Perceptions of Environmental Sustainability held by students in a NSW Primary School

A thesis submitted in fulfilment of the requirements for the degree of

Doctor of Education

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CERTIFICATE OF AUTHORSHIP

I certify that the work in this thesis has not previously been submitted for any degree nor has it been submitted as part of requirements for any other degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Graham Weeks

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This thesis is dedicated to my daughter Katie Alexandra Weeks.

> *Treat the Earth well. It was not given to you by your parents. It was loaned to you by your children. We do not inherit the Earth from our ancestors. We borrow it from our children.*
>
> Native American Proverbs and Wisdom.

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Abstract

The study aims to produce an insight into how young children perceive environmental sustainability and poses the research question: What perceptions of environmental sustainability do primary school students, in their final years of primary education, hold and express? Existing research (Phipps, 1991; Spork, 1992; Walker, 1995; Walker, 1997) indicates that the most significant work in environmental education in NSW is being done at the primary school level. However, evidence relating to the research question is limited. Therefore, it is important to gather and analyse data about these perceptions of primary school students if we are to develop and implement sustainability education curricula that best support the needs of students, is relevant to primary school teaching and learning, and provides insight into appropriate strategies for the professional development of teachers.

The study involves students in their final years of primary school education and explores their perceptions of environmental sustainability. It provides insight into how their perceptions are informed and how they may be best nurtured. The data are gathered from primary school students in Years 4, 5 and 6 and their teachers in one NSW primary school. Qualitative methods are used to collect data. These include students responding to three differing types of stimulus material using an

open-ended questionnaire, focus group discussions, and individual interviews. The data are gathered using methodology that is influenced by Grounded Theory and analysed with reference to the existing literature.

The conclusions report that the students in the study most frequently express notions of sustainability that are underpinned by homocentric views of sustainability; proximate cause and effect scenarios; and, proposed actions based on sharing natural resources fairly while maintaining the environmental balance and behaving responsibly. Finally, an emerging framework of primary school students' notions of environmental sustainability is presented and discussed along with the implications for sustainability curricula.

Acronyms and Abbreviations

AAEE – Australian Association for Environmental Education.

BOS – (NSW) Board of Studies.

CFCs – Chlorofluorocarbon pollutants.

CO_2 – Carbon Dioxide.

DET – NSW Department of Education and Training.

EE – Environmental Education.

ENSI – Environment and School Initiatives.

ESD – Ecological Sustainable Development, and also Education for Sustainable Development.

GW – Graham Weeks, the principal researcher and author of this thesis.

HREC – Human Research Ethics Committee (at UTS).

HSIE – Human Society and Its Environment (NSW Curriculum for Society and Environmental Education K-6).

IPCC – Intergovernmental Panel on Climate Change.

IUCN – International Union for Conservation of Nature and Natural Resources.

K-6 – Kindergarten to Year 6 (the range of student groups in NSW DET primary schools. This equates to elementary schools in the United States of America).

K-12 – Kindergarten to Year 12 (the range of student groups in NSW DET primary and secondary schools).

NEP – New Environmental Paradigm.

NSW – New South Wales.

OECD – Organisation for Economic Co-operation and Development.

SERAP – State Education Research Approval Process (DET, NSW).

SSP – Sustainable Schools Program (DET, NSW).

STS – Science, Technology and Society.

UK – United Kingdom of Britain and Northern Ireland.

UNEP – United Nations Environment Program.

UNESCO – United Nations Educational, Scientific and Cultural Organisation.

UNFCCC – United Nations Framework Convention on Climate Change.

UTS – University of Technology, Sydney.

WWFN – World Wildlife Fund for Nature.

Presentations

Aubusson, P. & Weeks, G. (2010). *Sustainability: Children's Perceptions and Implications.* Paper presented at the NSW DET Environmental Education Conference, University of Western Sydney, 10 February 2010.

Weeks, G. (2010). *Perceptions of Environmental Sustainability held by Senior Primary School Students.* Presentation at UTS Postgraduate Research Student Conference, 4 June 2010.

Weeks, G. (2010). *What perceptions of environmental sustainability do senior primary school students hold and express?* Poster presented at the Annual Lecture Evening of the Teachers' Guild of NSW, Trinity Grammar School, Sydney.

Weeks, G. (2010). *Perceptions of Environmental Sustainability held by Senior Primary School Students.* Paper presented at the Northern Beaches Sustainability Education Network Group, Davidson High School, Sydney.

Weeks, G. (2010). *Perceptions of Environmental Sustainability held by Senior Primary School Students.* Paper presented for information of teachers and parents at the primary school where the data were collected, Sydney.

Chapter 1: Introduction

I set out to tell the complicated issue
of how we are changing the environment without knowing it.
This change is hard to see from day to day
but it is nevertheless happening and it is happening fast.

The facts are alarming.
Scientists estimate that if we continue to destroy wilderness at this pace, by the year 2020 no wilderness will remain on our planet except for land protected in national parks and reserves.

By the same year, they estimate a quarter of our plant and animal species will be extinct.

Already, at least two species become extinct each hour.

But by opening a window in our minds,
by understanding how change takes place
and by changing the way we personally affect the environment,
we can make a difference.

Baker, J. (2002), *Window*, end page.

1.1 Introduction

The study examines the complicated issue of how young children perceive environmental sustainability. The need for people to develop environmentally sustainable practices commands international attention in science, politics, society, business and economics. Education for sustainability has become a matter of importance in schools and has come to occupy an important place in the primary curriculum. This thesis reports on a study of primary school children's perceptions of environmental sustainability. This chapter outlines the study providing background information and an overview of the context of the study and the methodology used. It also provides an overview of how the results were analysed and how the conclusions were derived. The conclusions have important

implications for the development and implementation of sustainability education curricula that best support the needs of students, are most appropriate for primary school teaching and learning, and provide insight into appropriate strategies for the professional development of teachers.

1.2 Background

The Context of the Study

The study investigates perceptions of environmental sustainability among students in a NSW primary school. The school in which the study took place was engaged in the trialling of the then new Sustainable Schools Program (NSW DET, 2001a). The development and implementation of sustainability education programs has been a recent curriculum initiative in sustainability education and during 2003-4 there were 198 schools throughout NSW (both private and public) involved in trialling the new Sustainable Schools Program (NSW DET, 2001a). The implementation of this program became mandatory for all DET schools from the beginning of 2006. Given this imperative for and investment in sustainability education, it is important to investigate how NSW primary school students (K-6) perceive environmental sustainability during their final years of primary education because there appears to be limited research about the perceptions of young children in this area. By equipping educators with a better understanding of young children's perceptions of environmental sustainability and how these are derived and best nurtured, sustainability curricula can be developed to best meet the needs of primary school students.

Sustainability education in NSW primary schools is based on fundamental principles, such as enabling students to engage in “local” action and thereby gain a better understanding of “global” environmental issues (NSW DET, 2001b). For the school involved in the study, students are involved in practical activities, such as monitoring the school’s consumption of electricity and water; recycling bio-degradable material by composting lunch scraps for use in the school vegetable garden; reusing rainwater (which is collected in tanks) to water school gardens and grass areas; and, reducing the amount of non-degradable plastics used in lunch-wraps. This complements a curriculum that aims to develop the students’ understanding of biodiversity. It is anticipated that this emphasis on local action and biodiversity, may influence knowledge and understandings about the environment, the influence of human activity on it, and environmental sustainability.

The NSW Department of Education and Training in its Environmental Education Policy for Schools states the aim of environmental education:

> *to foster students’ understanding of the environment as an integrated system, and to develop attitudes and skills which are conducive to the achievement of ecologically sustainable development* (NSW DET 2001a, p.10).

The implementation of this policy has been supported by the DET Sustainable Schools Program (NSW DET, 2001a). In relation to this research, the application of this program may have been a factor influencing the perceptions of

environmental sustainability among the students in the study. Students in primary school that have been involved in this program as part of its initial trial and its subsequent mandatory implementation in all primary schools from the beginning of 2006, might be expected to have developed richer perceptions of environmental sustainability than schools that were not involved in the trial or which have not given priority to implementing the program. Little is known about the effectiveness of this program. An evaluation of the general implementation of the program is beyond the scope of the research in this study and, additionally, is not permitted under the conditions of the SERAP approval. Nevertheless, this study does provide some insights into the perceptions of environmental sustainability held by a group of young students who have engaged in the DET Sustainable Schools Program (NSW DET, 2001a). Hence, its findings have particular implications for schools where the program is an integral part of the curriculum.

An evaluation of the DET Sustainable Schools Program (NSW DET, 2001a) in the trial primary schools was conducted in late 2004 by surveying selected teachers by e-mail and was subsequently released in 2005 (see Chodkiewicz & Flowers, 2005). An evaluation of the program since its mandatory implementation in 2006 in all DET schools does not appear to have been attempted. As McGaw et al. (1992, p. 13) reported, “some programs (in environmental education) are genuinely evaluated but much change is not monitored or investigated in any significant way”. More recently Henderson et al. (2004, p. 32) commented that “overall, limited research has been conducted by or for whole-school sustainability programs”. In short there is an absence of evidence to demonstrate the success or

otherwise of these programs in developing students' understandings and awareness of environmental sustainability. There is clearly a need for more research of students' perceptions of environmental sustainability to take place. The intention of this study was to focus on investigating the understandings of environmental sustainability held by students in their final years at a NSW primary school located in suburban Sydney.

The Researcher

Central to conducting qualitative research is the researcher as research instrument (Denzin & Lincoln, 2000). The author of this thesis was the key person engaged in obtaining and interpreting data from the subjects involved in the study. This situation suggests possible threats to the trustworthiness of the research and measures need to be used to identify and address these possible threats. These are discussed at 3.7.

The study developed out of the researcher's personal long-standing commitment to the teaching of education for environmental sustainability. Over a teaching career of some four decades I have taught mainly NSW primary school students (those aged from five years to 12 years) as a class teacher, a school executive and a school principal. At first there was a special interest in teaching the natural sciences and over time this developed into some personal expertise in teaching about biodiversity and the natural environment. In later years this has involved

developing students' understandings about, and attitudes towards environmental sustainability.

Some significant events in the researcher's teaching career have been:

- A BA degree from Macquarie University with a major in Earth Sciences specializing in petroleum geology.
- A MEd degree from The University of Sydney completed by both coursework and thesis. The title of the thesis was: "Environmental Education and its Role in the Primary School" (Weeks, 1977).
- Experience as a councillor with the Gould League of NSW (an organization committed to supporting environmental education in NSW schools mainly through conducting competitions for students and through the dissemination of educational resources for teachers). The researcher was the author of some of these educational resources.
- Experience as a writer of educational resources for Kosciuszko National Park for the NSW National Parks and Wildlife Service.
- Experience as a consultant to the Australian Development Aid Bureau in the writing, implementation and evaluation of a curriculum for Environmental Science K-6 for the Ministry of Education in the Kingdom of Tonga.

- Experience as a temporary lecturer in primary science (K-6) in the Teacher Education Program at Macquarie University.
- Experience as a foundation member of the Northern Beaches Sustainability Education Group (an organization of teachers concerned with promoting sustainability education in schools in the northern beaches area of Sydney).
- Experience as a sessional lecturer at The University of Technology, Sydney lecturing in the subjects “Society and Environmental Education” and “Society, Science and Environmental Education”.
- Completion of doctoral subjects at The University of Technology, Sydney. These subjects were: Introduction to the Doctor of Education; Research Perspectives; Analysing Professional Practice; and, Dissertation Development and Analysis.
- Peer Review and Presentations of the findings of this study as listed on page xiii.

1.3 Environmental Education

Environmental education has assumed international significance. In 1986 the Environment and School Initiatives (ENSI) was established by The Organisation for Economic Co-operation and Development (OECD) (Robottom, 1993). It was, and continues to be, an international network commissioned to support environmental educational developments, environmental understanding, active approaches to teaching and learning, through research and the exchange of

experiences. The following countries are currently involved in ENSI programs: Australia, Austria, Belgium, Canada, Croatia, Denmark, France, Finland, Germany, Greece, Hungary, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Slovenia, South Korea, Spain and Switzerland. ENSI continues to be the main international organization involved in environmental education (ENSI, 2008).

ENSI's main strengths and achievements are its ability to: initiate, coordinate and support research and school development activities; promote international exchange, understanding and cooperation, including cooperation with other international organizations and programs; make appropriate policy recommendations and statements; launch, manage and mainstream developments in Environmental Education and in Education for Sustainability; contribute to research in environmental education and in Education for Sustainability; and establish effective global networks (ENSI, 2008).

Sustainability education has become an international phenomenon as evidenced by the recent development and implementation of programs such as:

Enviroschools (New Zealand)

Green School Project (China)

Green Schools (Sweden)

Eco-schools (England, Wales and Scotland)

Eco-schools (South Africa)

Eco-schools (Europe)

Eco-schools (25 OECD countries)

The Sustainable Schools Program (DET, NSW, Australia)

(Henderson & Tilbury, 2004).

Environmental education has become a significant initiative in NSW with the development and implementation of the DET Sustainable Schools Program (NSW DET, 2001b). The question posed by this research: "What perceptions of environmental sustainability do primary school students, in their final years of primary education, hold and express?" arises from the current generation of sustainability education programs that focus on education for a sustainable environment or education for sustainable living.

This study was conducted in a NSW primary school. Hence, in this context there is a need to consider the more specific nature and origins of sustainability education in Australia with particular reference to NSW. The current NSW Environmental Education policy document (NSW DET, 2001a) is the product of a long period of curriculum development that has been influenced by local, national and international factors. These are explored in the literature review (Chapter 2).

1.4 Environmental Education as current in the NSW primary school curricula

Environmental education in NSW primary schools is not viewed as belonging to only one curriculum area such as sciences. It is a learning area that has links to all the key learning areas. In NSW these key learning areas stated as: English, Mathematics, Human Society and Its Environment, Science and Technology,

Creative and Performing Arts, and Personal Development, Health and Physical Education. In this sense, environmental education is regarded as multi-disciplinary or as a cross-curricular perspective wherein teachers are encouraged to infuse environmental education into the existing curriculum (Imeson & Skamp, 1995).

The NSW Department of Education and Training (DET) places the emphasis in environmental education on learning “about, in, and for” the environment. Integration across all curriculum areas is DET policy in primary schools and two key learning processes are stressed: sensing the environment and problem solving (Imeson & Skamp, 1995).

Environmental education in NSW draws on a complex interrelated set of curriculum documents. The significant policy statements and curriculum documents relating more directly to environmental education in NSW primary schools are:

- *The Environmental Education Policy for Schools* (NSW, DET, 2001b), and its support document *Implementing the Environmental Education Policy in your school* (NSW, DET, 2001a). These documents outline the student objectives for environmental education and group them into three areas: the curriculum, the management of school resources, and the management of school grounds (NSW, DET, 2001b).

- *Stage Outcomes Statements for Environmental Education* (NSW, DET, 2007a).
- The syllabus document for *Human Society and Its Environment K-6* (BOS, NSW, 1998). This document has “Environments” as one of the four main strands and states the outcomes and indicators for all four strands.
- The Syllabus and Support Document for *Science and Technology K-6* (NSW, BOS, 1991). This document has “Built Environments, Living Things, and Earth and its Surroundings” as three of the six content strands containing significant environmental elements. Learning outcomes are listed for all six strands (in BOS, NSW, 2000). In its collection of units of work it outlines a Stage 3 unit “Environment Matters” (p. 132) which is concerned with both the effects of human activities on environments, and with addressing some problems of environmental damage.
- *Science and Technology K-6: Outcomes and Indicators* (BOS, NSW, 2000). This document revised the learning outcomes of the Science and Technology K-6 Syllabus and Support Document (1991).
- *Global Perspectives, A Statement on Global Education for Australian Schools* (Curriculum Corporation, 2002). This document sees global education as transformative and aims to promote values, such as commitment to opposing poverty and injustice, affirming human rights and cultural diversity, seeking a peaceful and just world and working towards environmental sustainability (Curriculum Corporation, 2002).

1.5 The Research Problem

This research poses the question: What perceptions of environmental sustainability do primary school students, in their final years of primary education, hold and express?

It uses additional questions to further explore these understandings. These questions are:

- How are these understandings consistent or inconsistent with the actions these students propose?
- To what extent, and in what ways, do these primary school students (in Years 4, 5 and 6) feel that local action is able to impact on global environmental sustainability issues?
- Where do these primary school students (in Years 4, 5 and 6) attribute responsibility for environmental sustainability and why?
- What informs the responses of these primary school students in their descriptions of environmental sustainability?

1.6 Justification for the Research

There are **two broad areas** that are relevant to the justification of the research. The first relates to the purpose of education and its practice in NSW. The second relates to the sustainability of the environment both locally and globally.

Education and Sustainability

Education, like democracy, is fundamentally about empowerment and the freedom to choose (Dewey, 1916). Both provide the participants with the means to shape and direct their experiences. By choosing a course of action and experiencing the results, our beliefs and understandings about the world, how it works, and how we fit into it are reinforced or modified. The role of environmental education in a democratic society is to play a part in producing members of society who are well informed and able to make knowledgeable choices about the environment and environmental sustainability so that the condition of the environment is maintained in perpetuity for the benefit of future generations of humans.

Much of the research in environmental education is about children's environmental knowledge, attitudes, behaviours and learning outcomes (Carroll, 2002). Less is known about how and when children begin to understand or conceptualise the environment and environmental sustainability. Loughland et al. (2003) reported that while schools have a significant role in helping students to develop environmental awareness, relatively little is known about the environmental understandings held by students. A better understanding of how children perceive environmental sustainability will inform the development of more relevant sustainability education curricula. This study makes a contribution to this area.

Given that environmental education in schools is an important strategy in achieving environmental awareness, it is important that environmental education

curricula are based on students' understandings of the environment rather than on assumptions of what students know and believe (Loughland et al., 2002). As well as curricula that develop students' knowledge and understanding about the natural environment, there are now sustainability education programs that are directed at children on a K-12 continuum. These programs aim to develop student knowledge and understanding about human interaction with the natural environment including the use of natural resources. This study explores how primary school children understand these interactions between human use of natural resources and the environment.

The development and implementation of K-6 sustainability education curricula and policy statements (e.g. see NSW DET 2001a) imply that learning about human interaction with the natural environment is appropriate for primary school students. However, there is a paucity of research evidence to support that it is appropriate to be doing this at the primary school level (Carroll, 2002). There is also concern that children of primary school age should be protected from the anxiety that goes with exposing them to an understanding of environmental problems (Jensen & Schnack, 1997). Nevertheless, Jensen and Schnack (1997) argue that this should not be a reason for excluding young children from learning about environmental issues. Instead, they suggest that the focus should be on teaching students how to deal with anxiety that may arise. They maintain that where the anxiety is caused by a lack of understanding of the environmental problem, there is a responsibility on the part of educators to explore the environmental problem and its causes with

students and to discuss the range of actions that are available to minimize or eliminate the problem.

