideas.

**INCREASING COMPLEXITY**

- We have our ingredients. Is this porridge? What ‘conditions’ would we need to change the oats and water into porridge for Goldilocks (pour oats and water into a bowl, stir, place on a stove/microwave, electricity/gas)? (Display card: Goldilocks conditions). Elicit from children Goldilocks conditions are “not too hot, not too cold...just right!” So, from combining simple oats and water (and other ingredients we like – honey etc) we can make a more complex food. In Big History we call this increasing complexity – where we need ingredients and Goldilocks conditions. Making Porridge “threshold” card. Watch Increasing complexity thresholds: David Christian

- Another word we need is **threshold**. If we walk out the door is it the same/different as in here? This is what we call crossing a **threshold**. Take a post it note and in pairs you have three minutes to write some threshold moments in your life, when something important has happened (birth, baptism, childcare, moving house etc.). Name and post on large cardboard for class display or place in journals. We have shared our knowledge. We call this **collective learning**.

**ORIGIN STORIES**

What’s your story? What would be the 8 most important clues you would have in your photo album – the 8 most important events that have changed you? (Homework: children take home their list and discuss with parents)

1. What is my family story - 8 most important events that have changed your family’s lives in the last couple of generations (grandparents/great-grandparents lives)
2. We call these stories ‘origin’ stories (an attempt to explain the beginnings of humanity and the universe)

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Adapted from Big History Project for secondary schools (https://www.bighistoryproject.com) by Marilyn Ahearn towards current PhD research  Page 15
Updated 15/07/2016
3. Read and discuss origin stories from different cultures. Students use Unit 1 readings adapted for Yr3, (adapted for 8-10 year olds) for Christian creation story, Dreamtime Creation story, Modern origin story to read and compare origin stories: Aboriginal, Judeo-Christian, Scientific origin stories. Use expert groups to read then summarise the origin story to the class. Tr fills in comparison chart (from children’s summaries for display) Origin story summary and comparison charts.

4. (Religious Education) Tie the Genesis Christian story to this framework. Read Desmond Tutu’s picture book on creation, Let there be light. Show children Vatican Observatory page, pointing out Pope Francis’ I visit there. Vatican Observatory site

Visual Arts lesson: Our Christian origin story illustrated

1. Students view art depiction of Judeo-Christian video Judeo-Christian Creation reading and art video and discuss what other images they might use if the video is replayed and stopped at intervals, to allow them to create their own or a similar depiction of Creation. Demonstrate using chalk/pastels on edge and with varying pressure to produce different effects.

2. Use chalk/pastels to create own version of the bible reading on art paper (coloured paper as in video would look good!) as video is replayed and stopped at appropriate intervals. Allow extra time for student to finish their artwork.

3. If artwork is to be stuck in books you may need to apply a setting agent (hair spray?)

Share with class some details about your family story (e.g. where your family originates from, activities you like to share, family favourite food). Think, pair, share what you know about your family’s history. These are what we call origin stories. We could put the details on a timeline - demonstrate on board. Introduce and read Watch David Christian explain Big History.

CLAIM TESTERS
- Read My Place in Space My Place in Space these children know where they come from - their origins. Children complete first page of ‘Big History passport’ Big Passport template and place in journals.
- Do we really know if all the facts the boy in the story told the bus driver are true? How would we find out? We need to test claims people make to check if we believe them. In Big History we will learn about claim testers so we can make our own decisions about what we believe.
- Explain that we are working towards a project towards the end of the unit but that we need to have evidence before we can complete the project, Champions for Big History. (Display the parameters of the project (see Thresholds 8& 9 program) and discuss briefly.

Let there be light, Desmond Tutu (picture book on creation)

Laudato Si animation for children https://www.youtube.com/watch?v=KQgE2Kq996k
Optionnal bible story telling - magic cloth book

• Introduce Bob Bain video on claim testers (play from 1 min 28 secs) Claim testers, Bob Bain video
• Read pdf comic to introduce claim testers claim testers comic – display claim tester A4 poster

  II. While reading the comic:
  Ask students to draw the 4 symbols and hold up (without speaking) when they see one of the claim testers speaking in the comic strip.
  What claim tester does Big Sci represent and how do we know? Answer: Big Sci represents authority, and he has many ribbons and badges to support his credibility.
  What claim tester does Evy represent and what does she carry for support? Answer: Evy represents evidence, and she carries a briefcase full of images and measurements of the cosmos.
  What claim tester does Andor represent? Answer: logic
  What claim tester does Vera represent? Answer: Vera represents intuition.
  Which claim tester did Brianna use to test Big Sci’s claim that there was no such thing as space travel? Answer: Intuition

  After reading the comic
  Claim testing will play an important role in each unit of this course. You’ll want to learn the four claim testers and start using them as soon as you can.

  Play “Would you believe it?” game – do we believe what people claim (e.g. I went to the zoo on the weekend)? Ask 3-5 questions of the person claiming to have done something before class deciding if it’s true or false.

  SCALE
  Distance scale

  • Explain to class they are going to watch a video about all the places in the universe the boy mentioned and then decide if his claims where he lives are true. Powers of 10 video This video uses different way of measuring distance. I wonder why? - We need bigger and smaller scales and measuring tools (telescope- extra information: view The biggest radio telescope in the world - and microscope), to measure the small and ‘big’ of our universe. (Optional extra activity that could be linked to art activity on scale: Read Zoom story about scale: Zoom picture book )
  • Scale activity using photocopy of a children’s colouring in page Universe colouring-in page. Use journal to write title "Scale" then record a few points about what they see on the colouring in page. Students then fold paper 3 times (8 rectangle shapes). Colour in one rectangle section.
    Partners: discuss detail you now see in your smaller piece of paper. Students paste paper into journal and label “Scale” and write some of their observations about extra detail they now see on

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coloured in section. Discuss with class how when we look at part of a picture we see more detail – that is what we call using different scales.

**Time scale**

- **Activity:** The History of the Universe on a length of rope activity (Rope measured into ‘Threshold moments and threshold cards ready to place - outdoor activity.) Threshold labels for rope activity Religious Education: Universe cosmic walk introducing the 8 thresholds and timeline. Include prayers of praise for God’s creation.

**Optional activities**

5. Play Big History Bingo game */Big historybingo cards prog.pdf* or *Universe bingo cards*

6. Introduce the story telling cape and hat (stars etc on a witches hat and piece of cloth tied as a cape) – to be used by teacher and children when telling/reading a story to class or group.

**Summing up: My Big History**

Watch *Big History threshold of increasing complexity* then


b. Remind students that BH is finding out about these thresholds - we’ll ask about the ingredients and the Goldilocks Conditions. We’ll also ask what was new? What newer properties do these new complex things have?

**A. What is Big History?** Students write an introduction to their Big History Journal: Student journal narrative entry for What is Big History: A letter from themselves as ‘author’ introducing and explaining the importance of her/his BH Journal or their own *I wonder* questions about BH written into journals (uploaded onto Seesaw eportfolio?). Encourage students to relate their writing to school values posters if they see any links.

**Differentiated:** (structured) *Make a word cloud* using Big History words already discussed and displayed.

**A. BH self assess: complete after each threshold** or **BH pre and post assessment all thresholds**

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Updated 15/07/2016
Introduce Big History MI grid for independent enquiry learning and consolidation of threshold learning to date. Students can choose their activities. Teachers can adapt/delete tasks to suit. BH threshold independent MI tasks grid

Optional:
Extension group activity idea: [Wonder Project/Genius Hour]

<table>
<thead>
<tr>
<th>Teacher Evaluation</th>
<th>Comments/Variations</th>
</tr>
</thead>
<tbody>
<tr>
<td>How did the unit 'rate' in these areas?</td>
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</tbody>
</table>

2. The Big Bang

Big history will introduce you to many new ideas and claims. You won’t simply accept these claims as facts and move on. You’ll be encouraged to test them. You’ll learn how to evaluate information presented to you, and be encouraged to decide for yourself what to believe and what to investigate further. This is how our thinking advances. Today’s scientific view of the history of the Universe is based on the work of thousands of scientists and scholars over thousands of years. People built upon each other’s work. New technology and new observations have led to ever sharper theories about the Universe and its beginnings. As you study how these views have evolved, you’ll develop your own skills for testing the claims of others and making claims of your own.

Unit 1: THRESHOLD OF INCREASING COMPLEXITY (TIC) 1: NOTHING TO SOMETHING (BIG BANG) (Astronomy)

Driving Question: How do we understand where everything began?