> *There has been a lot of discussion in connection with environmental education about whether creating worry and anxiety in children is wise or useful. Studies made in several Nordic countries in recent years indicate that this is an inadequate way of presenting the problem. It is not so much a question of creating anxiety during environmental education. The problem is more how to handle the anxiety and worry which students already feel. So the question, then is not whether we dare create anxiety in children, but whether we dare let that anxiety and worry, which of course exists, remain undiscussed (Jensen & Schnack, 1997, p.3).*

While this study does not examine students' anxiety in relation to environmental problems, it does seek to understand how students perceive human actions that impact on the environment at both local and global levels. Education for environmental sustainability aims to equip students with the skills to take action on their environmental concerns on both an individual and societal level. This study examines this aim and explores the extent to which primary school students are able to make the association between environmental sustainability and human action happening in the environment. The Stern Review (2007) makes the following observation:

> *Schools have an especially important role. Educating people from an early age about how our actions influence the environment is a vital element in promoting responsible behaviour. Creative and practical ways can be found to help pupils translate the study of climate change into actions in their everyday lives. For instance, practical examples of sustainability, such as installing wind turbines in school grounds, can help provide pupils with an understanding of the consequences of their actions and a tangible example of how behaviour, incentives and technologies can provide solutions* (Stern, 2007, p.450.).

The extent to which students have developed an understanding of environmental sustainability by the time they reach their later primary school years has implications for the implementation of sustainability education at the primary school level and beyond. Furthermore, as the production of curriculum documents, policy statements and resource materials are not consistently based on the environmental understandings of students (Walker & Brady, 2002) a better understanding of students' perceptions of environmental sustainability is required to underpin the teaching of sustainability education.

It is important to gain insight into the nature of these understandings if we are to develop curricula that best meet the needs of primary school students. Anecdotal evidence, from secondary school teachers and one recently retired NSW DET Chief Education Officer with responsibility for environmental education (Smith, 2006), suggests that while there are some individual secondary schools with programs in sustainability education (such as "Streamwatch", e.g. Mackellar Girls High School, 2008 and "Solar Power Station" e.g. Pittwater High School, 2008), most secondary schools do not provide effective programs in this area even though environmental education is mandatory in all DET schools from Kindergarten to Year 12 (NSW DET, 2001a). These same people seem to suggest that in most secondary schools teaching and learning about the environment is accorded a low priority with one individual describing NSW secondary schools as "a desert when it comes to environmental education" (Smith, 2006).

A recent study by Boon (2010) reported that some pre-service secondary teachers (in Queensland) displayed a low engagement with environmental science, confusion about the scientific principles involved, and a reliance on informal sources of information such as popular media. Common misconceptions relating to climate change were: global warming is caused by increased penetration of solar radiation; climate change is connected to holes in the ozone layer; increased rates of skin cancer are a long term outcome of climate change; and, the use of unleaded petrol will reduce climate change. Boon concluded that given this situation it was not surprising that the quality of secondary students' knowledge on climate change remained consistently poor and had not improved in the past decade despite increased global awareness of climate change issues.

By contrast, Imerson and Skamp (1995) surveyed NSW teachers in the Northern NSW region and reported that primary school teachers incorporated environmental education far more into their curriculum than did secondary school teachers. The implication is that primary school teachers may have less difficulty in integrating sustainability education into their curriculum than do teachers in secondary schools.

The possible limited nature of sustainability education in secondary schools makes it important that students need to have experienced education for environmental sustainability before they leave primary school because it appears uncertain that it will be a focus of formal education in some secondary schools.

Environment and Sustainability

The second area to consider in justifying the research is the need to understand students' awareness of environmental sustainability and how it is informed by the students' knowledge of the condition of the environment both locally and globally. These students represent the next generation of citizens who will be responsible for making informed choices about human interaction with the environment and the need to manage its sustainability. This is particularly significant at the present time where environmental sustainability is threatened by the possibility of human-induced global warming and climate change.

Scientists who expound the view that global warming and climate change are human-induced, consider that these issues may be the greatest challenges confronting our planet (Schultz, 2006). If this is the case, it follows that it is important that our students become aware of these challenges so that they can make informed choices in the development of practices that support environmental sustainability. Extreme weather events and battles over resources highlight the urgent need to find sustainable solutions (Sayle, 2006). Related to the issues of global warming and climate change is the challenge of an ever-increasing world population and its increasing consumption of natural resources (Sayle, 2006). Education at all levels should foster understanding of the need for humans to make responsible choices in their use of natural resources.

In recent times there has been an increasing awareness of global warming and climate change issues. They have become mainstream ideas receiving comment from politicians and coverage in the media.

> *Public concern and media coverage are increasing nearly exponentially: in just a few months climate change has gone from the preoccupation of sandal-wearing greenies to the top level of policy posturing of presidents and prime ministers* (Reay, 2006, p. xiii).

Both global warming and global cooling are natural cycles as the Earth alternates between ice ages and warmer interglacial-glacial periods, like the one in which we currently live. Of real concern now is the possible unnaturally rapid, human-induced global warming imposed on the natural cycle caused by pollution with greenhouse gases (Hogarth, 2007).

Students need to be aware of global warming and climate change issues so that they are able to make responsible and informed choices in relation to actions that impact on sustainability issues. Recently, Reay (2006) summarized the concern relating the global warming and climate change issues as follows:

> *Sea (level) has risen almost 30cm since the mid-19th century and models suggest it could rise a further 90cm or more by around 2100* (p.12).
>
> *The precise impacts of global warming are often hard to predict because the world's climate system is so complicated. One effect may cause another, resulting in a cascade of problems. Some effects may cancel out others* (p.15).
>
> *Global average sea level has already risen by around 15cm over the past 100 years, with another 18cm rise predicted due to global warming in the*

> *next 30 years. If this trend continues, we could see a sea level rise of up to 88cm by 2100* (p.15).
>
> *Carbon dioxide concentrations are expected to more than double by 2100. As a result, global temperatures will rise by between 2 and 5 degrees C, having already gone up by about half a degree during the 20th century. It's this warming, and the catastrophic impact it may have on our global climate, that threatens us all* (p.17).
>
> *Most of the warming observed over the last 50 years is likely to be attributed to human activities* (p. 20).

Some fundamental facts (from Reay, 2006) in the argument supporting global warming and climate change are:

> ** Greenhouse gases warm the planet.*
> ** Global temperatures have risen 0.6 degrees C in the last 100 years.*
> ** Concentrations of greenhouse gases in our atmosphere are now higher than at any time in the last 420,000 years.*
> ** Since the industrial revolution greenhouse gas concentrations have risen by around 50%* (p. 21).
>
> *Along with rapid population increase in the 18th century came a big increase in consumerism* (p.24).
>
> *Close to half of all our greenhouse gas emissions (are derived from) transport* (p. 25).
>
> *(The generation of) Greenhouse Gas Emissions (is caused by):*
> *Cars 40%*
> *Households 36%*
> *Food 12%*
> *Flights 6%*
> *Waste 6%* (p. 26).

Sustainability education has a role in helping students to acquire knowledge of global warming and climate change issues, so that their actions are informed by a clear understanding of the scientific, ecological, socio-cultural and economic phenomena involved.

> *Dissemination of knowledge through education and public information campaigns can lead to adaptive behavioural change. Such activities have been little recognized and given little priority in the past, but are likely to assume increased importance.*
>
> *Educate, inform, and encourage behavioural change as the need to involve more communities, sectors, and regions in adaptation becomes apparent. Water conservation and fire prevention campaigns and regulations are already major adaptive trends in countries such as Australia* (Pittock, 2005, Item 8, p.136).

For educators and researchers a continuing difficulty is that the facts used by scientists who support human-induced global warming and climate change (e.g. Pittock, 2005; Reay, 2006) are disputed by other scientists (e.g. Ibbotson, 2007; Pilmer, 2009) who question the scientific basis for global warming and support the idea that if global warming (or even cooling) is happening it is more likely to be the result of natural events over which human activity has little or no influence. While this debate is a continuing one it is necessary to acknowledge that at the time that the data were collected, the view that global warming and climate change were the result of human action dominated media attention and was thus more frequently represented in the students' comments.

1.7 Theoretical Basis for the Research

The collection, reporting and analysis of the data are underpinned by a review of: the historical basis of environmental education (discussed at 2.2); the literature relating to environmental education (discussed at 2.5); and, environmental worldviews (discussed at 2.6).

While the environmental actions that students take are hopefully based on informed decisions, they are also likely to be influenced by the particular worldview (or attitude) held by individual students (Fien, 1993). An understanding of students' environmental worldviews is important as it is these worldviews that influence student behaviour towards the environment. The particular worldview that a student holds will determine their support for conserving or exploiting the environment (Fien, 1993). Environmental worldviews in the literature consist of three components: how people think the world works, what they think their role in the world should be, and what they believe is right and wrong environmental behaviour (Thinkquest, 2005).

Dunlap & Van Liere (1978) developed a New Environmental Paradigm (NEP) based on three human value orientations. They are: egoistic, biospheric and altruistic. They are also referred to (by Stern, 1993) as: an anthropocentric or homocentric or human-centred worldview; a biocentric or life-centred worldview; and, an ecocentric or Earth-centred worldview.

The nature of these environmental worldviews is explored at 2.6 and the extent to which they are held by the students in the study is explored in the conclusions at 5.2.5.

1.8 The Research Methods

This is a qualitative study that is interpretative and informed by Grounded Theory (Cohen et al., 2000; Marshall, 1995) in that it aims to investigate and explain how young children, in their final years of primary school education, perceive environmental sustainability and how these perceptions influence the environmental behaviours that they display or propose. It examines the perceptions of environmental sustainability as expressed both orally and in writing by the students involved in the study. It investigates how primary school students' worldviews impact on their understandings of environmental sustainability.

This study collected data from 146 students in Years 4, 5 and 6 in one NSW Sydney metropolitan primary school that had been involved in the trialling of the Sustainable Schools Program (NSW DET, 2001a). The data collection used an open-ended questionnaire applied to three different environmental scenarios. This was supported by focus group discussions and individual interviews of randomly selected students in order to enrich the data gathered. The data provide a rich insight into how the students in the study perceived environmental sustainability.

The data were analysed with reference to the literature relating to young children's understandings of the environment, sustainability and worldviews using a grounded theory approach.

1.9 Limitations of the Study

The study was conducted by the principal researcher (GW) and consideration was given to the need to guard against bias. This was achieved by involving teaching colleagues, co-supervisor and supervisor in interrogating the data collected so that the possibility of biased data influencing the study was reduced.

As there were limits on the amount of access that the researcher had to the students involved, data collection strategies involving triangulation (Bell, 1993; Burns, 1997; Lincoln & Guba, 1985; Wiersma, 1986) were used. This involved the collection of data on multiple occasions using an open-ended questionnaire, focus group discussions, and individual semi-structured interviews of students and teachers. Three scenarios about renewable and non-renewable natural resources (forests, fuels and fish) were used as the basis for the questionnaire, and to initiate the discussions in the focus groups and semi-structured interviews. While other natural resources were occasionally referred to by the students and the researcher, the extent to which they were discussed was limited mainly due to the time and access available for data collection. In the time available for data collection the three scenarios were the maximum number that could be used. Also, because of the time available it was not possible to conduct repeated individual interviews.

The study has some limitations and caution needs to be exercised in drawing wider generalisations. The results and conclusions drawn from the study are specific to the subject group involved in the study and care must be taken if extrapolating from the data and applying the findings and conclusions to a broader situation. As the case study involves only one sample group of 146 students in one school, and as this school has implemented a significant sustainability education program, broader investigation and the inclusion of schools from varying socio-economic backgrounds would be useful in clarifying and generalising from the conclusions. However, care is needed in using conclusions derived from this study when applying them to other situations that involve young children.

The study is not an evaluation of the DET Environmental Education Policy (NSW DET, 2001a). As previously stated, the trial of the DET Sustainable Schools Program (NSW DET, 2001b) has been evaluated (Chodkiewicz & Flowers, 2005) but an evaluation of the program since its mandatory implementation in all DET schools does not appear to have happened. The study does not examine in detail the influence of sustainability curricula and pedagogy on the students' perceptions of environmental sustainability. Instead it uses scenarios involving natural resources and applies these to an open-ended questionnaire and discussions in focus groups and individual semi-structured interviews.

It needs to be acknowledged that the subjects are young children with limited skills of articulation and expression. As the data were collected about complex environmental issues using written responses on an open-ended questionnaire

and digital voice recordings based on environmental scenarios that are deliberately highly contextualized, the responses of the children are limited by their capacity to express their ideas. Care has been exercised in interpreting the children's statements seeking confirming and disconfirming statements.

As the students are still developing understandings of scientific phenomena and environmental issues, their views on environmental sustainability may vary according to the nature of the discussion at the time. As a result some students may express views on different occasions that appear to be contradictory. Views that appear to be consistent may be somewhat tenuous and may change depending on the context of discussions at other times and in other situations.

1.10 Contribution of the Study

This study has implications for the implementation of sustainability education at the primary school level and beyond. It is important to understand young children's perceptions of environmental sustainability as this provides a basis for sustainability education curricula that best meet their needs. This study draws on its findings and the literature to elaborate significant changes to sustainability education curricula that will benefit young children. Walker and Brady (2002) reported that the production of curriculum documents, policy statements and resource material were not consistently based on the environmental understandings of students. A better understanding of students' perception of

environmental sustainability will support improved teaching and learning in environmental education.

1.11 Organisation of the Thesis

Chapter 1 presents an introduction to the research discussing the background and rationale for the research problem. It outlines the context of the research and the researcher. It explores the environmental education program currently used in NSW primary schools and the various policy documents that have influenced the program. It introduces the research method and discusses the limitations and contribution of the study. Finally, it provides definitions for significant terms used in later discussions.

Chapter 2 presents an analysis of literature that has informed and shaped the research. It begins with an account of the evolution of environmental education from the outdoor nature studies programs of the 1940s up to the current sustainability education programs. It also considers the tensions apparent in the literature that influenced these programs. The literature relating to environmental education and environmental sustainability is reviewed and discussed to provide insight into the complex nature of children's perceptions of the environment and sustainability. Worldviews are discussed as a key theory as the students in the study have expressed particular personal views that influence how they relate to the environment and the environmental actions that they propose.

Chapter 3 presents a description of the methodology of the study. The study is qualitative in nature and uses methodology informed by Grounded Theory to produce data which were analysed using a theoretical framework that is informed by the literature.

There are discussions of the methodology used, the design of the study, the NSW metropolitan primary school used, the students involved, the data collection strategies, and the validity of the study. How the data were analysed, ethical considerations, and problems that arose during the study are also discussed.

Chapter 4 presents and discusses the student data from the research. It lists the themes that emerged from the data collection and initial analysis phases of the study. It begins with the range of views of environmental sustainability held and expressed by the students in the study. Selected quotations from the student data are used to illustrate these views. Extreme and confused views are also defined and discussed.

Chapter 5 presents the research conclusions and discusses the implications for curricula. This discussion focuses on: students' perceptions of environmental sustainability; the socio-economic dimension; actions proposed by the students; catastrophic views; students' environmental worldviews and sustainability; and influences on children's perceptions of environmental sustainability.

Chapter 6 presents and discusses an emerging framework of primary school students' notions of environmental sustainability. Following this there is discussion of the implications for sustainability education curricula.

1.12 Definitions

Anthropocentric: A fundamental component of Western thought that places humans in a central position as the masters of nature (Alerby, 2000, p.217).

Biocentric: Rationales for environmental protection based on the value or rights of nature itself (Kempton et al., 1995, p. 106).

Carbon dioxide (CO_2): The greenhouse gas which human activities produce in massive quantities over and above natural emissions, mainly from digging up and burning carbon-based fossil fuels like coal, oil and gas. Scientific evidence suggests that rising and falling CO_2 levels in the atmosphere are closely related to variations in average temperatures (Hogarth, 2007).

Climate change: Climate is the medium to long-term average of the weather statistics and it changes naturally over time, with average temperature movements a major factor in determining the direction, severity and speed of change (Hogarth, 2007).

Ecocentric: Having an Earth-centred focus with the natural environment and biodiversity requiring continued protection (Fien, 1993).

Ecological Sustainable Development (ESD): Is an idea that is Australian in origin and involves: integrating economic and environmental goals in policies and activities; ensuring that environmental assets are properly valued; providing equity within and between generations; dealing cautiously with risk and irreversibility; and recognising the global dimension (Stokes, 2009).

Environmental sustainability: A dynamic balance among many factors, including the social, cultural and economic requirements of humans and the imperative need to safeguard the natural environment of which humanity is part (UNESCO, 1997). Environmental sustainability:

- Represents a shift from environmentalism (conservation of the natural environment) to embrace exploitation and development so long as the natural environment is not degraded to such a degree that it cannot naturally recover. That is that resources can be used to the benefit of the current generation without damaging the prospects of future generations.
- Is fundamentally homocentric or anthropocentric rather than ecocentric as in environmentalism.
- Is concerned with ensuring the quality of human life that permits certain costs to the environment.

- Is about human sustainability and only looks after the environment such that it permits human survival and improvement to the human condition.
- Makes “sustaining” the environment subject to economic growth where the activities for this growth are only limited if they impact adversely on the lives of future generations.

The definition used in the DET Environmental Education Policy for Schools views environmental sustainability as involving human impact on the environment for the benefit of the current generation so long as the environment is not degraded to the detriment of future generations (NSW DET, 2001b).

Global warming: Both global warming and global cooling are natural cycles as the Earth alternates between ice ages and warmer inter-glacial periods, like the one in which we currently live. Of concern now is the possible unnaturally rapid, human-induced global warming imposed on the natural cycle, which is caused by pollution with greenhouse gases (Hogarth, 2007).

Greenhouse gases: These are naturally occurring and industrial gases that can accumulate in the atmosphere and prevent heat from escaping into space, acting like a blanket around the planet, and in the right concentrations maintaining a habitable climate for humans. If the concentrations become excessive, greenhouse gases can trigger overheating (Hogarth, 2007).

Homocentric: The environment needs only to be protected when human welfare is at stake (Kahn & McCoy, 1992).

Social Critical Theory: In environmental education social critical theory requires that along with the understanding of environmental issues there is an awareness of the related socio-cultural issues involved and commitment to action to redress both sets of issues (Cohen et al., 2004, p.28).

Sustainability: The classic definition of sustainability is meeting the needs of today's generations while not compromising the ability of future generations to meet their own needs. Sustainability in a community or business or in our own lives means integrating social, environmental and economic factors into a single stream for day-to-day management, in ways that deliver wellbeing for human civilization without compromising our planetary support system (Hogarth, 2007).

Sustainability is a complex notion that means different things to different people (especially to developers and conservationists) but essentially it represents a shift from an ecocentric view of the environment (conservation of the natural environment) to a homocentric or anthropocentric view (the importance of humans in relating to the natural environment). This shift has been fundamental to the development of sustainability education programs. If teachers and their students are to develop an understanding of "environmental sustainability" it is important that they be aware of the origins and intent of the idea.

Chapter 2: Literature Review

Humans! Please be kind to all Bush Creatures
and don't pull flowers up by the roots.

Gibbs, M. (1918). *Snugglepot and Cuddlepie,* p.3.

2.1 Introduction

Education for environmental sustainability gained prominence in the 1990s and developed from the environmental education programs that existed at that time (Fien, 1997; Greenall-Gough, 1992). The intention of sustainability education was to incorporate human issues such as peace, human rights, gender, race and social equity with conservation of the natural environment (Fien, 1997). Internationally this conceptual initiative was facilitated by the Earth Summit in Rio de Janeiro in 1992, which sought to align sustainable development and sustainability with environmental education (Fien, 1997). In Australia this initiative was promoted by the Australian Association for Environmental Education (AAEE) at its 1990 international conference: "Our Common Future: Pathways for Environmental Education" (Greenall-Gough, 1992).

Sustainability education has evolved from various historical trends in education. These are traced in 2.2 from its antecedents in the outdoor education movements of the 1940s to the present time.

The meaning of sustainability is discussed in 2.3 in order to provide insight into the complex nature of sustainability and the environment. The discussion examines and seeks to clarify the terms that appear in the literature, such as: sustainability, sustainable development, education for sustainable living, environmental sustainability, and ecologically sustainable development.

The current orientation of environmental education as education for environmental sustainability or education for sustainable living is discussed in 2.4.

The research literature focusing mainly on studies that are relevant to the primary school is reviewed in 2.5.

Literature relating to environmental attitudes or environmental worldviews is reported and analysed in 2.6. This has relevance for the study as an individual's worldview underpins their behaviour towards the environment. Worldviews are discussed as a key theory in this study. Students in the study have expressed particular personal views that influence how they relate to the environment and the environmental actions that they propose.

2.2 From Outdoor Education to Education for Environmental Sustainability

Sustainability education has evolved from its antecedents in the outdoor education movements of the 1940s to the present situation and may be represented diagrammatically as follows in Figure 2.1:

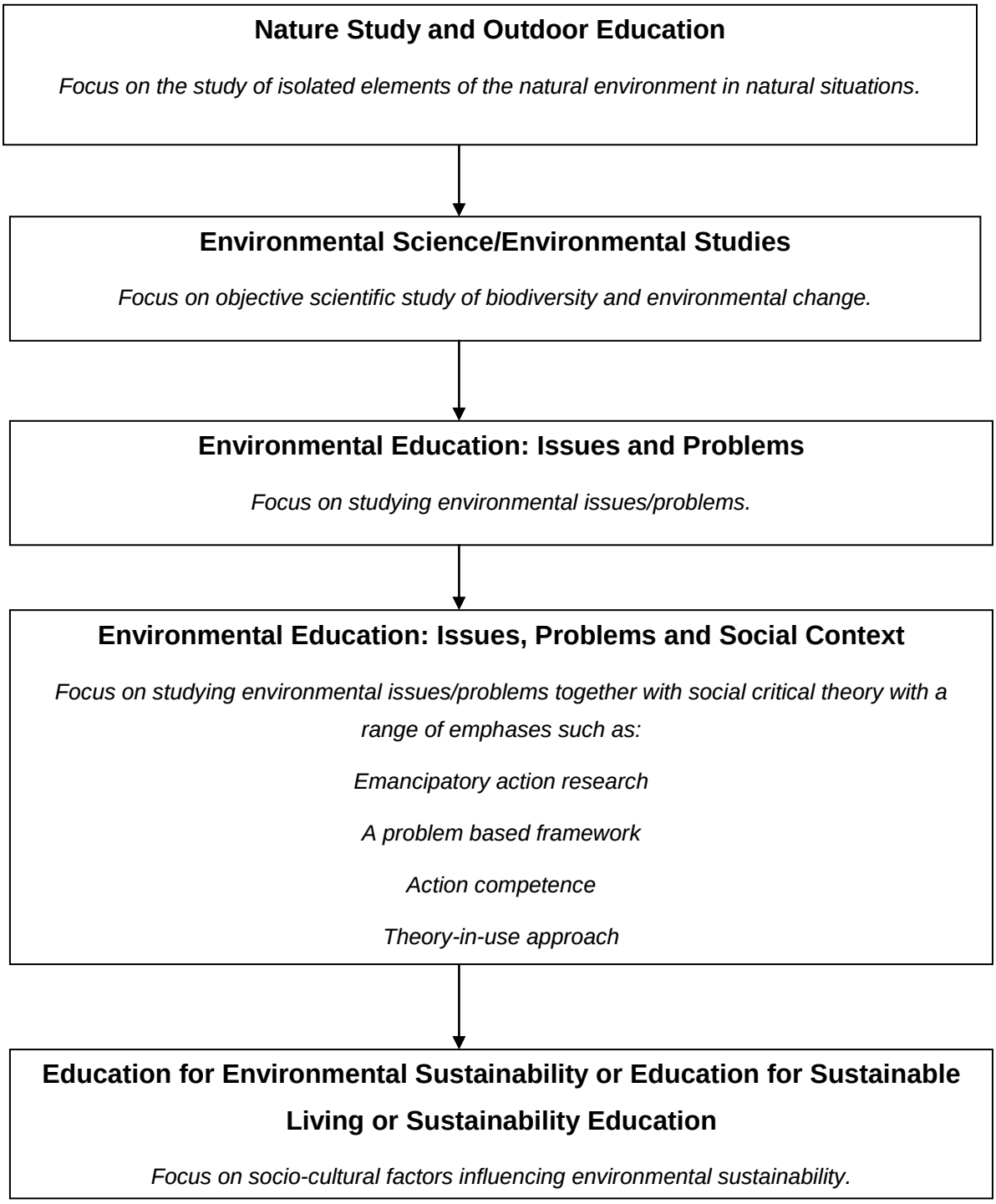


Figure 2.1: The Evolution of Environmental Education (as derived by the researcher from the literature).

Environmental education has its origins in the related elements of nature study curricula that became popular in the 1800s (Smith, 1972). These curricula aimed to study elements of the natural environment such as geology, marine life and botany. They were largely activity-based and encouraged curiosity and the development of observation skills in students. However, they also aimed to develop in students a love of nature that would lead to a caring attitude towards the natural environment (Knapp, 1990).

The 1940s saw a resurgence of outdoor education programs. This was in response to the increasing industrialisation and urbanization that followed World War II (Donaldson & Goering, 1972). Educators were concerned that increasing urbanization was decreasing children's contact with nature and they felt that schools should provide access to nature and wild places as part of their curricula (Kelley, 1972). With outdoor education programs being implemented as a component of school curricula, outdoor education became more widely accepted (Smith, 1972).

The 1960s saw increasing concern about the environment and environmental degradation highlighted by writings such as that of Carson (1963) "The Silent Spring". As a result there was an increase in outdoor education and related training programs for teachers. This led to the development of environmental education as a cross-curricular initiative (Carroll, 2002) meaning that environmental education

was not viewed as belonging to only one curriculum area such as sciences but was recast as a field of study endeavour that had links to all key learning areas requiring multidisciplinary knowledge, understandings and skills (Salmivalli, 1998).

In Australia the term “environmental education” developed in the 1970s. It was first recognised at the Australian Academy of Science conference on *Education and the Environment* in 1970 (Gough, 1992). In the mid 1970s it was viewed as Environmental Science and was linked to rural or agricultural sciences. Technological advances during the 1980s saw support for environmentalism decline as technological advances were viewed as being able to solve environmental problems (Fensham, 1990). Environmental Science also changed as a result of an epistemological debate between the natural sciences and the social sciences (Fensham, 1990). Environmental Science was considered to be more aligned with geography than with science and was increasingly referred to as Environmental Studies. As such it was located in the social sciences rather than science. While this name change occurred in a NSW curriculum context, it was typical of a worldwide movement that saw studies of the environment take on more socio-cultural directions (Fensham, 1990).

These developments in environmental studies witnessed a similar movement in the natural sciences with the development of science, technology and society (STS). However, the two curriculum areas, according to Fensham (1990) and Hart (1990), viewed their “social” contexts in different ways. While science focused on the “social impact” of science, including its “social usefulness” and the “social

problems” that science could solve or cause, environmental studies followed a social science perspective that incorporated social values and attitudes into their concept of environmentalism. During the late 1980s environmental education policy statements and curricula were developed and implemented nationally in Australian schools and in other countries.

At this time, there was an increase in the research literature that addressed teaching and learning in environmental education. Educational researchers studied and reported cases of best practice (Walker, 1997). However some researchers argued that this research had little influence on guiding and improving the teaching of environmental education in some schools and, furthermore, suggested that environmental education was not being implemented in many schools (Phipps, 1991; Spork, 1992; Walker, 1995; Walker, 1997).

Environmental education continued to focus on environmental issues with the study of issues such as the greenhouse effect, pollution and acid rain, being the focus of learning rather than studying the socio-cultural issues responsible for them (Walker, 1997). Environmental education policy statements and curricula were developed and implemented with the meaning of the words “about, in and for the environment” as their focus (see NSW DET, 2001a, p. 9). The assumption was that teachers taught “about” the environment, while student experiences occurred “in” the environment, with the purpose of learning “for” the sake of the environment. This process of learning “about”, “in” and “for” the environment was the only change from studying specific environmental issues. While this scaffolding could

be regarded as providing a theoretical basis for environmental education, it was lacking as a comprehensive and powerful tool for engaging students in critical, reflective analysis of human socioecology and global environmentalism (Watson, 2002). Additionally, the use of the term “the environment” implied the notion that environments were viewed as the natural environment devoid of socio-cultural impact and separate from built environments (Walker, 1995).

Internationally, the need to have a socio-cultural focus in environmental education was supported by *The Organisation for Economic Co-operation and Development* (OECD) with an international research study called the *Environment and School Initiatives* (ENSI) project (Robottom, 1993). Australia developed and contributed nine case studies to this project and these related environmental education outcomes to “more socially critical” criteria (Robottom, 1993, p. 64) by using social critical theory to evaluate the teaching of environmental education. Of the case studies only two demonstrated a commitment by teachers to socially critical values and attitudes and therefore there was a poor alignment with a socio-critical theoretical framework. However, they did illustrate the value of social critical theory as a useful, theoretical framework for environmental education. Social critical theory requires that along with the understanding of environmental issues there is an awareness of the related social and cultural issues involved and commitment to action to address both sets of issues (Cohen et al., 2004). However, it was the action component of social critical theory that was problematic for many teachers

because such actions, as well as being difficult, could also be politically and economically controversial.

Researchers (Greenall-Gough, 1990; Huckle, 1991) argued for the use of social critical theory as it would provide a holistic perspective for environmental education. However, there was debate about the meaning of “critical” in critical theory and of “education” in environmental education. It was argued that education for the environment should involve more than teaching students appropriate values and attitudes towards the environment and how they should act. Instead students needed to be taught to actively consider opposing views and to determine their own course of action after developing their own values and attitudes (Fien, 1992; Greenall-Gough, 1992; Jickling, 1991; Robottom, 1992; Spork, 1992). The ENSI project reflected the evolutionary path followed by environmental education (shown in figure 2.1) and gave some insight into its possible future direction. The focus of environmental education was changing from an objective scientific study to a more subjective political and economic analysis with action and advocacy as features, along with an evolution towards understanding the complexity, controversy and importance of global sustainability within an ethical and moral code (Coolsaet, 1994). Environmental sustainability and the socio-cultural factors inherent in this were to be the focus of environmental education supporting the scientific study of the environment and environmental issues.

A preliminary discussion paper, ”Educating for a Sustainable Future: A Transdisciplinary Vision for Concerted Action”, presented at the 1997 UNESCO Thessaloniki International Conference on *Environment and Society: Education and Public Awareness for Sustainability*, contextualised the outcomes of previous conferences in terms of social critical theory. It focused on social issues such as population, poverty, environmental degradation, democracy, human rights and peace, development and interdependence (UNESCO, 1997) placing environmental issues within a socially critical context. It endorsed social critical theory as a suitable theoretical framework for studying environmental issues and directing environmental education.

However, some researchers argued that social critical theory had limitations as a framework for environmental education. Walker (1997) argued that the implementation of environmental education in schools had been problematic given that while some environmental problems were identified, they remained unresolved. She agreed that environmental education was influenced by social critical theory but argued that social critical theory was not workable as a theoretical basis for environmental education. She argued that social critical theory advocated the adoption of “socially critical curriculum theory” (p. 155) wherein teachers were required to question prevailing practices and adopt a pedagogy that encouraged students to question authority and to be politically active in this process. For many teachers who viewed teaching and learning as taking place within an apolitical curriculum, the issue of socially critical environmental education

was unacceptable (Walker, 1997). It was the “for the environment”, or the action component which differentiated environmental education from other curriculum areas and required teachers to revise their views of teaching and learning. Learning outcomes were only achieved when students were able to take action “for the environment” (Walker, 1997).

The opinion of Walker (1997) was that it was the “action” feature of social critical theory that was unlikely to be supported by many teachers. She suggested that “action” might be redefined as “change”, as in a change in values and attitudes. However, this was not fundamentally different from the outcomes sought from socially critical theory. A change in attitudes or values was an action and could be an outcome of the existing social critical theoretical framework, depending on the context. Therefore, such a move was more a recontextualisation of the existing theoretical framework as there was very little to be gained in changing attitudes if this did not result in a change in action.

However, the main reason behind Walker’s reorientation of environmental education to a new theoretical framework remained. According to Walker social critical theory was limited by constraints such as “the structures of school education” (Walker, 1997, p. 160) meaning that the action component could not be accommodated by most teachers and schools. This was such a significant problem that a more practical theoretical framework needed to be found. She suggested that the action component that distinguished environmental education from other

curriculum areas and was the feature that gave environmental education its strength of identity, was also its greatest weakness. Her solution was to use a problem-based theoretical framework where students would study an environmental problem and consider the actions needed to address the problem. Walker (1997) concluded that such a pedagogical framework was also likely to be too difficult for teachers to implement and therefore would not be a useful solution. Similarly, Robinson (1994) argued that in schools, social critical theory was not a viable strategy for social action as schools could not accommodate the action component of the radical social change required by the theory.

According to Huckle (1991) the competing ideologies of economics and ecology needed a pedagogical framework that was a compromise and social critical theory was only a part of this compromise. He claimed that environmental education was failing at the school level because current environmental education practices failed to reveal the underlying causes of environmental problems. They were therefore unable to educate students in a manner that allowed them to comprehend environmental sustainability. Although social critical theory was a useful theoretical basis for environmental education, the school context did not provide a broad curriculum base for adequately addressing highly complex socio-cultural issues like poverty and human rights and their connections to environmental problems. Huckle (1991) argued that such abstract ideas and the connections between them were difficult for adults, let alone children, to understand. Furthermore, as schools were socially conservative organisations that did not promote radical, interventionist strategies to overcome perceived social problems, schools, rather than being sites

for counter social movements, preserved the status quo (Huckle, 1991). Similarly, Fien (1993) and Robinson (1994) both argued that social critical theory as a framework for environmental education was not useful since there was a lack of connection between theory and practice. They saw teachers and students as passive victims of wider economic forces and argued that for environmental education to be effective, teachers and students needed to resist conservative, apolitical forces and work towards social reform through active participation.

An outcome of these debates was that some social critical theorists promoted a pedagogy called “emancipatory action research” (Fien, 1993; Greenall-Gough, 1990; Huckle, 1983; Robottom, 1993). In this, students identified environmental problems, conducted investigations, collated data, suggested solutions, developed action plans, implemented these plans and identified other problems which moved the action spiral towards new solutions that produced further problems to be addressed (Walker, 1997). At each stage students reflected on their findings and modified their action plans.

Emancipatory action research was criticised by Walker (1997) who argued that it was about inquiring into practice and not necessarily about solving the problems that result from the inquiries. She argued for a problem-based theoretical framework for environmental education in which students worked collaboratively to inquire into environmental problems with the intention of devising appropriate solutions and taking action to address the problems. A problem-based theoretical

framework accommodated the different views held by teachers, including social critical theory, and the many factors impacting on the teaching and learning of environmental education in schools.

After examining the theories and practices of environmental education Walker (1995) provided recommendations that were influential in the development of sustainability education programs in NSW schools. These provided a practical problem-based theoretical framework as way to achieve the interdisciplinary objectives of an environmental education curriculum that involves knowledge and understanding about the natural environment, skills in learning about and managing the environment, and the attitudes and values implicit in such ideas as human rights and responsibility, intergenerational equity, solidarity, justice, democracy, freedom of expression and tolerance.

Other researchers (Breiting, 1994; Morgensen, 1996; Schnack ,1996 & 1998) argued for an approach to teaching environmental education where an “action competence” and a conflict of interest perspective were central. Action competence was defined as a:

> *Capability (based on critical thinking and incomplete knowledge) to involve yourself as a person with other persons in responsible actions and counter-actions for a more humane world* (Schnack, 1996, p. 15*).*

An action competence approach provided students with insight into the social and structural problems and conflicts of interests that underpin environmental

problems. The approach also implied a desire to solve the problem by taking action to achieve change (Wickman & Ostman, 2002).

Similar to action competence was the theory-in-use approach (Agyris & Schon, 2004). Before the introduction of the idea of education for sustainable living (or education for sustainable development), teaching about the environment was linked to studies in ecology or the natural sciences (Breiting, 1994) and this arrangement appears to have been based on the belief that experiences in nature and an appreciation of ecological relationships would promote care and concern for the natural environment. In opposition to this teaching and research paradigm is the view that the supposed link between experiences in the natural environment and care and concern for the natural environment is without relevance (Breiting, 1994; Morgensen, 1996). These researchers promoted a view of environmental education that began with social issues and encouraged critical thinking in relation to human conflicts of interest. They advocated a “change in the values of theory-in-use” (Agyris & Schon, 2004, p. 65) which involved examining the social issues that gave rise to environmental issues and then using these as the basis for educating active, constructive and oppositional citizens that could question the basis of the existing system (Sterling, 2004). Their concern was that teaching about the environment should not only be analysed in terms of how it reproduces existing social practices, but also in terms of its potential to nurture moral courage and constructive opposition.

In terms of curriculum implementation, some researchers (Lundegard & Wickman, 2007) were critical of many of the environmental projects undertaken in schools because they felt that they were actually teacher inspired projects and that these projects tended to focus on the symptoms of an environmental problem rather than finding the cause. For example, when students cleaned up litter, they became passive beings with little opportunity for independent thinking about the underlying causes of an environmental problem. Although the students were involved in direct physical action “for the environment” their actions were unlikely to encourage a change of attitude towards the environment (Lundegard & Wickman, 2007).