Learning intentions/goals:

I will:
- learn that the universe started from a single point and is expanding
- Find out how people’s views of the universe have changed over time with the introduction of new ideas and technologies (Ptolemy, Copernicus, Newton, Hubble)
- Use the ‘claim testers’ to evaluate a claim or resource relating to Threshold of Increasing Complexity 1
- Identify ingredients, Goldilocks conditions and new form of complexity for Threshold of Increasing Complexity 1
- Identify what astronomers, astrophysicists and cosmologists study
Success Criteria:

I have:

- Used the evidence I learnt to write a persuasive text to show that the universe started from a single point and is expanding
- Shown that views of the universe have changed over time. (Ptolemy, Copernicus, Newton, Hubble)
- Use the 'claim testers' to investigate Threshold of Increasing Complexity 1
- Identify ingredients, goldilocks conditions and new form of complexity for Threshold of Increasing Complexity 1
- Written about what astronomers, astrophysicists and cosmologists study

A. BH self assess: complete after each threshold

<table>
<thead>
<tr>
<th>Teaching, learning and assessment and resources</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>HT2-2 HT2-5</strong></td>
<td><strong>THRESHOLD 1: The Big Bang. Students have ‘Passports’ “stamped” and write threshold 1: big Bang on page - add their favourite key words/drawing at end of threshold</strong></td>
</tr>
<tr>
<td><strong>1.0 HOW DID OUR UNDERSTANDING OF THE UNIVERSE CHANGE?</strong></td>
<td><strong>Resources</strong></td>
</tr>
<tr>
<td>a. Brainstorm how we learn new things. Brainstorm all the devices we have to help us learn different subject areas. (Internet, I pads, telescopes etc.). How would people have learnt before these devices were invented?</td>
<td>Threshold 1 Macquarie University BH Institute Threshold 1 resources</td>
</tr>
<tr>
<td>c. Introduce Big Bang vocabulary The Big Bang vocabulary cards</td>
<td>Dunbar, James Lu, Universe Verse Book Part 1</td>
</tr>
<tr>
<td><strong>DIFFERENTIATED LEARNING ACTIVITY: Investigate an astronomer from history. (Note the following site has sound for structured learning and varying levels of reading comprehension to extend more able students.)</strong></td>
<td><strong>History of the universe in 4 mins:</strong> <a href="https://www.bbc.com/ideas/videos/history-of-the-universe-in-4-minutes/p067jozy?playlist=sustainable-thinking">https://www.bbc.com/ideas/videos/history-of-the-universe-in-4-minutes/p067jozy?playlist=sustainable-thinking</a></td>
</tr>
<tr>
<td><strong>Investigating an astronomer</strong> Students are to choose from the following: Galileo Galilei, Tycho Brahe, Nicolaus Copernicus, Urban Jean Joseph Le Verrier, Isaac Newton, Caroline Hersche</td>
<td></td>
</tr>
<tr>
<td><strong>Additional resource for the above activity:</strong></td>
<td></td>
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<tr>
<td>- Wonderworld of space workbook (pp. 18-21 handouts of early astronomers)</td>
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Adapted from Big History Project for secondary schools (https://www.bighistoryproject.com) by Marilyn Ahearn towards current PhD research Page 21 Updated 15/9/2016
1.1 THE BIG BANG: the universe started from a single point and is expanding

Introductory activity: expanding balloon experiment adapt as a whole class or group experiment to introduce the expanding universe.

Claim testing - fact or fiction: claim tester prompts for teacher

View and discuss all or some of the following links using claim tester prompts from teacher link above

1. Discuss what is cosmology? Cosmos description and image
2. View and discuss as a class: The Big Bang briefly (Big Bang Briefly - 2:20 mins) and What is the Big Bang or From the Big Bang to me (to 1 min)
3. Birth of the Universe parts 1-4
4. Catholic Earthcare online resource The Cosmic Story: Catholic Earthcare The beginnings

Additional independent research: History of the universe

Describe this as the first moment and compare with children’s own birth (their first ‘threshold’).

b. Read and discuss to p.23: ‘Born with a Bang’ story book. Look at 100s chart to show how much hydrogen and helium are in the universe. If & He in our universe

- How do we know if this is true – what evidence (fact) is there in each resource? What parts are story/narrative? Watch Video: Hydrogen metal revolution
- Complete a class or small group retrieval sheet (ability based) Threshold learning retrieval chart on the above. What I have learnt about the universe and rate the fact – true/probably/maybe/not true (relate to claim testers) e.g.

<table>
<thead>
<tr>
<th>The Big Bang: Our learning</th>
<th>Rate the fact</th>
<th>Claim tester we used</th>
</tr>
</thead>
<tbody>
<tr>
<td>The universe is 13.8 billion years old</td>
<td>True</td>
<td>evidence, authority</td>
</tr>
</tbody>
</table>

Visual Arts lesson Threshold 1: The Big Bang using one-point perspective drawing

Adapted from Big History Project for secondary schools (https://www.bighistoryproject.com) by Marilyn Ahearne towards current PhD research Page 22
Updated 15/07/2016
1.2 CLAIM TESTING: FACT OR FICTION? 