For students to acquire action competence they needed to be aware of the controversy and conflicts of interest (the theory-in-use) underlying the environmental problems. Questions of environment and sustainable development were not just about relations between humans and nature, but also about the conflicts of interest between (and within) human beings (Schnack, 1998). Students needed to be involved in informed and democratic discussion about environmental problems so that a range of different arguments were expressed, debate encouraged, and conflicts of interest understood so that the result was student awareness and empowerment (Benhabib, 1992).

Contributors to this debate saw education as a means for students to address the challenges of the future and to effectively participate in developing new and meaningful relationships between people and a greater respect for the environment

(UNESCO, 1997). Teachers and education were fundamentally important in implementing global change through the dissemination of knowledge; the development of skills; changing lifestyles, behaviours and values; and developing critical, ethical attitudes for solving environmental problems (UNESCO, 1997, p.16).

The Earth Summit in Rio de Janeiro in 1992 had served to facilitate an international trend towards this expanded view of environmental education and its alignment with sustainability. It encouraged environmental education to abandon its preoccupation with natural systems and to incorporate the concept of sustainable development, including the issues of peace, human rights, gender, race and social equity as well as nature conservation (Fien, 1997).

A realignment of environmental education was also supported by the UNESCO paper prepared for the Thessaloniki Conference (1997). It argued that because most of the world was neatly compartmentalised within nations, so human activities and their effects were also confined within boundaries. Human activities were confined within broad areas of concern such as the social, the economic and the environmental. Various crises such as an environmental crisis, an economic crisis, and an energy crisis were other divisions. However, these crises were not separate but were in fact all aspects of the same crisis relating to world environmental sustainability. The boundaries were artificial and were now no longer relevant (UNESCO, 1997). Realigning education to sustainability recognised the need to

remove the artificial boundaries. This new perspective on environmental education was needed to cope with the complexities of human effects at the local, regional and global environmental levels as well as those of the present and future. This was expressed in the conference conclusion that:

> *sustainable development will require an education that not only continues throughout life, but is also as broad as life itself, an education that serves all people, draws upon all domains of knowledge and seeks to integrate learning into all of life's major activities* (UNESCO, 1997, p. 21).

An alignment of environmental education with the concept of sustainability was advocated by the UNESCO (1997) paper and by Fien (1997). The UNESCO paper argued that through the pursuit of sustainable development reforms, humanity might learn to educate for, and move towards, sustainable lifestyles. Environmental education was viewed as part of a larger process that served to educate people in making informed choices about living sustainably. The Thessaloniki Conference discussion paper (UNESCO, 1997) also questioned the conceptual framework for environmental education and advocated a reconceptualisation of environmental education as part of a universal process of educating for a sustainable future.

The UNESCO (1997) paper called for changes in perceptions and values that might assist communities to adopt sustainable lifestyles and used the expression "education for sustainable living" (UNESCO, 1997, p. 29). "Education for sustainable living" would involve rethinking fundamental values such as human

rights and responsibility, intergenerational equity, solidarity, justice, democracy, freedom of expression and tolerance (UNESCO, 1997). The notion of sustainable living saw as its goal a:

> *move towards a new global ethic which transcends all other systems of allegiance and belief, which is rooted in a consciousness of the interrelatedness and sanctity of life (*UNESCO, 1997, p. 32).

Past environmental education curricula had tended not to question an unsustainable culture that intensified environmental and development problems rather than empowering people to act and work towards solutions. Education for sustainable living aimed to help students determine what was best to conserve in their environment and what required change as well as nurturing the values and strategies for attaining sustainability.

Throughout this debate, some researchers (e.g. Walker, 2002) expressed the concern that there was a lack of alignment between the theory and practice of environmental education. Walker was also concerned that environmental education programs were being developed based on assumptions of what children know and believe. In doing this she was identifying the paucity of studies that focus on children's knowledge and understanding of the environment. This theme is at the core of this research and is explored in 2.5.

Environmental education had become more than the study of scientific and environmental phenomena. It had incorporated the study of environmental

problems and their inherent socio-cultural issues along with the need to propose solutions and to take action to address environmental problems. Differences existed in the means by which this might be done. Some educators advocated beginning with the conflicts of interest within and between humans (theory-in-use approach). Other educators advocated beginning with the study of environmental problems (emancipatory action research, problem-based learning, action competence). Despite these different approaches there was agreement that students needed to be actively engaged in learning about the environment and environmental problems so that the sustainability of the environment in perpetuity was ensured. With this basis, environmental education came to be referred to as education for sustainability or sustainability education.

The two UNESCO conferences (Rio de Janeiro 1992 and Thessaloniki 1997) had initiated the current position of education for sustainable living or education for environmental sustainability. Sustainability education is viewed as having a focus on three interrelated areas:

Care for the environment and environmental sustainability,

The socio-cultural influences affecting the environment, and

Environmental problems and the means by which to address them.

2.3 Environmental Sustainability

It is useful to consider the implications that are involved in education for sustainable living or education for environmental sustainability. To clarify the meaning of “sustainability” it is pertinent to consider the definitions used. There are many definitions relating to “sustainability”. Most refer to the natural environment with some minor variation in emphasis. There seem to be some different regional preferences for the definitions that involve sustainability and these indicate different emphases placed on sustainability.

The terms such as sustainability, sustainable development, education for sustainable living, environmental sustainability, and ecologically sustainable development, need to be clarified. For the purpose of this thesis they can be clarified as follows:

Sustainability

Sustainability is:

> *a dynamic balance among many factors, including the social, cultural and economic requirements of humans and the imperative need to safeguard the natural environment of which humanity is part* (UNESCO, 1997, p. 13).

Sustainability allows human impact on the environment for the benefit of the current generation so long as the environment is not degraded to the detriment of future generations. This is the position used in the DET Environmental Education Policy for Schools (NSW DET, 2001a, p. 24). In essence this orientation permits

the use of the environment for the benefit of humans providing it is not degraded to a level where it will not sustain itself. In NSW educators tend to refer to “education for sustainability” or “sustainability education” (See NSW DET Sustainable Schools Website, 2007b). In the UK and Europe educators tend to refer to “education for sustainable development” or “education for sustainable living” in much the same way as NSW educators refer to “education for sustainability” or “sustainability education” (Corney & Reid, 2007; Luke, 2001; Rauch, 2002; Sauve, 2002).

Sustainability implies compromise between the physical, economic, social and cultural needs of humans and the environment and its need to remain sustainable. Development should not be at the cost of inflicting irreparable damage on environments while at the same time preservation of environments should not be achieved at the cost of constraining much of humanity to poverty (UNESCO, 1997). Sustainability implies interdependence of human needs and environmental requirements through the rejection of the single-minded pursuit of one objective in isolation from others (UNESCO, 1997). Many factors (population, poverty, environmental degradation, democracy, human rights and peace, development and interdependence) cannot be considered in isolation from each other. They are in constant and dynamic interaction. They are related both physically and psychologically (UNESCO, 1997). Environmental problems are, in reality, social problems. They are not problems of nature but of society and are the consequence of human thinking, values and practices in social, economic and political affairs (Di Chiro, 1987). Therefore, “fixing nature” cannot solve environmental problems but

changing the perceptions and behaviours of people to alter how societies interact with environments may solve environmental problems (Whitehouse & Taylor, 1996). To ensure that people understand the interrelationships between the many factors that produce environmental problems, environmental education needs to incorporate the knowledge and understandings, the skills, the attitudes and the values relating to sustainability. For this reason education about sustainable living is important for maintaining the future of both the natural environment and humanity (Whitehouse & Taylor, 1996).

Sustainability is a complex idea that means different things to developers and conservationists. It is the result of discussions between parties that come from very different viewpoints (Fien, 1997). Some environmental conservationists argue that ecological sustainability should be a goal in its own right and not linked to development in any way (Yencken, 1994). In contrast, for business, industry and commerce, economic sustainability is more important than ecological sustainability because development needs to be profitable in order to fund the implementation of environmental regulations and conservation (Fien, 1997).

Lindenmayer (2007) reflects on “sustainability” and the use and misuse of the term. He expresses the concern that the term can be used to mean virtually all things to all people when he comments:

> *There are many definitions of “ecological sustainable” resource management. Indeed, the term “sustainability” has been so widely used and abused that it is regarded by many as a “weasel word”, bereft of true*

> *meaning. It has been used to mean virtually all things to all people. Ecological sustainability doesn't mean the same thing as "sustained production". For example, there might be a sustained yield of timber from a forest (say, 300,000 m3 per year), but if the timber extraction is poorly managed it is not considered "ecologically sustainable" as it has the potential to seriously damage the environment. The best way to illustrate "ecological sustainable" resource management is to define it for a particular sector. Forestry provides an example. "Ecologically sustainable" forest management involves perpetuating ecosystem integrity while continuing to provide wood and non-wood values; where ecosystem integrity means the maintenance of forest structure, species composition, and the rate of ecological processes and functions within the bounds of normal disturbance regimes* (Lindenmayer, 2007, p. xiv).

Sustainable Development

According to Bonnett (1996, 2002), all sustainability education programs must consider the three spheres of sustainable development: environment, society (including culture), and economy. In essence sustainable development has an emphasis that relates to economic growth and development and is concerned with meeting the needs of humans through economically sustainable development. With sustainability cast as sustainable development there are no fixed limits on development and it evolves in relation to changing requirements and technological advances (Watson, 2002).

Sustainable development has been defined by The World Commission on Environment and Development in terms of the present and the future as:

> *Development that meets the needs of the present without compromising the ability of future generations to meet their own needs* (UNESCO, 1997, Item 31).

This is the definition drawn up by the United Nations Earth Summit in 1992 (Agenda 21) and relates to those human activities that comprise a balance

between economic, environmental and social forces. This definition is also used in the DET Environmental Education Policy for Schools (NSW DET, 2001a).

This definition contextualises sustainability in terms of human development and its requirements. Other definitions have extended the notion of equity between the present and the future, to equity between countries and continents, races and classes and genders and ages (UNESCO, 1997). The most widely used definitions focus on the relationship between social development and economic opportunity, on the one hand, and the requirements of environments on the other (UNESCO, 1997). They emphasise the improvement in quality of life for all, especially the poor and deprived, so long as it is within the carrying capacity of supporting ecosystems. Sustainable development has also been defined as the use of renewable resources to promote economic growth, the protection of animal species and biodiversity, and commitment to maintaining clean air and water (Giddens, 2001; UNDP, 1992).

Ecologically sustainable development

O'Riorden (2003) defines ecologically sustainable development as:

> *A constant process of transformation of a society and an economy towards acting as trustees for future generations of the planet that maintain and nurture life and habitability.* (O'Riorden, 2003, p.35)

This definition is similar to that for sustainable development except that the emphasis is on maintaining ecological sustainability which in practice implies sustainability of the natural environment but not for its own sake.

Education for sustainable living

Education for sustainable living has been defined as a process that:

> *develops human capacity and creativity to participate in determining the future, and encourages technical progress as well as fostering the cultural conditions favouring social and economic change to improve the quality of life and produce more equitable economic growth while living within the carrying capacity of supporting ecosystems to maintain life indefinitely*
>
> (IUCN Commission on Education and Communication, 1993, p. 21).

Education for sustainable living avoided the perception that sustainable development was more responsive to the interests of developers as compared to those of environmentalists. However, it was not very demanding as it advocated a focus on economic growth and the quality of human life without an equal need to maintain natural ecosystems.

Environmental sustainability

Environmental sustainability has been defined as:

> *a dynamic balance among many factors, including the social, cultural and economic requirements of humans and the imperative need to safeguard the natural environment of which humanity is part* (UNESCO, 1997, Item 32).

This is a broader interpretation of sustainability that permits the use of the environment for the benefit of humans providing it is not degraded to a level where it

will not sustain itself. Human impact on the natural environment will have effects on natural resources depending on whether the resources are sustainable or non-sustainable. This may relate to whether the natural resource being used or harvested is non-depletable (e.g. solar energy) or renewable (e.g. forests and fishing) or non-renewable (e.g. fossil fuels) and the practices employed in the use or harvesting of the resource.

There are many definitions of environmental sustainability and many of these have political, economic and social overtones. Governments have a responsibility to maintain environmental sustainability by enacting legislation that addresses environmental concerns. In 2009 the Australian Government developed the Carbon Pollution Reduction Scheme also known as the Carbon Trading Scheme. This was opposed in the Senate and failed to become law. The Australian Government has also been involved in international forums (Climate Summits in Kyoto, 1997, Bali 2007, and Copenhagen, 2009) seeking, for example, to reduce greenhouse gases in the atmosphere. This also failed possibly due to the complexity of the international political, economic and social issues involved.

While there are different emphases in education for “environmental sustainability” and “sustainable development” two general themes can be recognized. The first is the concern about damage to the natural environment arising from human lifestyles and their relationships with other humans and with the world around them. The

second is the concern for fostering environmental sustainability by understanding the issues associated with the first theme and how they affect both the quality of people's lives and the future of life on the planet. Ability to address the two themes at school level depends on teachers' knowledge and beliefs about subject matter and pedagogy (Corney & Reid, 2007).

2.4 Education for Environmental Sustainability

The current orientation of environmental education towards sustainability is a continuation of the debate about how environmental education is interpreted since its inception in the 1970s (see e.g. Carroll, 2002; Donaldson & Goering, 1972; Gough, 1990; Gough 1993; Greenall, 1987; Hungerford, Peyton & Wilke, 1983; Robottom, 1984; Shaw, 1982). This is illustrated by the following quotation in which the term "environmental education" has been substituted for "outdoor education":

> *Upon hearing the term (environmental education) for the first time, teachers and administrators frequently ask, What do you mean by that? To many, the meaning of the term is not obvious. In fact, there are a number of different explanations of the term. For some, (environmental education) means going to unspoiled natural areas to learn about nature. To others it means doing any activity considered educational out-of-doors…; while to others it means any educational activity in any natural or cultural environment, outside the confines of a classroom. In the first instance (environmental education) suggests a field of study, in the second instance it means a place for activity, and in the third it suggests a process for learning* (Langton, 1972, p. 71).

This orientation of environmental education towards sustainability with reference to sustainable development, was initiated in Australia by the Australian Association for Environmental Education (AAEE) at its 1990 international conference: "Our

Common Future: Pathways for Environmental Education" (Greenall-Gough, 1992). This expanded view of sustainable development influenced the Earth Summit's Non-Government Organisation Forum Treaty on Environmental Education for Sustainable Societies and Global Responsibility and suggested that sustainability was value-laden and served particular social and economic interests that needed to be critically analysed and assessed (Fien, 1997).

To avoid the debate between conservationists and developers over the meaning of the term sustainable development , the IUCN, UNEP and the WWFN, when planning the second World Conservation Strategy, "Caring for the Earth", introduced the term "sustainable living" instead of sustainable development (Fien, 1997).

"Education for sustainable living" was a reconceptualisation of the aim of environmental education and made a case for broadening the scope of environmental education by exploring its integration with development, citizenship, peace and human rights education (Fien, 1997). Fien reviewed the traditional environmental education content areas of nature study, nature-based learning experiences and the generation of responsible environmental behaviour in individuals and concluded that these areas were still relevant and useful. He argued that they were not sufficient by themselves or conceptually sophisticated enough to remain centrally thematic in their contribution to "education for sustainable living". In other words a pedagogical change was needed. "Education for sustainable living" needed to extend the idea of education for effective

environmental behaviour, to education for political literacy that would lead to more active and informed citizenship (Fien, 1997). Fien was scaffolding a theoretical framework for environmental education in terms of political, economic and social contexts and reaffirming its action pedagogy.

In doing this, Fien (1997) proposed that people learn to live by a new world "ethic of sustainability" that outlined eight values, four that related to ecological sustainability (humanity's responsibility to care for nature), and four that related to social justice (humanity's responsibility to care for each other). These eight values provided a curriculum focus for environmental education.

The eight values were:

<u>People and Nature: Ecological Sustainability:</u>

1. Interdependence: People are a part of nature and depend utterly on it.
2. Biodiversity: Every life form warrants respect and preservation independently of its worth to people.
3. Living lightly on the Earth: All persons should take responsibility for their impact on nature.
4. Interspecies equity: People should treat all creatures decently and protect them from cruelty and avoidable suffering.

<u>People and People: Social Justice:</u>

1. Basic human needs: The needs of all individuals and societies should be met, within the constraints imposed by the biosphere.

2. Intergenerational equity: Each generation should leave to the future a world that is at least as diverse and productive as the one it inherited.
3. Human rights: All persons should have the fundamental freedoms of conscience and religion, expression, peaceful assembly and association.
4. Participation: All persons and communities should be empowered to exercise responsibility for their own lives and for life on Earth.

Fein (1997, p. 22)

These eight values provide an outline of the components needed for action-based environmental education curricula (see Figure 2.2).

'People and Nature' **Ecological Sustainability**	**'People and People'** **Social Justice**
Species interdependence	Human needs
Biodiversity	Intergenerational equity
Ecological impact of humans	Human rights
Interspecies equity	Responsibility and empowerment

Figure 2.2: Components for Action-Based Environmental Education Curricula (after Fien, 1997)

Fien (1997) advocated that these eight values outlined by the new "ethic of sustainability" provided a curriculum focus for environmental education. He proposed the mechanism by which environmental education could change, assimilate new content, reaffirm an action-based pedagogy and be identified as education for sustainable living. This view acknowledged the impact that humans have on ecosystems because it advocated a fundamental understanding of people

and their interactions with environments. It acknowledged the significance of an action-based pedagogy and the incorporation of political literacy to promote a more informed citizenship. Thus, education for sustainable living required that people understand who they are as well as having an understanding of their relationships with other living things, including other humans. Education for sustainable living advocated an active and informed view of the variety of socio-cultural characteristics of which humanity is comprised, along with an understanding of the close relationship between humans and the environment (Fien, 1997).

2.5 Environmental Perceptions of Primary School Students

If we are to develop sustainability education curricula that best meet the needs of primary school students and teachers, it follows that we need to begin this by exploring the existing literature about how these students perceive the environment and sustainability and how their perceptions are best nurtured and extended.

This literature search focuses mainly on studies that are of relevance to children of primary school age. In order to develop relevant, effective and meaningful curricula for environmental education it is essential to understand children's perceptions of the environment and sustainability (Walker, 2002; Wals, 1994). With regard to the perceptions of the environment held by primary school students there is a modest body of studies that provides some insight.

The findings from these studies are theoretically and methodologically varied and sometimes contradictory. For example, some studies reported that young children perceive the environment as including humans (e.g. Wals, 1992, 1994); other studies reported that young children excluded humans from the environment (e.g. Bonnett & Williams, 1998; Carroll, 2002); and still other studies reported that young children might or might not include humans as a part of the environment (e.g. Payne 1998). Some variations and contradictions in the findings may be explained by the differences in the populations sampled which involve a range of primary school children from kindergarten to senior primary classes, differences in modes of data collection, and differences in methods of analysis. Where this occurs the variations are discussed.