Assessment

Investigation: How do we understand where everything began? (Pairs/individual activity)

Introduction to investigation - Scientists study Forces at work. Some claims to be tested! View the following to gather facts and evidence.

1. Distribute Threshold 1: Claim testers sheet - student investigation (share with students via google docs so they can access the sites). NB. Teacher modelling/sharing for initial activity for first site on forces.

2. Pairs assessment task using teacher modelling from above as a guide. Children are given a worksheet and are asked to document their investigations below using the claim testers, ENSURING THEY GIVE REASONS FOR THEIR DECISIONS. What are the four fundamental forces of nature? Possible teacher prompts: What evidence do you see on this page? (e.g. author, reference to famous scientist Albert Einstein, the written information).

Read What is gravity? Differentiated: Structured group continue working with teacher for second site.

3. What is redshift? What is cosmic background radiation and what evidence does it tell us about our universe? (Te background: Telescopes picks up microwave radiation from all sorts of places, but part of that is cosmic background radiation - photons from the Big Bang (the energy left over from the big bang). A special system converts all the photons into sound, creating this eerie hiss, which is actually hearing the photons left over from the Big Bang itself. If we could see microwaves, the sky would have a uniform glow from the background radiation. Telescopes have been launched into orbit to observe the background radiation right across the entire sky.)

Atoms and elements About atoms and Atoms and elements

Plenary: Discuss threshold learning in terms of Threshold of increasing complexity 1 card then: Students continue their journal – Chapter 2 narrative entry for Threshold 1 continuing on as the same ‘author’. Encourage students to relate their writing to Threshold 1 driving question "How do we understand where everything began?" and to school values posters if they see any links. Optional - BH self assess school values: complete after each threshold or BH pre and post assessment all thresholds

OR Make a crossword: Junior crossword puzzle maker or cross word puzzle maker

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Updated 15/07/2016
### Evaluation

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</table>

### Relevant outcome codes &/or enquiry learning strategies

**Weeks 4&5: UNITS 2&3**  
Ref: Big History Project for secondary schools ([https://www.bighistoryproject.com](https://www.bighistoryproject.com))

Adapted from Big History Project for secondary schools ([https://www.bighistoryproject.com](https://www.bighistoryproject.com)) by Marilyn Ahearn towards current PhD research  Page 24
APPENDIX D:

Interview discussion during pedagogical intervention – adapted for the relevant Big History threshold learning

Group names: ___________________________ Date:

Threshold 1: Interview 1 discussions during pedagogical intervention

1. My Big History learning
   I used to know… Now I know…

   I was surprised…

   I wonder…

2. Group discussion activity
   We’ve discussed what we know about Big History, but if you really know about Big History you would know …

Group names: ___________________________ Date:

Threshold 2&3 Interview 2 co researcher discussions during pedagogical intervention

1. My learning about stars
I used to know… Now I know…

I was surprised…

I wonder…

2. Group discussion activity

We’ve discussed what we know about Stars, but if you really know about stars you would know …

3. Summing up: Why are Thresholds 2&3 important for our human story?

Group names: ____________________________________________

_____Date:

Threshold 4 Interview co researcher discussions during pedagogical intervention

1. My Big History learning about Earth and our Solar system

   I used to know… Now I know…

   I was surprised…
I wonder…

2. Group discussion activity
We’ve discussed what we know about Earth and our Solar system, but if you really know about Earth and our Solar system you would know …

3. Summing up: Why is Threshold 4 important for our human story?

Group names: ___________________________ Date: ___________________________

Threshold 5 Interview 3 co researcher discussions during pedagogical intervention

1. My Big History learning about life
   I used to know… Now I know…

   I was surprised…

   I wonder…

2. Group discussion activity
We’ve discussed what we know about Life, but if you really know about Life you would know …
3. Summing up: Why is Threshold 5 important for our human story?