An analysis of the body of literature yielded a set of seven themes which are discussed in this section. The themes are:

- Children's knowledge and perceptions of the environment and nature.
- Children's knowledge of environmental issues.
- Children's concern for the environment and nature.
- The relationship between children's knowledge of environmental issues and the actions that they propose.
- Children's perceptions of people in relation to the environment.
- Insights into the factors that influence children's ideas and perceptions of the environment.

- Factors related to children's attitudes towards the environment and nature.

Many of the studies reported examine views across a range of these themes. Hence, the findings overlap and interact with more than one of these. A brief outline of each study is provided often where it is first reported or where it is most relevant.

Children's knowledge and perceptions of the environment and nature

Young children's notions of the environment and nature have been researched mostly from the 1990s to the present time. An understanding of the insights provided by recent studies is fundamental to a study of children's perceptions of environmental sustainability.

An early study by Rejeski (1982) investigated children's perceptions of the natural environment using their drawings of nature. The children (285 children aged from 6 to 7 years, 9 and 10 years and 13 to 14 years old) were given a piece of paper with the words "Nature is" at the top and asked to write or draw their ideas of nature. Categories that were identified from the drawings were:

a) Species including the self, humans, animals and birds,

b) The environment including natural and built objects,

c) Relationships of humans with nature, and

d) Transformations relating to children's awareness of changes over time (Rejeski, 1992, p. 30).

While Rejeski did not specify the results in each category, he did discuss how children viewed humans in relation to the environment. Children in the 6 to 7 age group did not include people and the tree was the main natural element. Children in the 9 to 10 age group perceived people “doing things in nature (but) not to nature” (p. 35). Children in the 13 to 14 age group recognised people “as a part of nature” (p. 35). One conclusion of Rejeski’s 1982 study was that children perceive the environment and nature as being synonymous, and that their perceptions of how people relate to the environment can change as the children mature.

A study by Keliher (1997) extended Rejeski’s 1982 study and analysed children’s (6 to 7 year olds) drawings about the environment. She used questionnaires, photographs and drawings as stimulus material to explore the children’s perspectives of nature. In this study, Keliher reported that the children saw “nature (as being) everywhere” (p. 245) and that they could distinguish between the built environment and the natural environment. She argued that the children’s perceptions of nature and the environment developed early in life and were unlikely to change significantly unless there was some further intervention. This conclusion is not necessarily at odds with that of Rejeski (1982) given that the children in Keliher’s study were 6 to 7 years old and that a longitudinal study of 6 to 14 year olds would be required to determine significant change in the children’s perceptions of nature and the environment.

In a study by Payne (1998), involving nine girls and five boys in Year 6, the children's writing and their responses to cartoon illustrations, along with philosophical discussions with the other children in the group involving reflection on the children's daily lives, provided a basis for analysis. In relation to the children's perception of the environment and nature, some of the more significant conclusions from the study were:

- The children did not distinguish between nature and environment and frequently equated nature as a place untouched by people, "with minimal human influence, interference or effect" (p. 21).
- The children perceived nature as living things (humans included) and non-living things existing naturally in the external environment (p. 21).
- The children's concepts of nature and the environment were not fully developed with half the children excluding humans and their artefacts and half the children including humans and their artefacts (p. 21).
- The children tended to associate indigenous people with nature or a natural lifestyle. Anglo-Australian lifestyle was associated negatively with nature and positively with the built environment and technology (pp. 25-26).

The theme of people in the environment was also explored by Bonnet and Williams (1998). Their study is discussed in more detail later. The children in this study were undecided as to whether people were to be considered as "a part of nature" (p. 163). This finding is in contrast with primary school children perceiving nature as

living things (humans included) and non-living things existing naturally in the external environment. (Payne, 1998).

A study by Walker et al. (2000) involved a survey of 2,249 students in Years 3, 6, 8, and 11 in NSW schools. Their study explored the socio-cultural influences on the environmental understandings of NSW school children and sought to determine their environmental knowledge, attitudes, values, skills and behaviours. The survey reported an extensive range of conclusions and significant among these were:

- Most primary school students see the environment as an object or place that may include living things including people. Environment as an object places the environment “out there” with humans outside the ecological system rather than in relationship with the system (pp. 21-25). Their conclusion suggested that “science” had encouraged this view and that there was a need to develop children’s understandings of the relationships between species and human effects “in” the system rather than “on” the system meaning that humans are an integral part of the ecological system rather than external to it.
- Primary school students have a good knowledge of biodiversity, water pollution and species extinction but confuse the concepts of greenhouse effect and ozone depletion (p. 25).

More recently, Carroll (2002) investigated children's (11 to 13 year olds) perceptions of the environment using children's drawings, interviews, questionnaires and documents from local media. She reported that the children perceived the environment as nearly synonymous with nature and that it was seen as a place without people. The children in Carroll's study were very concerned about environmental issues, especially issues in their local areas, but generally did not attribute individuals with responsibility for the environment. This understanding is in agreement with that of Walker et al. (2000) whose informants placed humans outside the ecological system rather than in relationship with the system (pp. 21-25).

In respect of understanding the environment, these studies (Bonnet & Williams, 1998; Carroll, 2002; Keliher, 1997; Payne, 1998; Rejeski, 1982; Walker et al., 2000) reveal that primary school children perceive environment to mean the natural environment which may or may not include humans. The children's perception of nature and the environment appears to be developing and may show a dichotomy with respect to humans in relation to the environment with some of the children excluding humans and their artefacts and others children including humans and their artefacts (Payne, 1998). When humans are included in the environment, children tend to associate Indigenous people with the natural environment and Anglo-Australian people with the built environment and technology (Payne, 1998).They can also distinguish between built and natural environments (Keliher, 1997). Children's perception of nature and the environment develops early in life

and does not change significantly unless there is some further intervention (Keliher, 1997). This conclusion may be interpreted as endorsing the role of effective environmental education as a means of intervention.

Primary school children have a sense of nature as a threatened place (Keliher, 1997; Wals, 1994) although there is a lack of studies that explore the children's knowledge and understandings of possible threats to the environment in any depth. The study by Wals (1994) is discussed in more detail later. The idea of nature as a threatened place implies that the children are aware of some of the environmental issues or problems that may adversely affect the natural environment. Wals (1994) reported that the children in the study understood nature to be "entertainment, a challenging place, a reflection of the past, a threatening place, a background to activities, a place to reflect and a threatened place" (p. 185). The idea of nature as a threatening place suggests that some children may attach an element of fear to unknown natural environments, which may seem quite different from familiar built environments. Generally the study reveals that children of the same age manifest a complex range of understandings about the environment and nature.

There appears to be an absence of studies that explore primary school children's perceptions of environmental sustainability although some studies (Bonnet & Williams, 1998; Keliher, 1997; Walker et al., 2000; Wals, 1992, 1994; Yencken et al., 2000) report that children are aware of some of the threats to the continuing

sustainability of the environment. These are discussed as environmental issues in the next theme.

Children's knowledge of environmental issues

In exploring children's perceptions of environmental sustainability it is useful to know what young children perceive as significant environmental issues (or problems) and their level of understanding of these issues.

During the introductory phase of an education sustainability program, Bonnet and Williams (1998) interviewed Year 5 and 6 children in four UK schools and used discussion to explore their ideas about the environment and nature. They used drawings and photographs as the stimulus for discussions about perceptions of the environment and nature. The children were asked to list the things that worried them in the environment and they listed cutting down trees, vehicles, litter, pollution and extinction as significant issues (p. 167). They regarded recycling as a positive action but were unable to link this with possible benefits for the environment. Some children equated the environment as a "set of problems" (p. 165) and felt that some adults didn't care about the environment.

The social context within which children come to understand the environment and their relationship with it has been explored by some researchers (e.g. Wals, 1992). Wals focused on how children make sense of their own environment through their "everyday interactions with the lifeworld" (p. 45). The study comprised 30 children

from Detroit, aged 12 to 13 years. The children kept journals and some were involved in informal semi-structured interviews which used a list of key words and topics to be addressed (Wals, 1994, p. 181). Wals (1994) reported that the children in the study were concerned about pollution and the quality of the environment although students within the same age group had very different ideas about these issues varying from simplistic interpretations of nature to more complex ideas of nature as being a threatened place.

Young children have an awareness of pollution as a significant environmental issue. Keliher (1997) reported that children equated pollution mostly with litter and had a sense of nature as a threatened place (p. 242). Children in the study by Bonnet and Williams (1998) also listed pollution as a significant environmental issue.

Concerns about environmental issues were also reported by Walker et al. (2000) with primary school students identifying “litter, needles left by drug addicts, and drunk people” as examples of local environmental concerns; “hunting of animals, crime, clearing away of trees and bushes” as examples of national environmental concerns; and, “war, extinction of plants and animals, and poverty” as examples of global environmental concerns (p. 13).

Yencken et al. (2000) studied older students aged 15 to 17 from schools in Brisbane and Melbourne asking them questions about the meaning of “environment”, their

major concerns about the environment, causes of environmental problems, and what could be done to deal with environmental problems. The students talked about urban development and destruction of forests as major local problems and overpopulation as the worst global problem. They attributed responsibility for environmental problems to a vague elsewhere and expressed feelings of helplessness or lack of empowerment. As in previous studies the students were vague in making links between human interaction with the environment and the possible resulting environmental problems.

The studies indicate that children have an awareness of environmental issues, especially issues in their local areas, but generally do not attribute individuals with responsibility for the environment (Bonnet & Williams, 1998; Carroll, 2002; Walker et al., 2002; Wals, 1992, 1994; Yenken et al., 2000). Environmental issues listed by children include: pollution (Wals, 1992), or more specifically litter (Bonnet & Williams, 1998; Keliher, 1997), urban development, destruction of forests or trees (Bonnet & Williams, 1998; Yencken et al., 2000), over population (Yencken et al., 2000), vehicles (Bonnet & Williams, 1998), extinction (Bonnet & Williams, 1998; Walker et al., 2002), war and poverty (Walker et al., 2002). Some studies implied that the children could differentiate between local and global environmental issues although most of their understandings were based on local environmental issues (Walker et al., 2000; Yencken et al., 2000). This finding has important ramifications for sustainability education curricula and supports the assertion by Stokes (2009)

that young children understand and relate best to their local environment and local environmental problems.

Some studies report that primary school children have a good understanding of water pollution and species extinction but confuse the concepts of greenhouse effect and ozone depletion (Walker et al., 2000). The implication of this is that while the children may identify significant environmental issues, their understanding of these issues may be limited or still developing.

Insight into children's knowledge of environmental issues has been revealed almost incidentally in some studies but there is limited detail of children's understanding (or misunderstanding) of these issues and their causes. Also of significance is the problem that young children may not associate humans with contributing to environmental issues which is necessary if they are to begin to develop a knowledge base of the complex socio-cultural influences that impact on environmental sustainability.

Children's concern for the environment and nature

Young children do express concern for the environment and this is revealed almost indirectly in some studies. Children express concern for animals more frequently than concern for plants (Bonnet & Williams, 1998; Wals, 1992, 1994). This may be

because children identify more easily with animals than plants as living things like themselves.

The children in Carroll's (2002) study were very concerned about environmental issues, especially issues in their local areas, but generally did not attribute people with responsibility for the environment. This is consistent with the conclusion of Yencken et al. (2000) where the children attributed responsibility for environmental problems to a vague elsewhere and expressed feelings of helplessness or lack of empowerment. As in previous studies the students, while expressing concern for the environment, did not make links between human interaction with the environment and the possible resulting environmental issues. This is similar to the findings of Walker et al. (2000) that while students in the study saw themselves as responsible for the environment, unknown "others" such as factory workers did not care (p. 17) implying that "others" were responsible for environmental issues.

The studies indicate that primary school children are concerned about the environment generally and especially about the local environment. However, they do not necessarily associate people with environmental change (Bonnet & Williams, 1998; Carroll, 2002; Walker et al., 2002; Wals, 1992, 1994; Yencken et al., 2000), although their perceptions of how people relate to the environment can change as the children mature (Rejeski, 1982). This suggests that some of the evidence from the studies is conflicting but this may be due to the differing age groups of the students involved. The general pattern from the studies suggests that primary

school children express concern for the environment and environmental problems but further investigation is needed.

The relationship between children's knowledge of environmental issues and the actions that they propose

While there is a deficit of studies that investigate the relationship between primary school children's knowledge of environmental issues and the actions that they propose, studies from other contexts may provide some insight. Some studies have found that children's knowledge of environmental issues and their behaviour are related. The Yencken et al. (2000) study of older students reported a clear relationship between knowledge and behaviour. However, in other studies (Kollmuss & Agyeman, 2002; Posch, 1993; Rajecki, 1982), the relationship between awareness of, or knowledge about, an environmental issue and taking environmental action was often not a strong one. Kollmuss and Agyeman (2002) report what has become known as the "gap" between knowledge and behaviour.

This "gap" between knowledge and behaviour involves two important factors. Firstly, because behaviour is influenced by many variables (e.g. attitudes towards the environment, the ease or difficulty of taking action, individual social background, individual worldview) awareness of an environmental issue does not automatically lead to a person taking pro-environmental action (Pruneau et al., 2007). Secondly, understanding an environmental issue may require a grasp of the complex ecological facts, the causes and effects, the strategies for change, and alternative

visions involved (Jensen, 2002). Thus the relationship between environmental knowledge and behaviour is a complex one and awareness of an environmental issue may not result in pro-environmental action.

Children's perceptions of people in relation to the environment

Children's perceptions of the environment and nature in a broader social context have been investigated by some researchers (e.g. Bonnet & Williams, 1998; Payne, 1998; Wals, 1992, 1994). Their research explored environmental education in the school and how it related to children's perceptions of people in relation to the environment and nature.

From their study, Bonnet and Williams (1998) concluded that the children were undecided as to whether people were to be considered as "a part of nature" (p. 163) while in contrast the children in Wals' (1992) study were aware that there was a relationship between people and the environment or nature. This variation is difficult to explain given that the populations sampled in both studies were of similar ages although the variation may be due to the studies being conducted in different parts of the world.

The study by Payne (1998), as previously discussed, explored how children perceive people in relationship with nature. In relation to this aspect, Payne reported that half the children excluded humans and their artefacts from the natural environment while half the children included humans and their artefacts (p. 21).

Furthermore, most of the children constructed a largely negative view of the relationship of people with nature (p. 25) which is consistent with the general view of the natural environment being that untouched by humans. The apparent inconsistencies in these conclusions suggest that different children in the study group perceived the relationship of people in the environment in a variety of ways.

Of significance is the finding that primary school children were more likely to express relationships between humans and the environment than were secondary school students (Walker et al., 2000, p. 22). This is in contrast with the earlier findings that the children are more likely to view the environment as a place without people. While this adds a difficulty to the analysis, primary school children may be more likely to express relationships between humans and the environment particularly if they have experienced some form of intervention at the primary school level (as alluded to by Keliher, 1997). It also raises questions about whether some primary school children are beginning to make the association between people and their actions that affect the environment. These concerns and questions require further investigation.

In short, the studies do not provide a consistent position regarding primary school children's perceptions of humans in relation to the environment. Some studies conclude that primary school children do not express a relationship between people and the environment (Bonnet & Williams, 1998), while other studies imply that the children do perceive the relationship (Wals, 1992, 1994), and still other studies

conclude that some of the children in the study see a relationship but others in the same study do not (Payne, 1998). This position is not surprising given the variations of age groups and numbers of children involved in the studies. This inconsistency and variation in findings suggests that it is appropriate to further investigate children's awareness of human, and specifically socio-cultural, influences on environmental sustainability.

Factors that influence children's ideas and perceptions of the environment

A range of studies has explored the influences that shape children's perceptions of the environment. Implicit in this is the idea that many factors are involved in children developing well informed perceptions of the environment.

Students identified their families, the media and community events as the main influences on their perceptions about the environment (Bonnet & Williams, 1998). Other studies (e.g. Musser & Diamond, 1999) acknowledge that children's environmental attitudes develop from a wide variety of influences other than parents (such as siblings, grandparents, teachers, media and books). Television nature documentaries have been identified as a significant influence on children's perceptions of the environment (Keliher, 1997; Payne, 1998). While researchers such as Bonnet and Williams (1998) and Musser and Diamond (1999), refer to media influences in general, it might be assumed that these include television nature documentaries.

A study by Musser and Diamond (1999), which is discussed in more detail later, implied that children's participation in relevant environmentally friendly activities developed positive environmental attitudes. Another study (Zimmerman, 1996) reported that children's environmental attitudes were negatively correlated with their parents' participation in conservation and ecology organizations although the possible reasons for this negative correlation were not stated.

Walker et al. (2000) reported that the top five environmental influences on primary school students were: schools, nature shows (on television), books, environmental clubs and outdoors (p. 15). Parents were not identified as a significant influence (p. 24).

While the influence of schools and teachers are identified as significant influences on children (Musser & Diamond, 1999; Walker et al., 2000), there is a paucity of evidence suggesting that specific environmental education programs influence children's perceptions of nature and the environment over time. The ambiguity in the findings warrants further investigation.

Factors related to children's attitudes towards the environment and nature

An understanding of environmental attitudes is important when considering students' perceptions of the environment as these attitudes influence human

behaviour towards the environment. The particular attitude that a person holds will determine their support for conserving or exploiting the environment (Fien, 1993).

During the 1990s studies of children's relationship with the environment were frequently quantitative. In these studies, children's perspectives were reported using responses on written questionnaires or surveys in which the issues were preset. Examples of such quantitative studies are those by Musser and Diamond (1999) and Zimmerman (1996) and these are discussed here.

Musser and Diamond (1999) reported on the development of pre-school children's attitudes towards the environment. Children made oral responses to a questionnaire. The attitudes of the children and their parents were compared although how the parents' attitudes were collected was not stated. The children's attitudes were not correlated with verbal ability, but with the degree to which children participated in environmentally relevant activities in the home. The results reported a lack of relationship between parental attitudes and the attitudes of their children. The children's attitudes developed from a wide variety of influences other than parents (such as siblings, grandparents, teachers, media and books). However the study showed that there was a relationship between children's attitudes and their participation in relevant environmentally friendly activities. Children who participated in environmentally friendly activities had a more positive attitude towards the environment than did those children who did not.

Zimmerman (1996) sought to create a quantitative scale to assess and compare the environmental attitudes and values of parents with those of their children. The study used a Likert scale of 1 to 5 to score the responses of the participants to environmental statements. The environmental statements related to conservation, pollution, and both the built and the natural environments. The study reported that environmental attitudes of children were negatively correlated with their parents' participation in conservation and ecological organizations. Men scored more positively than women on the belief that humans had a right to dominate nature; males had a more negative environmental attitude than females; and ethnic differences existed in relation to environmental values and attitudes although these were not explained. The views of parents were compared to those of their children but the correlations were not significant.

Perhaps the most significant finding is that there is a positive relationship between children's attitudes towards the environment and their participation in relevant environmentally friendly activities (Musser & Diamond, 1999).

From the discussion in 2.5 it is possible to conclude that while there are some reasonably consistent findings in some areas in respect to primary school children's perceptions of the environment (e.g. children perceive pollution as a significant environmental issue), in other key areas the findings are mixed (e.g. children's perception of people in relation to the environment). Education for sustainable living

requires that people understand their relationships with other living things, including other humans, and their environment generally (Fien, 1997). If we are to develop sustainability education curricula that best meet the needs of primary school students and teachers then we need to understand how these students perceive the environment and sustainability and specifically how they perceive human relationships with the environment because this is fundamental to understanding environmental issues and environmental change.

2.6 Environmental Worldviews as a Key Theory

A discussion of environmental worldviews is included here as these can be used to analyse children's perceptions of environmental sustainability and their environmental behaviours or proposed behaviours. Attitudes are underpinned by worldviews (Fien, 1993). Environmental worldviews consist of three components: how people think the world works, what they think their role in the world should be, and what they believe is right and wrong environmental behaviour (Thinkquest, 2005).

Dunlap and Van Liere (1978) first developed a New Environmental Paradigm (NEP) upon which the work of Stern et al. (1993) and others is based. Stern et al. (1993) refers to three human value orientations (these might also be thought of as worldviews) towards the environment, viz: egoistic, biospheric and altruistic. Dunlap et al. (2000) revised the original NEP, reconceptualising it as the New Ecological Paradigm which sought to avoid the issues driven nature of environmentalism.

Fien (1993) explains environmental worldviews as follows:

An Anthropocentric view (also referred to as Homocentric) is human-centred with humans being the “masters” of the natural environment. Stern et al. (1993) categorise anthropocentric views as akin to Egocentric although this is placing the emphasis on individuals rather than on humans in general. Anthropocentric thinkers believe that humans have intrinsic value while nature has instrumental value in that its worth is determined only by its value to humans. Thinkquest (2005) outlines a number of different anthropocentric worldviews (referred to as “schools” as in schools of thought) that describe different approaches to dealing with the environment and its resources. These are:

- The “free-market school” which advocates a free-market global economy, with unlimited competition and minimal government interference.
- The “no-problem school” which claims that environmental and resource problems are negligible and that any problems that do exist can be solved by better management and technology.
- The “responsible planetary management school” which combines the views of a free-market and technology while recognizing that government interference is sometimes necessary to achieve environmental protection.
- The “spaceship-Earth school” that views the planet as a single, complex machine that can be managed, protected and controlled.

- The “stewardship school” is similar to the “spaceship-Earth school” as it believes that humans have an ethical responsibility to protect and manage the environment.

A Biocentric view (also referred to as Biospheric) is life-centred with all forms of life having an equal right to exist. A biocentric worldview sees the non-living environment as having only an instrumental or utilitarian value in supporting the living environment. Most people with a biocentric worldview consider that protecting a species is more important than protecting individual members of that species. Others see that humans have an obligation to protect all living creatures, implying that the protection of fauna is more important that the protection of flora.

An Ecocentric view is Earth-centred with the natural environment and biodiversity requiring continued protection. Stern et al. (1993) refer to an Altruistic worldview which may be seen as a similar position.

Thinkquest (2005) outlines a number of different ecocentric worldviews that describe different approaches to dealing with the environment and its resources. These are:

- The “environmental wisdom school” which holds the view that the Earth’s resources are limited and that technology and economic growth may either

help or harm the environment. They believe that humans must adapt their needs to the environment in order to maintain a sustainable future.

- The “deep ecology school” recognizes the intrinsic values of species, ecosystems and the biosphere but further advocates that humans have no right to interfere with environmental richness and diversity.

Leeming et al. (1995) encouraged more research on the environmental attitudes and behaviours of children because “early attitudes and knowledge shape the later thinking of adolescents and adults” (p. 23), and research in the past had underrepresented this population. Manoli et al. (2007) applied ideas about environmental worldviews to the views of upper elementary school children and developed the “New Ecological Paradigm for Use with Children” which explored environmental worldviews, ecological understandings, and environmental actions and how education affects those variables.

If environmental attitudes are underpinned by environmental worldviews then the consideration of primary school aged students’ worldviews (or orientations) may help to inform their understandings or perceptions of sustainability. An extensive survey of primary school students’ worldviews is beyond the scope of this study. However, it is relevant to consider the evidence of environmental worldviews held by the children in the study, as these are likely to influence their perceptions of

environmental sustainability, as well as their proposed and actual environmental actions.

2.7 Conclusions

This chapter has presented an analysis of literature that has informed and shaped the research beginning with an account of the evolution of environmental education from the outdoor nature studies programs of the 1940s up to the current sustainability education programs. It has also considered the tensions apparent in the theoretical underpinnings that influenced these programs. Significant among these are:

- The theoretical tensions inherent in social critical theory and its limitations in applying a problem-based or an action-based component for environmental education curricula in schools.
- The varying ideologies inherent in emancipatory action research, action competence and theory-in-use approach and the implications for pedagogy.
- The transition from environmental science emphasising scientific or ecological studies to environmental education giving greater recognition to social, cultural and economic influences that are essential for an understanding of complex sustainability issues.
- The evolution of sustainability education and the varying ideologies and theoretical tensions inherent in education for sustainability, sustainable development, sustainable living, and ecologically sustainable development.

- The significance of individual worldviews in determining environmental attitudes, actions or proposed actions.

The literature relating to environmental education and environmental sustainability was reviewed and discussed to provide insight into the complex nature of children's perceptions of the environment and sustainability. This affirms the need to understand young children's perceptions of the environmental sustainability. Then, sustainability education curricula may be designed to nurture the development of a well informed citizenry with the capacity to make decisions that will impact on future generations.

The next chapter outlines the theoretical underpinnings of the qualitative methodology used in the study. It discusses the design of the study; its context and location; the students and teachers involved; the data collection strategies; and, the research trustworthiness of the study. The methods of data analysis are justified and explained. Finally, ethical considerations and problems that arose during the study are elaborated.

Chapter 3: Methodology and Design of the Study

> *Faster than a speeding bullet … the world's tropical rainforests are being cut down at a rate of about 10 to 25 hectares a minute. At this rate in just a century or so, there won't be any rainforest left.*
>
> *Most of the 2 billion hectares of rainforest left in the world is found in the developing countries. These countries are poor. They are overpopulated, and the people often live in very crowded conditions. The pressure on the people to chop down rainforests in these countries is huge. Cutting down the rainforests has two advantages for them --- wood to sell as timber or wood chips, and more land to live on.*
>
> *This means Australia has a very special role in preserving our rainforests. We are a wealthy, well-educated nation. We can certainly afford to save our rainforests for the future.*
>
> Kruszelnicki, K. (2002). *Great Australian Facts and Firsts,* p. 201.

3.1 Introduction

This chapter presents and explains the methods used in the study. From the beginning the intention was to explore primary school children's perceptions of environmental sustainability in a way that would produce an extensive range of rich and insightful data. To achieve this, the study embraced qualitative methods employing survey, interview and focus group methods of data collection. Data collection was informed by Grounded Theory and analysed with reference to the literature.

The context and location of the study is described. This includes discussion of the NSW metropolitan primary school used in the study, the students involved, ethical

considerations, problems that arose during the study, and the trustworthiness of the study.

3.2 Methodology

In order to address the research questions this study uses a qualitative approach (Cohen et al., 2000; Marshall, 1995) that is intended to provide insight into students' perceptions and developing understandings of environmental sustainability. An overwhelming amount of research in environmental education has been quantitative, mainly focusing on students' knowledge about the environment and giving little attention to feelings or attitudes (Chawla, 1998). More recently, Rickinson (2001) commented that much of the evidence on children's understandings of the environment and environmental issues was quantitative in nature and were reported using very specific criteria. The scarcity to date of qualitative research into primary aged children's understandings of the environment and environmental issues has also been identified by Cutter-Mackenzie and Edwards (2006). Qualitative research provides the means to study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them (Denzin & Lincoln, 2000). Therefore, it may be more effective in producing information about young children's knowledge, understandings, attitudes and views of environmental sustainability.

This is a qualitative study that is interpretative and informed by Grounded Theory (Cohen et al., 2000; Marshall, 1995) in that it seeks to investigate and explain how

young children, in their final years of primary school education, perceive environmental sustainability and how these perceptions influence the environmental actions that they display or propose.

> *Qualitative research is a situated activity that locates the observer in the world. It consists of a set of interpretative, material practices that make the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations, photographs, recordings, and memos to the self* (Denzin & Lincoln, 2000, p. 3).

Qualitative research involves the collection of data using a variety of interrelated interpretative practices such as: observations, case studies, interviews, personal accounts, life stories, and the study of texts. Because each practice interprets the world in a different way, researchers are likely to use more than one practice to gather data (Denzin & Lincoln, 2000). This study aims to produce an explication of particular phenomena (young children's perceptions of environmental sustainability) and to contribute to a theoretical framework of sustainability education.

In this study, the interaction between the researcher, the participants, the case and the context under study requires careful consideration so that the participants' experiences, their views, their perceptions, their beliefs and their feelings about the world are brought to the fore and not those of the researcher.

> *All research is interpretative; it is guided by a set of beliefs and feelings about the world and how it should be understood and studied. Some beliefs may be taken for granted, invisible, only assumed, whereas others are highly problematic and controversial* (Denzin & Lincoln, 2000, p. 19).

This necessitates that such things as the questions asked by the researcher and the responses given by the participants need to be carefully considered so that in their interpretation the researcher sets aside his or her personal predispositions (Bogdan & Biklen, 1998).

The methodology is informed by **Grounded Theory** which seeks to understand the research situation and to discover the theory implicit in the data (Glaser & Strauss, 1967). In other words, a grounded theory is induced from the data rather than being hypothesised before the collection of the data (Lincoln & Guba, 1985). While qualitative research seeks to produce detailed description and analysis of phenomena, Grounded Theory goes beyond the description to develop detailed concepts or hypotheses that relate to particular phenomena.

The term Grounded Theory is often used in a nonspecific way to refer to any approach to forming theoretical ideas that somehow begins with data. However, grounded theory methodology is a qualitative approach that uses a systematic set of procedures to develop an inductively derived theory about phenomena (Strauss & Corbin, 1990).

McMillan and Schumacher (2006) outline the key features of Grounded Theory. These involve the researcher collecting data using a variety of data collection methods and making multiple visits to the field. The initial data collection is done to

gain a variety of perspectives on the phenomena. The collection methods need to be open-ended so that the data are wide-ranging with respect to the particular phenomena being studied. From the data collected from this first step, the key points are marked with a series of codes, which are extracted from the text. The codes are grouped into similar concepts or themes, in order to make them more workable. From these concepts or themes, categories are formed, which are the basis for the creation of a hypothesis. Data are collected until categories of information are saturated. The researcher uses a constant comparative method involving simultaneous data analysis using the techniques of induction, deduction, and verification across the categories of information. The researcher then selects the central phenomena, develops a description, and states hypotheses that specify the social and historical conditions and consequences influencing the phenomenon.

A generalised procedure for Grounded Theory is shown in Figure 3.1 which follows. This can be compared with the procedure which was designed for use in this study and which is outlined in Figure 3.2.

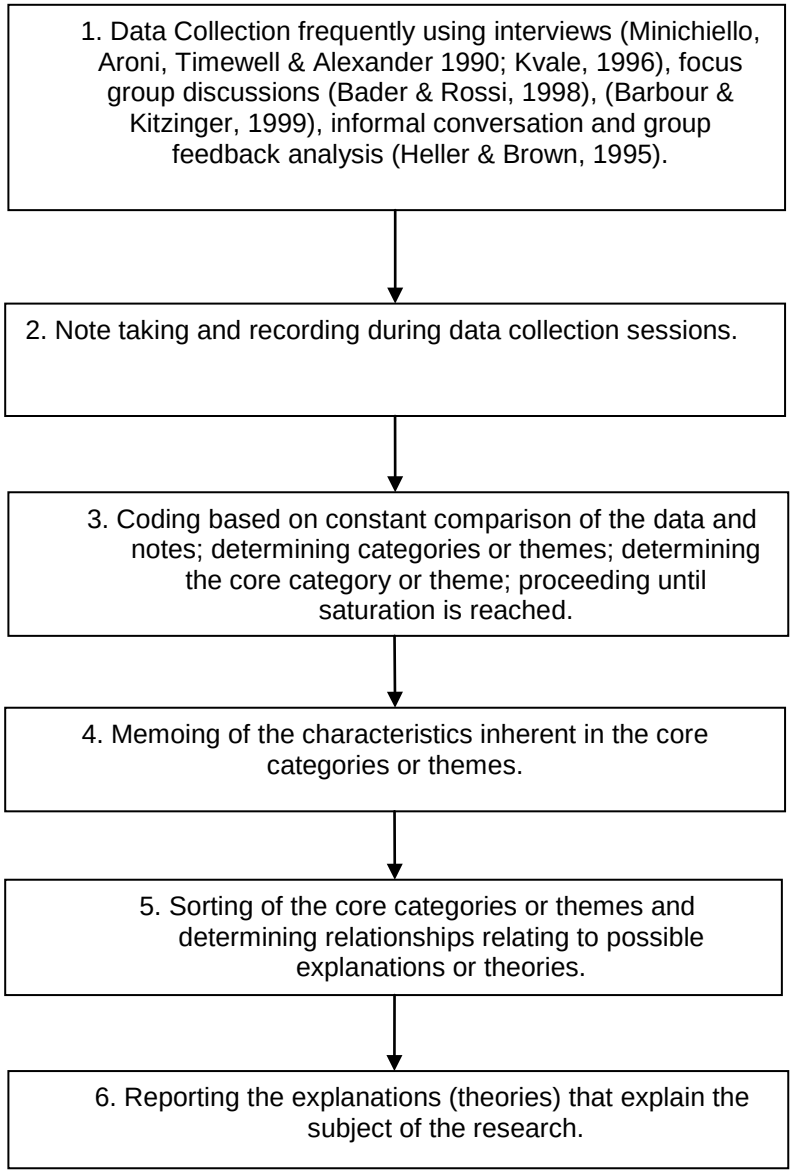


Figure 3.1: Generalised Procedure for Research using Grounded Theory (after Dick, 2008).

As studies in sustainability education and children's perceptions of sustainability are limited, imposing a rigid system of analysis should be avoided. Grounded Theory is a theory that can be used in this situation. Rather than forcing the themes or

categories when analysing the data, these are allowed to emerge from the data. These themes or categories are then relevant and able to meaningfully explain, the behaviour or phenomena being studied (Glaser & Strauss, 1967).

In more recent years, Glaser and Strauss differed over the interpretation of Grounded Theory method but both continued with Grounded Theory research. Glaser (1978, 1992, 1998, 2001, 2005) extended his original 1967 text to detail concepts such as emergence, theoretical sampling, theoretical coding, and use of theoretical memos, while Strauss, working with Corbin, focused on developing the structure for the analytical techniques (Strauss & Corbin, 1990).

Glaser (1978, 1992) advocated the gathering of data without "forcing" preconceived questions, structures or frameworks on the participants. "Without forcing" implies that phenomena emerge from the data and are described, defined and explained by the data with the explanation being accepted until new data require a redefinition and explanation of the phenomena (Denzin & Lincoln, 2000). Glaser was concerned that Strauss and Corbin used well-informed preconceptions of phenomena and methodological techniques which "forced" the data. In this manner, data were gathered to define and explain predetermined phenomena. The key differences are issues relating to conceptualisation (Glaser, 2001) versus description (Strauss & Corbin, 1990, 1994) with Glaser (1992) arguing that the purpose of Grounded Theory is to generate theory, not to verify it.

This study is informed by three related schools of grounded theory but deliberately not located in only one as this might restrict the capacity for describing phenomena. These three related schools are: Straussian Grounded Theory, Dimensional Analysis, and Situational Analysis.

In **Straussian Grounded Theory** (Richards & Morse, 2007; Strauss, 1987) prior knowledge and assumptions about the phenomena are brought to the study rather than being generated by the study and consideration is given to how the data support or alter the description and explanation of the phenomena. The phenomenon being studied is environmental sustainability and it is assumed that young children will hold and be able to express knowledge, understandings, views and attitudes about the phenomenon.

While the data are primarily derived using Straussian Grounded Theory, they are also informed by **Dimensional Analysis** (Kools et al., 1996; Richards & Morse, 2007) in which an explicit analytical process is used to guide the analysis of the study. In this study the analysis is informed by the literature relating to young children's perceptions of the environment.

The study is influenced by some elements of **Situational Analysis** (Clark, 2005; Richards & Morse, 2007; Strauss, 1987) in which both the data and the analysis are informed by the individual participants and how they locate themselves in relation to the environment and environmental sustainability, and also the specific location of

the study. Situational analysis focuses on the situation (the context, the participants, their actions and interactions) and uses interview, observation and other sources to generate and analyse data. Situational analysis

> *allows researchers to draw together studies of discourse and agency, action and structure, image, text and context, history and the present moment, to analyse complex situations of inquiry broadly conceived* (Clark, 2005, p. xxii).

Situational analysis is aligned to the structure developed by Strauss wherein the situation becomes the unit for analysis and understanding its elements and their relations becomes the purpose of the study (Clark, 2005). In this study the participants are informed by a specific school situation and are subject to a specific environmental education policy and program: The NSW DET Policy for Environmental Education (NSW DET, 2001a).

This study examines the views of children in a particular school. Hence, the study is informed by **case study research** which is commonly used in the social sciences (Stake, 2005). While there is no general agreement on a definition of case or case study, case study examines in detail a bounded system, or a case, at a specific time or over a period of time and uses multiple sources of data found in the setting. The case may be a program, an event, an activity, or a set of individuals bounded in time and place. The researcher defines the case and its boundaries. A case can be selected because of its uniqueness or used to illustrate an issue (Stake, 1995).

Case study research may be categorized according to three types of research designs: Intrinsic, Collective, and Instrumental (Stake, 1995). Intrinsic and collective case studies are used for theory building while instrumental case study is used when the particular cases are instrumental to understanding a phenomenon. This study is informed by **instrumental case study** design as the intention is to generate knowledge and understanding about the phenomenon of children's perceptions of environmental sustainability from the context of a specific school situation and a specific environmental education policy and program: The NSW DET Policy for Environmental Education (NSW DET, 2001a). The use of multiple data collection instruments (questionnaires, focus group discussions and individual interviews of the subjects and their teachers) are consistent with the data collection techniques suggested by Stake (2000, 2005).

3.3 Trustworthiness

The aim of trustworthiness in qualitative research is to support the argument that the research findings are "worth paying attention to" (Lincoln & Guba, 1985, p. 290). Closely associated with trustworthiness are **credibility, transferability, dependability** and **confirmability**. These are central to establishing confidence in the research process and results (Bogdan & Biklen, 1998; Lincoln & Guba, 1985; Seale, 1999).