Group names: ____________________________ Date:

**Threshold 6 Interview 4 co researcher discussions during pedagogical intervention**

1. My Big History learning about early humans
   
   I used to know… Now I know…

   I was surprised…

   I wonder…

2. Group discussion activity
   
   We’ve discussed what we know about early humans, but if you *really* know about early humans you would know …

3. Summing up: Why is Threshold 6 important for our human story?

Group names: ____________________________ Date:
Threshold 7 Interview co researcher discussions during pedagogical intervention

1. My Big History learning about agriculture and early civilisations

I used to know… Now I know…

I was surprised…

I wonder…

2. Group discussion activity

We’ve discussed what we know about agriculture and early civilisations, but if you
really know about agriculture and early civilisations you would know …

3. Summing up: Why is Threshold 7 important for our human story?

Group names: _____________________________ Date:

Threshold 8 Interview co researcher discussions during pedagogical intervention

1. My Big History learning about the modern revolution

I used to know… Now I know…

I was surprised…

I wonder…
2. Group discussion activity

We’ve discussed what we know about modern revolution, but if you really know about modern revolution you would know …

3. Summing up: Why is Threshold 8 important for our human story?

Group names: ___________________________ Date:

Threshold 9 Interview 6 co researcher discussions during pedagogical intervention

1. My Big History learning about Big History and the future

   I used to know… Now I know…

   I was surprised…

   I wonder…

2. Group discussion activity

We’ve discussed what we know about Big History and the future, but if you really know about Big History and the future you would know …

3. Summing up: Why is Threshold 9 important for our human story?
APPENDIX E:
Teacher as co-researcher post-pedagogical intervention interview

__ December 2016

Values needed for a sustainable future environment

6. What would you consider the most important aspects students have learnt through the Big History pedagogical intervention about:
   i. the universe?
   ii. the environment?

7. How do you perceive the students’ new learning in Big History changed the way they think about the future?

8. Do you consider the book ‘Just a Dream’ that we shared with the children in class helped them identify what they valued/didn’t value about the importance of caring for our future sustainable environment?

9. Tell me about your perception of how children’s prior knowledge of school values helped them think about, and identify, the values needed for a sustainable future environment?

10. Would you recommend Big History as an important study for children in Year 3? I wonder if you have seen evidence of children identifying a role they could play towards a sustainable future?

11. Any other observations you have made:

   a. In the classroom learning
b. teaching strategies used in Big History teaching and learning
c. transdisciplinary learning
d. With individual students
e. Enquiry learning and children’s interest levels
f. Awe and wonder
g. How Big History learning can enrich the value of God’s creation
h. Future sustainability
i. Importance of incorporating Big History into an enriching Religious Education program
APPENDIX F:
Data analysis research prompts
Possible markers for analysing data

Did children describe:

- What you learned in class about our universe (or current threshold) – including important words and why they are important (Knowledge)
- If you have changed the way you feel about the universe – something you saw? Heard? Did? A story? An activity? (Attitudes and values informed)
- How any of your learning has changed how you would now describe the universe? (Attitudes and values informed)
- Do you think what you have learnt/are learning will change how you will care for the environment? If yes, what do you think you will do? (Behaviour – towards transformation)

For each of these learning events analyse children’s answers regarding:

- Can you remember where you were when your learning happened?
- Can you describe what helped you learn or change?
- How have you felt when you were learning?

Local school Values indicators

Peace
1. Cooperate In Our Work And Play.
2. Accept That People Have Their Own Points Of View
3. Resolve Our Differences In Non-Violent, Peaceful Ways
4. Spend Time With God In Prayer
5. Spend Time appreciating Our Natural Environment
6. ...And One Easy One: SMILE!

Respect
1. Are Polite And Use Kind Words
2. Obey School Rules
3. Care For Others
4. Listen And Respectfully Discuss Ideas And Feelings
5. Make Fair Decisions In Our Work And Play
6. Understand Different Cultures And Points Of View
7. Reduce, Reuse & Recycle - Care For Our World

Empathy
1. Listen To Others
2. Respect Other People’s Values, Traditions And Cultures
3. Imagine How Others Might Feel To Help Us Understand Them
4. Understand That Students Learn In Different Ways
5. Understand How We Are Connected To Our Environment

Compassion
1. Take Care Of People Who Need Help
2. Listen To Other People And Try To Understand Their Lives
3. Work With Others, Be Fair And Wait Our Turn
4. Speak Out If People Are Treated Unjustly
5. Show Concern And Care For Our Environment

Tolerance
1. Welcome, Trust, Forgive And Include Others
2. Listen To And Learn From Others
3. Understand Other People Need Their Own Space
4. Talk About A Problem Calmly And Fairly And Come To An Agreement
5. Respect How Other People Live
6. Understand That All God’s Creatures And His Creation Are Valuable And Linked

Love
1. Pray Together And By Ourselves
2. Show Loving Care For Others And The World Around Us
3. Do Our Part To Complete Group Tasks Responsibly
4. Are Polite And Kind, Share With Others And Take Turns
5. Make Behaviour Choices To Keep Ourselves And Others Safe
6. Care Responsibly For God’s Creation – For All Creatures And The Environment

APPENDIX G:
Post-pedagogical assessment worksheet

Values needed for a sustainable future environment

<table>
<thead>
<tr>
<th>Name:____________________</th>
<th>Date: ______________</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Scenario (situation)</th>
<th>Attitudes displayed</th>
<th>Values displayed (or needed)</th>
<th>How this can affect a sustainable future</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walter tossing a wrapper on the ground</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walter making fun of Rosie</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rosie planting a tree</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Three places Walter flew to in his bed:

1.                      
2.                      
3.                      

Walter’s birthday

Now I have learnt about Big History I can identify my attitudes better to caring for the environment:

Examples of how (local) school values are important in caring for our future environment:

1. _________ because
2. _________ because
3. __________ because

I can explain how my attitudes and values could affect our sustainable future environment:

My assessment rubric:

<table>
<thead>
<tr>
<th></th>
<th>Basic</th>
<th>satisfactory</th>
<th>thorough</th>
<th>extensive</th>
<th>Teacher mark/comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>I can <strong>identify</strong> most times in the story <em>Just a Dream</em>, when people <strong>display</strong> their attitudes about the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can <strong>identify</strong> most times in the story <em>Just a Dream</em>, when people <strong>display</strong> changes in their attitude about the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can <strong>name the different values</strong> people display in the story <em>Just a Dream</em>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can <strong>explain</strong> how people’s attitudes and values in <em>Just a Dream</em>, could affect our sustainable future environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Now I have learnt about Big History I can identify my attitudes better to caring for the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can use (local) school values to help me name the values needed to care for our future environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I can explain how my attitudes and values could affect our sustainable future environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I am proud of my Big History learning because:
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

Children in Year 3 should/shouldn’t learn Big History because:
_____________________________________________________________________________________
_____________________________________________________________________________________
_____________________________________________________________________________________

I wonder about Big History:

Data collated from the above sheet

Now I have learnt about Big History I can identify my attitudes better to caring for the environment:

Charlie: by being PRhOJECT LOVE and being ‘think before you do’ (sic).
Jemma: By not only caring about everyone but you should care for everything. That’s how we can have a sustainable future :) (sic).
Imogen: empathy because I need to water my plants at home more.
Gabby: I can use all the PRhOJECT LOVE values that are peace, respect, honesty, justice, empathy, compassion, tolerance and last...LOVE. Displays inherent knowledge and reference to local school values.

Examples of how St Joseph’s school values are important in caring for our future environment:

Aaron: respect because we have to respect animals, plants and everything (displays new learning and move away from anthropocentric worldview)...Love because we have to love what God gave us (Catholic view)
Theo: honesty because the fishermen (in ‘Just a Dream’ story) need to be honest of taking all the fish. (sic)
Mia: love because we need to be fair and take what we need. Tolerance...and empathy because all of
the living creatures need to be fair with everything, (sic) move from anthropocentric? (underlining everything – inclusive?)

Jack: Love because when we love we will be close to nature and not destroying it.
Jemma: love because we need to love the environment just like God loves us.
Gabby: Justice because you should care for the future environment instead of letting cre(a)tures become extinct; Compassion like Jesus had compassion for us we should have compassion for the environment
Indi: peace because we would have a wonderful future with animals and nature.
Emma: Love because if we showed love we would have a good future so people won’t fight and there will be enough for everything forever because no one would be selfish.

I can explain how my attitudes and values could affect our sustainable future environment:

Theo: that the fishermen need respect to the baby fish in the sea. If they don’t have respect then the baby fish will die and not grow older (sic). Used situation from a storybook, ‘Just a Dream’ (Van Allsburg, 1990) read in class, to explain local value needed.
Mia: if we don’t have PRhOJECT LOVE then the environment would be polluted. Honesty because if we are honest we will be nice to nature.
Georgia: if we are not respectful of the environment all the sharks and fish will die if we take more than we need.
Jemma: if we only think about people we will have a terrible future. If we think about EVERYTHING (sic) we will have an amazing and sustainable future.
Gabby: …If I do have justice the world will be fair and everything could be better.
Emma: by caring for the environment we would have a better future. By ignoring the environment we would probably die.
<table>
<thead>
<tr>
<th>What is the biosphere?</th>
<th>In the deep oceans.</th>
<th>The eggs had a hard shell.</th>
<th>Bacteria: a group of very small living things that usually help us stay healthy</th>
</tr>
</thead>
<tbody>
<tr>
<td>About 3.8 BYA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What is biology?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What are primates?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How many years did dinosaurs live on the earth?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>over 150 million years</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When did life on earth appear?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where do scientists think life began?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When amphibians moved from the sea to land how had their eggs changed?</td>
<td>mammals that evolved after the extinction of the dinosaurs.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX I:
Sample from interdisciplinary tasks’ grid (Adapted from Pirozzo, 1997)