Credibility is an evaluation of whether or not the research findings represent a "credible" analysis and interpretation of the data drawn from the participants in the

study (Lincoln & Guba, 1985, p. 296). In this study credibility was enhanced by triangulation of the data collection techniques. Triangulation has been defined as "the use of two or more methods of data collection in the study of some aspect of human behavior" (Cohen et al., 2000, p. 112). It involves using multiple data collection sources that seek to clarify meaning through verifying the repeatability of an observation or interpretation (Stake, 2005). Triangulation of data as recommended by Lincoln and Guba (1985, pp. 305-309), was achieved by using a variety of data collection sources including students, teachers and artefacts (See 1.3: NSW Board of Studies and NSW DET documents); and, by using a variety of data gathering techniques including questionnaires, focus group discussions and individual interviews of the children and their teachers. Data collection strategies were refined using a pilot study and through regular discussions with my supervisor and co-supervisor.

Transferability is the degree to which the findings of the study can apply, or transfer, beyond the bounds of the study (Lincoln & Guba, 1985). To enhance transferability, the data and the data analysis are retained on file so that it would be possible to apply the findings of this study to other cases, or to repeat the procedures used in this study in other situations. Care needs to be taken if applying the findings to other cases. The context of this study, as outlined in detail, would need to be carefully considered and judged whether applicable to other circumstances.

Dependability is an assessment of the quality of the data collection processes, data analysis, and theory generation (Lincoln & Guba, 1985). To achieve dependability, address bias, and manage, report and analyse the data, a number of tasks, as recommended by Erickson (1986, pp. 145-146), were used. These included an audit trail involving the children, the teachers, the researcher, the co-supervisor and the supervisor. This provided scrutiny of the study and encouraged the review of interpretations. In addition, the data collection techniques were selected to produced “rich descriptions” derived from multiple perspectives (Denzin & Lincoln, 2000, p. 16). These included survey, focus group discussions, and individual interviews of teachers and children.

Dependability was also achieved by selecting methods of interpretation appropriate for analysing the perceptions and views of young children. These involved coding, checking and recoding of the data collected along with both confirming and disconfirming analysis (Drisko, 1997). As the study generated a large amount of data, it was necessary to exercise caution both in its recording and interpretation. This was achieved by checking the findings generated against all data collected and contained in the children’s completed questionnaires, the transcripts of focus group discussions and individual interviews, the researcher’s field notes, and the digital audio recordings. It was essential to consider only the meanings intended by the children and to avoid the meanings that the researcher brought to the study (Mitchell, 1997). Consideration was given to the “Bartlett effect” which is unintentionally misrepresenting the data by selecting only responses that represent

the desired theoretical stance being taken (Brown, 1992). To avoid this, Brown's suggestion of keeping all data on file so that "selection bias" could be checked, has been used where necessary. This ensured that all data were considered as codes and themes emerged during the data analysis.

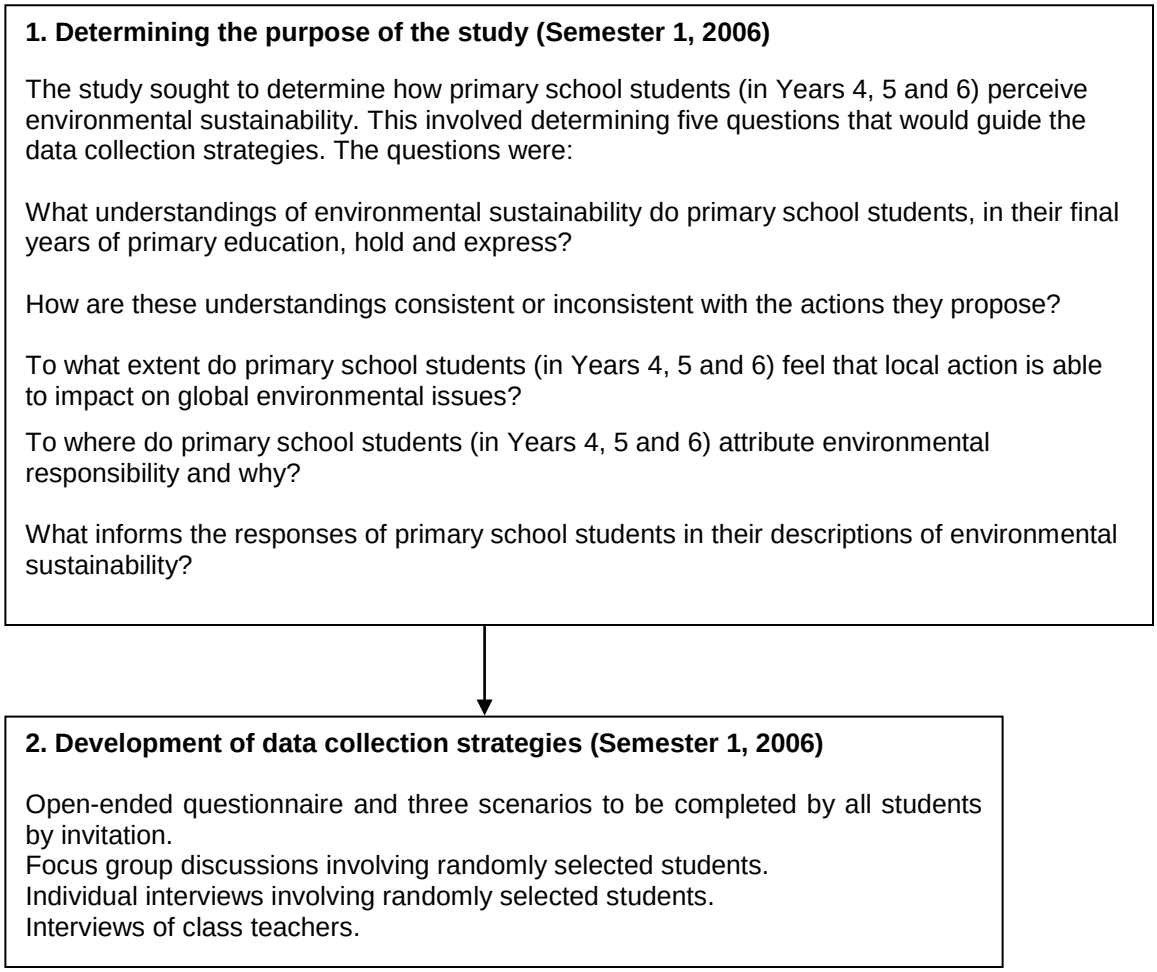
The data collected were grouped according to themes and interpreted using a theoretical framework involving categories that were derived from the literature review. These categories were discussed in 2.5. They are: children's knowledge and perceptions of the environment and nature; children's knowledge of environmental issues; children's concern for the environment and nature; children's perceptions of people in relation to the environment; insights into the factors that influence children's ideas and perceptions of the environment; and, factors related to children's attitudes towards the environment and nature. There was some analysis of data related to the influence of environmental worldviews. The general worldviews were: egocentric, homocentric, biocentric, and ecocentric and these were discussed in 2.6.

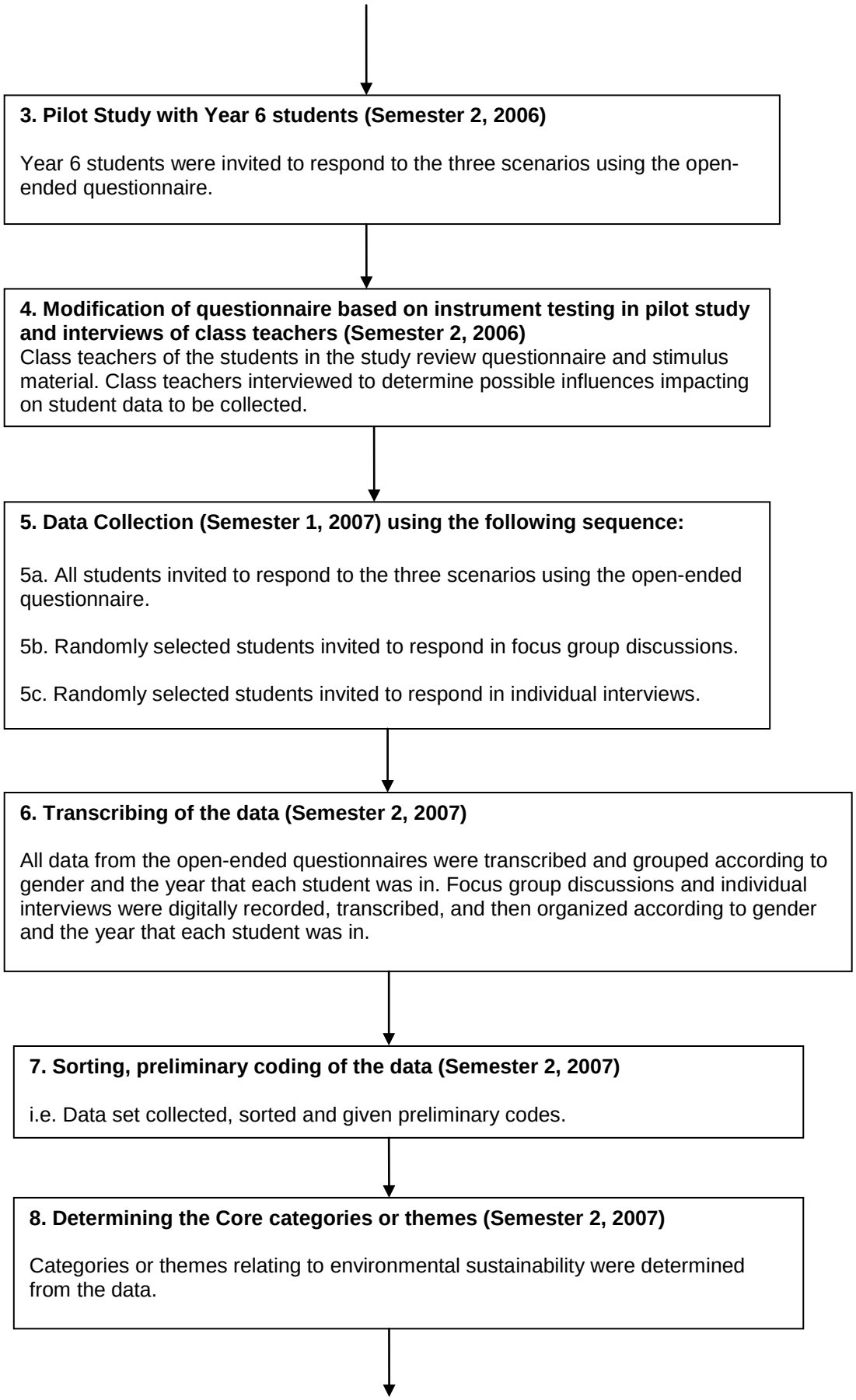
Confirmability is a measure of how well the study's findings are supported by the data collected (Lincoln & Guba, 1985). Where qualitative research involves the researcher being engaged in the research process, trustworthiness and confirmability are dependent on the skill, competence and rigor of the person doing the fieldwork (Patton, 2002). This was of concern because the study took place in a context that was well understood by the researcher who had been a teacher at the

school over a period of 13 years. While the researcher was known to the children, the researcher had not been a class teacher of any of the children in the study group. To improve confirmability, peer and expert consultation with teachers, doctoral colleagues, co-supervisor and supervisor included discussion and critique of the methodology and findings as well as data analysis sets, emerging codes, themes and conclusions.

3.4 Design of the Study

This study was designed drawing on the steps/phases of Grounded Theory (outlined in Figure 3.1) and the specifics pertaining to this research may be represented by the flow chart (and timeline) shown in Figure 3.2 which follows.




3. Pilot Study with Year 6 students (Semester 2, 2006)
Year 6 students were invited to respond to the three scenarios using the open-ended questionnaire.
4. Modification of questionnaire based on instrument testing in pilot study and interviews of class teachers (Semester 2, 2006)
Class teachers of the students in the study review questionnaire and stimulus material. Class teachers interviewed to determine possible influences impacting on student data to be collected.
5. Data Collection (Semester 1, 2007) using the following sequence:
5a. All students invited to respond to the three scenarios using the open-ended questionnaire.
5b. Randomly selected students invited to respond in focus group discussions.
5c. Randomly selected students invited to respond in individual interviews.
6. Transcribing of the data (Semester 2, 2007)
All data from the open-ended questionnaires were transcribed and grouped according to gender and the year that each student was in. Focus group discussions and individual interviews were digitally recorded, transcribed, and then organized according to gender and the year that each student was in.
7. Sorting, preliminary coding of the data (Semester 2, 2007)
i.e. Data set collected, sorted and given preliminary codes.
8. Determining the Core categories or themes (Semester 2, 2007)
Categories or themes relating to environmental sustainability were determined from the data.

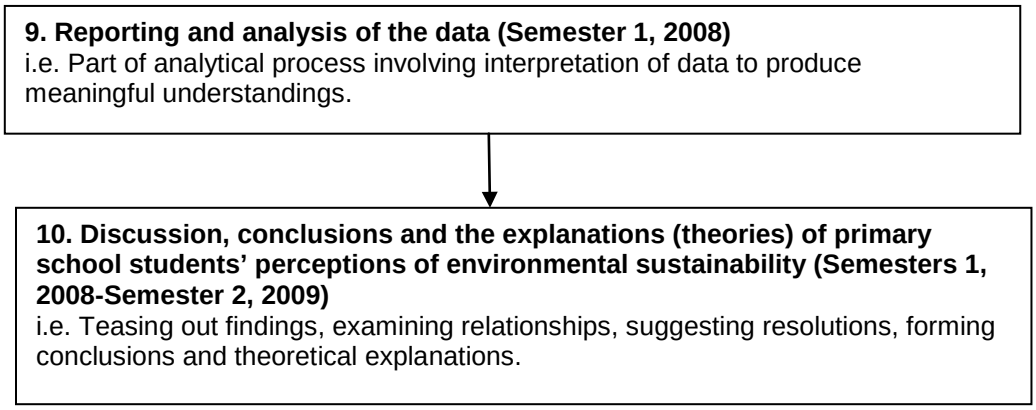


Figure 3.2: Flow Chart for the Research Methodology informed by Grounded Theory.

3.5 The Setting and Context

This study was located in a DET co-educational primary school located in a suburb of Sydney. The school has a total enrolment of 380 children from Kindergarten to Year Six ranging in age from five years old to 11 years old at the time of the study. Nearly all the students were of Anglo-Australian background and had English as their first language. Fewer than five students of the total school enrolment had a language other than English as their first language.

The school was involved in the trialling of the DET Sustainable Schools Program (NSW DET, 2002b). This program involved all students in practical activities such as the monitoring of the school's use of resources (e.g. usage of electricity, paper, and water) and the practical improvement and management of the school's physical environment (e.g. tree planting, garden maintenance, and classroom and playground improvement). The school placed a high priority on the mandatory implementation of this program. The program may have influenced the students'

perceptions and understandings of environment and environmental sustainability as compared with those understandings of students from primary schools where the program did not receive the same level of support.

The researcher negotiated access to the school and the study had the support of the school principal, classroom teachers and the parents of the children in the sample group. The principal researcher was previously a teacher in the school but had not been a class teacher of any of the sample group of students involved in the study.

3.6 The Sample

Access was negotiated to a sample group of 146 students (of the total population of 148 students) in Years 4, 5 and 6 who were the participants in the study. These students were those made available by the school and provided the opportunity to explore patterns of change although subsequently, such changes were not evident in the data. This sample group comprised all the students in these years in the school except for one Year 4 student who was a recent arrival in Australia and who had significant limitations in speaking, writing, reading and understanding English language; and one Year 6 student for whom parental permission was withheld.

Figure 3.3 shows the sample group of 146 students (51 boys and 85 girls) comprising 50 Year 4 students (19 boys and 31 girls), 58 Year 5 students (31 boys

and 27 girls), and 38 Year 6 students (11 boys and 27 girls). The percentage of boys and girls in each year is also shown.

	Boys	Girls	Total
Year 4	19 (38%)	31 (62%)	50
Year 5	31 (53%)	27 (47%)	58
Year 6	11 (29%)	27 (71%)	38
Total	61 (42%)	85 (58%)	146

Figure 3.3: The Sample Group.

The sample group of students were from six different classes (two Year 4 classes, two Year 5 classes and two Year 6 classes. One class was a composite Year 5/Year 6 class). The classes involved in the study were selected by the school but comprised all students in the school in Years 4, 5 and 6 except for the two students omitted as previously stated.

The students varied in age from 9 to 11 years old at the time that the data were collected. As the data were collected throughout Semester 1 of 2007 none of the students in Year 6 had turned 12 years of age.

3.7 Data Collection

The data were collected using a variety of sources and methods of collection providing data triangulation (Flick, 2006; Lincoln & Guba, 1985). The study involved

the collection of multiple data sets using three sets of differing stimulus materials applied to an open-ended questionnaire on three separate occasions. The three sets of stimulus material were also used to initiate student discussion in focus groups and individual interviews.

The stimulus materials:

In order to maximise student engagement and thus strengthen and enrich the data collected, the stimulus material chosen contained multi-modal representations (Tytler, 2003) of scenarios with inherent sustainability issues. Multi-modal refers to the linked use of science discourse of different modes of scientific reasonings and findings (Tytler, 2003).

> *Students need to be engaged actively with explanatory ideas and evidence that they can connect to real purposes and practices in their everyday world (Tytler, 2003, p.273)*

Three sets of differing stimulus materials relating to three different environmental scenarios were used on three separate occasions to gather data from the total group of participants (a copy of each of the three sets of stimulus material is included in the appendices). The environmental scenarios were considered appropriate as they were broadly representative of local environmental issues with critical implications for sustainability that were within the range of experiences of this age group of students. To allow for data triangulation, the scenarios were presented in three quite different ways, viz. a cartoon, a photograph, and an item of

newspaper text suitable for subjects having a reading age of 10 years. The suitability of all three scenarios was checked with the class teachers before they were used in the pilot study (see 2.8). The class teachers considered that they were likely to encourage student engagement and thus strengthen and enrich the data collected. The scenarios illustrated the use of either renewable or non-renewable resources that were likely to be within the comprehension and experiences of the students involved in the study. The three scenarios might be thought of as referring to the three “Fs” of forests, fuels and fishing. They comprised:

1. A cartoon (see Appendix 1) that depicted a paper seller with a board proclaiming “Sydney Morning Herald, Last Edition”, in front of the stumps of what may be the last forest (either locally or globally). The cartoon was drawn by the researcher (GW). The sustainability issues relate broadly to renewable resources, forestry management and paper manufacture. While a generically named newspaper could have been used, a named Sydney newspaper was shown because the students would be aware that the name represented an Australian newspaper and would thereby place the cartoon in a context that would be identifiable to the students.