<table>
<thead>
<tr>
<th>Big History Tasks:</th>
<th>Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thinking levels:</strong></td>
<td></td>
</tr>
<tr>
<td>Remember 1 point</td>
<td></td>
</tr>
<tr>
<td>Use visuals to recall the information about the threshold we are studying to inform your reader.</td>
<td></td>
</tr>
<tr>
<td>Understand 2 points</td>
<td></td>
</tr>
<tr>
<td>You are a space traveler. With an existing journal template, present your experiences creatively to inform your classmates.</td>
<td></td>
</tr>
<tr>
<td>Apply 3 points</td>
<td></td>
</tr>
<tr>
<td>Final 5 facts from your favourite threshold. Present your findings as a PMI.</td>
<td></td>
</tr>
<tr>
<td>Analyse 4 points</td>
<td></td>
</tr>
<tr>
<td>Compare two different thresholds. Show your findings creatively.</td>
<td></td>
</tr>
<tr>
<td>Evaluate 6 points</td>
<td></td>
</tr>
<tr>
<td>Write a response to your family who has asked you why you are studying Big History at school.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ways of learning</th>
<th>Language I enjoy reading, writing and speaking</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maths</strong></td>
<td>I enjoy working with numbers and science</td>
</tr>
<tr>
<td>Create a mind map of significant facts from our current threshold</td>
<td></td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td>I enjoy painting, drawing and visuals</td>
</tr>
<tr>
<td>Create an artwork from the title of a threshold we have studied.</td>
<td></td>
</tr>
<tr>
<td><strong>Moving making</strong></td>
<td>I enjoy doing hands-on activities</td>
</tr>
<tr>
<td>Create a board game based on the facts you’ve learnt about Big History.</td>
<td></td>
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<th>Big History Tasks:</th>
<th>Name:</th>
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<tr>
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<tr>
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<td></td>
</tr>
<tr>
<td><strong>Moving making</strong></td>
<td>I enjoy doing hands-on activities</td>
</tr>
<tr>
<td>Create a board game based on the facts you’ve learnt about Big History.</td>
<td></td>
</tr>
</tbody>
</table>
| **Musical**  
| I enjoy making and listening to music | Perform a soundscape to go with a Big History threshold. | Write a 2-3 verse rap to describe a threshold. | Find a song that could be used as a theme song for information you've read in Big History. | Write a sound poem (use onomatopoeia) for a Big History threshold. | Write a song about Big History. | Perform a 1-2 minute movement or dance from one of the thresholds. Use appropriate music. |
| **Social**  
| I enjoy working with others | You are a TV presenter who needs to write five interview questions to ask a Big Historian. | With 1-2 of your group members, perform a news broadcast of a tragedy from facts in one of the thresholds (when there were not Goldilocks conditions!). | Send an email to a friend telling her/him how Big History is helping you understand the importance of looking after our earth. | Undertake a class survey of what students know about the information in one of the thresholds. | Create a playground game about facts from a threshold. Name your game, write the instructions and teach the class to play it. | Write and deliver a speech to persuade your audience: *The information in Big History is important for Yr 3 students to learn.* |
| **Individual**  
| I enjoy working by myself | Draw a picture of your favourite scene from one of the thresholds and record 4 of its important features. | Explain why you found the information from a Big History threshold interesting or uninteresting. | You are a children’s author. Write and illustrate a picture book to tell kindergarten children what values you have thought about in Big History. | Make a mind map to describe your feelings about Big History. | Prepare a *Wonder Word* or crossword puzzle using technical words from one of the Big History thresholds. | Judge if Big History helps people to understand the importance of looking after our environment. Remember to explain why. |

**Choosing your tasks:**
- You must select one task from each column (21 points).
- You must select at least four shaded tasks.

**My Big History learning:**

| | |
|———|———|
| 🌟 | Points add up to **between 21-30 points** |
| 🌟🌟 | Points add up to **between 30-40 points.** |
| 🌟🌟🌟🌟 | Points add up to more than 40 points. |

**What I need to do next:**

**I wonder:**

---

APPENDIX J:
Sample: Planned Project based learning task - synthesising and evaluating socioecological learning
Term 4: Champions for Big History group assessment

<table>
<thead>
<tr>
<th>In our Market stall we included _____ of the following tasks:</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>Teacher assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our own letter to the editor promoting our Big History threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An advertisement supporting our threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dot points prepared to show our learning about our threshold when people visit our stall</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Posters/banners we created to promote the cause</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Brochure or pamphlet including a slogan about our threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our Big History journals opened at the page of which we are most proud</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enrichment: We created a website for Champions for Big History</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>We also chose to complete the following optional activities:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Created a book cover using the online Book cover creator to summarise the arguments of our Big History threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><a href="http://www.readwritethink.org/files/resources/interactives/bookcover/">http://www.readwritethink.org/files/resources/interactives/bookcover/</a></td>
</tr>
<tr>
<td>A google slides presentation (or other technology) about our threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photograph collage supporting our threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graphs/statistics displayed</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maps</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poem/rap to promote our campaign</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extra persuasive slogans displayed to promote our threshold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business cards promoting our Big History threshold</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>We considered the appropriate use of colour, font, size and layout of our stall. Our display is visible from at least 1 metre distance.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Overall we give our market stall

APPENDIX K:
Ethics approval
8 December 2015

Ref: Research Application 967

Marilyn Ahearn
4/96 Junction Road
SUMMER HILL NSW 2130

Dear Marilyn

RE: RESEARCH APPLICATION REF: 967 - LETTER OF APPROVAL

Thank you for the submission of your application to conduct research in Archdiocesan Catholic Schools under the jurisdiction of the Catholic Education Office (CEO) Sydney. Approval is given by CEO Sydney to conduct this study. This approval is granted subject to full compliance with NSW Child Protection and Commonwealth Privacy Act legislation. It is the prerogative of any Principal or staff member whom you might approach to decline your invitation to be involved in this study or to withdraw from involvement at any time. Any study involving the participation of students will require written, informed consent by parents/guardians.

Permission is given for you to approach the Principals of the schools in the Inner Western Region (until you have confirmed your school), requesting participants for your study: “An Alinearch (Threshold): An exploration of connecting the emerging scientific story of the universe to authentic Catholic primary school environmental education”.

COMMONWEALTH PRIVACY ACT

The privacy of the school and that of any school personnel or students involved in your study must, of course, be preserved at all times and comply with requirements under the Commonwealth Privacy Amendment (Private Sector) Act 2000. In complying with this legislation, the CEO Sydney has decided that individual research participants should not be identified in the report.

FURTHER REQUIREMENTS

When you have established your participating school, please complete the attached form and return it to this office.

It is a condition of approval that when your research has been completed you will forward a summary report of the findings and/or recommendations to this office as soon as results are to hand.

Yours sincerely,
APPENDIX L:

Big History Letter of support

To whom it may concern

This letter is written in support of Marilyn Ahearn’s PhD research involving Big History. Marilyn introduced herself to members of the Big History Institute at Macquarie University in 2012. She is an Associate Member of the Institute, which supports educators from all sectors, working on research and teaching projects.

Big History is the attempt to understand, in a unified and interdisciplinary way, the history of the Cosmos, Earth, Life and Humanity. It offers the possibility to understand our universe, our world, and our humanity in a new way. Big History is a field of vast scope and innovative research; it may well provide key knowledge to unlock some of the critical challenges of our future.

The Big History Institute is committed to supporting the development of Big History courses for school and university students. Professor David Christian, Director of the Big History Institute and Bill Gates have co-founded the online Big History Project, as the mechanism by which a broader engagement with Big History at the secondary school level has been achieved. Marilyn’s intended research is significant as it explores Big History’s unified vision of knowledge at the primary school level. Marilyn is currently collaborating with Tracy Sullivan, Education Leader for the Big History Institute, to introduce the Big History Project in the Australian primary school curriculum. We believe her research will contribute to our pursuit of Big History as a major turning point in modern education. Big History develops the skills of synthesis and synopsis needed to integrate ideas, information, and paradigms from multiple disciplines and domains. Such skills are increasingly vital for students at all levels, including primary, in today’s interconnected world.

Big History is a credible educational initiative and its applicability in a range of educational contexts is gaining recognition. It has been taught as a large first year course at Macquarie University since 1989, and more recently at the graduate level. In addition it provides a focus for PhD students and it complements the university’s strong specialisation in education and teacher training. As such we encourage Marilyn’s contribution to research Big History in the Australian primary school.

In summary, we fully support the innovative research that Marilyn Ahearn is intending to conduct in the primary school context.