2. A photograph (see Appendix 2) that depicts motor vehicles passing signs showing the prices for automotive fuels. The photograph was taken by the researcher (GW). The sustainability issues relate broadly to non-renewable resources oil and petroleum products. There are also explicit economic and

social issues relating to the selling of automotive fuels and the retailing of petroleum products by multi-national companies.

3. A newspaper text (Welling, 2005) with three photographs (see Appendix 3) from a local newspaper, “The Manly Daily”, with a circulation that includes some of the students’ homes. The text contains explicit economic and social issues as it describes the reasons why a commercial fisherman is selling his home. The sustainability issues relate broadly to renewable resources and the management of commercial fishing.

The scenarios relate to renewable resources (trees, forests and fish) and non-renewable resources (oil and petroleum products derived from hydrocarbons) where the environmental issues (or problems) were more likely to be understood by the students in the study. The students were less likely to have direct experience with the issues associated with solar or wind energy as these are regarded as “green” and renewable resources that might not prompt them to elaborate on their perceptions of sustainability. In short, the scenarios selected were more likely to generate discussion related to local sustainability issues.

Throughout the study the term “issues” was used, as opposed to the term “problems”, as it was thought that the term “issues” would be less value laden as “issues” could have either positive or negative connotation.

The decision to use three sets of stimulus material on three occasions was influenced by the time available and the extent of access to the school consistent

with what was achievable following negotiations between the school and the researcher.

The open-ended questionnaire:

(A copy of the open-ended questionnaire is included in Appendix 4)

The research began with an open-ended questionnaire (Bouma, 2000)**.** The questions asked in the questionnaire allowed respondents

> *to write a free response in their own terms, to explain and quantify their responses and avoid the limitations of pre-set categories of responses* (Cohen et al., 2000, p. 248).

An open-ended questionnaire was considered to be appropriate for word-based qualitative research where a rich variety of data was being sought (Cohen et al., 2000). Each open-ended question was followed by a large blank rectangle which allowed individual subjects to respond without being restricted by space or lines.

All students completed the open-ended questionnaire by responding in writing (and/or drawing). The same open-ended questionnaire was applied to all three sets of stimulus material as it was felt that this would more readily allow the researcher to make comparisons between the responses of different individual participants and their separate responses to the different sets of stimulus material. After all open-ended questionnaires had been completed, the same three items of stimulus material were also used to initiate discussions in focus group and individual

interviews. These discussions were encouraged to be more wide-ranging in order to extend and enrich the data gathered.

The wording of questionnaires is crucial to the success of any study (Cohen et al., 2000). The open-ended questionnaire used in this study was checked by the class teachers to increase reliability, validity and practicality of the questions. Classroom teachers suggested a change substituting “environmental” for “sustainability” as the word “sustainability” might not be understood by some students. In practice this was considered unlikely to impact on the quality or extent of the students’ perceptions of sustainability being gathered. The scenarios and questionnaire were designed to be consistent with the students’ normal classroom learning activities. Teachers checked the materials’ content and design and confirmed that they were within the comprehension and experience of all students. All students (146) were involved in completing the open-ended questionnaire for all three sets of stimulus materials. This was done on three separate occasions approximately one week apart.

The same open-ended questionnaire (See Appendix 4) was used for each of the three environmental scenarios. Using an open-ended exploratory approach (Bouma, 2000) it asked students:

What are the local environmental issues?

What are the related global environmental issues?

What action can be taken to limit the impact of these global environmental issues?

What natural resource is being used?

How much of this resource should people use? Give reasons for your answer.

From where do you find out about environmental issues?

Students were encouraged to express their understanding and thinking related to local environmental issues as shown in the stimulus material. These local environmental issues related to forestry, timber and fishing (renewable resources) and oil (a non renewable resource). The questionnaire asked whether these local environmental issues were linked to global environmental issues and if so how. The questionnaire also asked the students to express their views on the extent of resource usage that should be allowed in each of the three given scenarios as all scenarios depicted contained implicitly unsustainable elements.

The open-ended questionnaire, together with the three environmental scenarios, were trialled in a pilot study involving Year 6 students in Semester 2, 2006 (see 3.8). This group of students were moving to secondary school at the beginning of 2007 and therefore it was unlikely that their involvement in the trial of the data collection instruments would influence the responses of the students in the actual study in Semester 1, 2007. Following the trial, minor changes were made to the data collection instruments to reduce the possibility of confusion. These are discussed in 3.7.

The questionnaire was completed on three separate occasions using one of the three items of stimulus material on each occasion. After their completion they were transcribed and the text kept on file along with any drawings completed by students prior to analysis and interpretation.

Focus Group Discussions:

The use of the open-ended questionnaire was followed up with focus group discussions. In focus groups, the topic for discussion is supplied by the researcher but it is the interaction between the participants in the group that encourages the views of the participants to emerge (Morgan, 1988).

The students in the focus groups were randomly selected and the discussion was used to clarify where necessary and to add detail to the data gathered by the open-ended questionnaire. While the focus group discussions provided an efficient way to enrich the data, care was taken in analysing and interpreting the results as some of the responses of individual group members may have been influenced by those of other members of the group.

The focus groups represented a subset of the population sampled and their purpose was to encourage more wide-ranging discussion that would extend and enrich the scope and variety of the data gathered about children's perceptions of sustainability. Individual students involved in these discussions participated on one occasion which lasted 40 minutes. This was the extent of time made available for access to

the students by the school for the research. The total number of students involved in the focus group discussions was 48. This comprised 16 Year 4 students, 18 Year 5 students and 14 Year 6 students. This was approximately 35% of the total number of students involved in the study. The students involved in the focus group discussions were selected randomly while maintaining, where possible, an equal number of boys and girls so that the groups remained representative of the sample population. Student participation in the focus groups was by invitation. No student declined the invitation. The number of students in each focus group varied for two reasons:

1. The focus groups for Years 4 and 5 were made up of an even number of boys and girls. However this was not possible for Year 6 where there were more than twice as many girls as there were boys (11boys and 27girls).

2. In the first two focus group discussions there were six students in each group. This was found to be a less than ideal arrangement as it was difficult to get a breadth of views about sustainability and the later groups were reduced to four students.

	Boys	Girls	Totals	Percentage of Year
Year 4	8	8	16	32%
Year 5	8	10	18	31%
Year 6	5	9	14	37%
Totals	21	21	48	35%

Figure 3.4: The Focus Groups.

The focus group discussions were conducted in Semester 1, 2007, approximately one week after the questionnaires had been completed by all students. This ensured that all students had had time to reflect on the content of the three scenarios and the issues explored in the questionnaire. The focus group discussions were conducted in a room removed from the students' classrooms.

At the start of each focus group discussion, students were asked to introduce themselves by saying their first name, their age and the grade they were in. These details were omitted from the transcript. These introductions assisted identification in the recording. They also provided the researcher with an opportunity to warmly welcome the participants and "break the ice" ensuring that every student was able to speak in the focus group. The researcher also explained that:

- They could say whatever they wanted to and that their comments would not be identified.

- The researcher would be asking questions to guide the discussion and that if the answers to these questions seemed to be self evident, the purpose for asking them was to record the students' personal responses.

- There were no right or wrong answers and that they should say whatever they were thinking.

- For the purposes of the digital voice recording it was preferable that only one person spoke at any one time.

The focus group discussions were then initiated by showing the students one or more of the three items of stimulus material and then inviting them to comment on the environmental issues involved. The students then contributed their own comments. At times the researcher prompted individual students to elaborate on comments made by asking "open-ended" questions (Kvale, 1996; Patton, 1987) such as: "Why do you say that?" Open-ended questions do not pre-determine the answers and allow room for the informants to respond in their own terms (Kvale, 1996; Patton, 1987).

The focus group discussions were digitally audio recorded and later transcribed. The text was added to the student data that had been transcribed from the questionnaires prior to analysis and interpretation.

Semi-structured individual interviews:

The focus group discussions were followed by semi-structured individual interviews (Burns, 1997; Flick, 2006). These involved a face-to-face encounter between the researcher and each participant directed towards understanding the participants' perspectives on their lives, experiences or situations in relation to the research topic (Taylor & Bogdan, 1984). Semi-structured interviews are commonly used in Grounded Theory when the researcher knows enough about the study to frame the open-ended questions in advance (Richards & Morse, 2007). Although some

questions were pre-planned, the researcher needed to present them to the participants in such a way as to encourage detailed, complex answers expressed in the participants' own words (Richards & Morse, 2007).

The individual students involved were randomly selected. The interviews were conducted to further clarify and elaborate on the responses of the students to the scenarios contained in the stimulus material. During the interviews the students were asked to comment on their views of environmental sustainability and how these related to the environmental issues raised in the scenarios. Students were also asked to explain the influences that have informed and shaped their responses.

Individual student interviews were used to encourage more wide-ranging discussion that would enrich the scope and variety of the data gathered. These were conducted over a period of approximately two months following the focus group discussions. Individual students were involved in these interviews and participated on only one occasion which lasted no more than 30 minutes. This was the extent of time made available for access to the students by the school which was done to ensure that there was no harm or dislocation caused by the students missing normal class activities.

A total of 12 students were interviewed (6 boys and 6 girls) representing 9% of the total sample. These comprised 4 Year 4 students (2 boys and 2 girls) representing 8% of the Year 4 students; 4 Year 5 students (2 boys and 2 girls) representing 8%

of the Year 5 students; and, 4 Year 6 students (2 boys and 2 girls) representing 11% of the Year 6 students. The students involved in the individual interviews were selected randomly while maintaining an equal number of boys and girls. Student participation in the discussions was by invitation and no student declined to be involved.

	Boys	Girls	Totals	Percentage of Year
Year 4	2	2	4	8%
Year 5	2	2	4	8%
Year 6	2	2	4	11%
Totals	6	6	12	9%

Figure 3.5: Individual Students Interviewed.

The individual student interviews were conducted in a room removed from the students' classrooms. This room was the school library and while no other students were present there were two other adults in the library (the librarian and an adult library clerical assistant) who took no part in the individual interview. This arrangement was established to satisfy any ethical concerns relating to child protection issues.

At the start of each interview, each student was asked to introduce themselves by saying their first name, their age and the grade they were in. These introductions assisted identification in the recording. They also provided the researcher with an

opportunity to warmly welcome each student and “break the ice” ensuring that their comments would be valued. These details were omitted from the transcript.

At the start of each individual interview the students were told that:

- They could say whatever they wanted to and that their comments would not be identified.

- The researcher would be asking questions to guide the discussion and that if the answers to these questions seemed to be self evident, the purpose for asking them was to record the students’ personal responses.

- They were told that there were no right or wrong answers and that they should say whatever they were thinking.

The individual interviews were then initiated by showing the student one or more of the three items of stimulus material and then inviting them to comment on the environmental issues involved. Students then contributed their own comments. At times the researcher prompted individual students to elaborate on comments made by asking “open-ended” questions (Kvale, 1996; Patton, 1987) such as: “Why do you say that?”

The individual interviews were digitally audio recorded and later transcribed. The text was added to the student data that had been transcribed from the questionnaires and focus group discussions prior to analysis and interpretation.

Interviews of Class Teachers:

Interviews involving the six class teachers of the students involved in the study took the form of informal conversational interviews (Kvale, 1996). This type of interview resembles a chat, during which the informants may sometimes forget that they are being interviewed. Most of the questions asked flow from the immediate context. Informal conversational interviews are useful for exploring interesting topic/s for investigation and are typical of 'ongoing' participant observation fieldwork (Kvale, 1996).

The purpose of these interviews was, firstly, to determine possible influences that might impact on the student data. These might include perceptions of environmental sustainability present in: units of work completed by classes; class discussions relating to topical issues; programs conducted in the school; and, individual teachers' perceptions of environmental sustainability. These are reported and discussed in 4.2. Secondly, the interviews occurred in conjunction with teachers checking the proposed open-ended questionnaire and stimulus material. As previously reported this resulted in minor changes to the questionnaire.

The individual teacher interviews were conducted prior to the collection of the student data. They occurred in each teacher's classroom at times when students were not present. Teachers participated on only one occasion which lasted no more than 40 minutes. This was the extent of time made available for access to the teachers by the school and was done to minimise possible disruption to teachers' other duties. In some instances individual class teachers also contributed their own notes.

3.8 Pilot Study

The main purpose of a pilot study is to increase the reliability and validity of the research (Cohen et al., 2000). The selection of the three items of stimulus material and the related questions in the open-ended questionnaire were examined by the teachers in the school, amended as previously discussed, and confirmed as appropriate for the students involved in the study. These data collection instruments were then used in a pilot study with Year 6 students in November of 2006. As these Year 6 students moved to Year 7 and secondary school in 2007 they were therefore not present in this primary school in 2007 when the data collection was carried out with the study group. As a result the responses of the pilot group were unlikely to have influenced the responses of the study group in 2007.

Following the pilot study the open-ended questionnaire was amended by:

- Providing boxes for students to enter their written (or drawn) responses rather than lines that might restrict how much children wrote or drew.

- Adding: “Give reasons for your answer” to the question that asked “How much of this resource should people use?” This was done so that individual students could elaborate on their response rather than simply stating a one word answer or a fraction such as ½ .

- It was also decided that the students should be guided through the questionnaire by the researcher reading each question and then pausing while individual students made their responses. This was found to be necessary for students in Year 4, though less important for students in Years 5 and 6, particularly after they had completed the first questionnaire for scenario one.

There was only one change made to the three sets of stimulus material. That was made to the cartoon where the name of the newspaper on the paper-boy’s frame was shown as “Sydney Morning Herald” rather than “Newspapers”. This was done so that the name of the newspaper (and the text-type in which it is usually written) was one that was local and was likely to be identifiable as such by the students in the study.

The data collected in the pilot study indicated that the open-ended questionnaire and the three items of stimulus material would generate the responses required to address the questions raised in the study.

3.9 Data Management and Analysis

The data collected from the participants was contained in written questionnaires; digital audio recordings of the focus group discussions and individual interviews; and, comments and notes from the class teacher of the students involved in the study. All data generated by these sources were transcribed and grouped in a variety of ways. The student data were first grouped without reference to the literature and categorised by age and gender. These data were then coded according to ecological and scientific phenomena. After comparison and revision the final set of codes that emerged from this regrouping was: Alternative Fuels and Energy; Carbon Cycle; Food Chains and Food Webs; Pollution; and, Extinction. These same data were then regrouped using codes relating to environmental phenomena and sustainability issues. After comparison and revision the final set of codes that emerged from this regrouping was: Renewable and Non-renewable Resources; Climate Change and Global Warming; Greenhouse Gases and Greenhouse Effect; and, Environmental Sustainability. Data transcription, grouping, coding and recoding was done by the researcher and this supported the generation of codes and later themes as the researcher became familiar with the data collected. An audit trail involving colleagues, co-supervisor and supervisor was involved in this process. Through conversation and repeated interrogation of the data, the groupings, the codes and the themes later developed.

Data collected from the class teachers were summarised and listed as possible influences impacting on the students' comments. These influences were considered in the discussion and interpretation of students' comments.

The final set of student coded data was used to determine themes. These themes were then interrogated with reference to the literature. Themes that emerged from the student data related to:

- Scientific and ecological phenomena (e.g. cycles and extinction).
- Environmental phenomena (e.g. global warming, greenhouse effect, renewable and non-renewable resources).
- Economic, cultural and social phenomena (e.g. economic growth and development, social inequality, social justice, poverty, whale hunting).
- Environmental worldviews (e.g. Homocentric, Biocentric and Ecocentric) as described by Fein (1993).
- Ethical principles (e.g. conserving, sharing, maintaining a balance, behaving responsibly).
- Environmental actions and proposed actions.
- Influences that inform of children's notions of the environment and sustainability.
- Environmental sustainability.

When the data relating to these themes was compared and analysed on an age/grade basis the differences in the responses between students was found to be relatively small or negligible. Another concern was that the number of students in the grades varied with Year 4 having 50 students, Year 5 having 58 students and Year 6 having 38 students. While Year 5 was the largest group many of the Year 4 students formed the largest component of the school environmental group ("The Green Team").

When the responses were grouped by gender in the analysis, it indicated differences within the gender groups, although the differences between gender groups were relatively small or negligible. As a result the data are reported, analysed and interpreted for the group as a whole without regard to age or gender although the minor inconsistencies are noted in the results where relevant.

In completing the three open-ended questionnaires students could respond by writing and/or drawing. While some students did use drawings to support their response, the drawings only reiterated the text. As a result these drawings did not add further to the ideas being expressed by individual students. Therefore, they have not been used in the reporting of the results.

In some instances it was possible to quantify the responses of the students with respect to a particular theme. Where this is done the number of responses of a similar nature is shown for example as (50) or they are shown as a proportion of the

total number of students involved, e.g. (50/146). In still other instances where individual students have made a particular response on more than one occasion, the number of responses may exceed the total number of students involved in the study (146). Quantifying the responses was not always possible because students' names were optional and it was therefore not possible to match one student to three sets of responses on the three questionnaires. Attempting to do so might have resulted in a sense of ambiguity by giving a weighting to the data that would be invalid or inappropriate. Where it was possible to qualify a view expressed by a large number of students, statements are used that indicate the strength of the view and these give meaning to the terms used. Expressions that qualify the number of students who articulated a particular view fall within the following limits:

"Few" or "A small number" indicates up to 6% of the students.

"Some" indicates up to 18% of the students.

"Numerous" indicates up to 30% of the students.

"Many" indicates up to 50% or half of the students.

"Large" indicates up to 80% of the students.

"Most" indicates up to 98% of the students.

"All" indicates 100% of the students.

3.10 Ethical Considerations

Approval from The University of Technology Human Research Ethics Committee was received. The clearance number is UTS HREC REF NO. 2006-195A. See Attachment 7.

Approval from The NSW Department of Education and Training to conduct research in a NSW school was received. The SERAP number is 06.363. See Attachment 8.

Particular consideration was taken as the participants in the study included students of senior primary school age. All data collection activities had time limits appropriate for the attention spans of the children. Questionnaires and individual interviews were limited to 30 minutes each. Focus group discussions were limited to 40 minutes. For ethical considerations, all individual interviews were conducted in the school library at times when other students were not present. However, at the same time there were two other adults present (the librarian and the library assistant) who took no part in the interviews. When interviews and focus group discussions were initiated, care was taken to welcome the students and to put them at ease so that the data were contributed in a relaxed situation.

The participation of students and teachers in the study was by invitation. Written permission to be involved in the study was required and in the case of students, parental permission was also required (see Appendix 5: Parental Consent Form and Appendix 6: Teacher's Consent Form). Students were assured that their participation was voluntary and that no consequences would arise from non-participation. Their responses to the stimulus material using the open-ended questionnaire formed a part of normal classroom learning activities. Their participation in the focus group discussions and individual interviews was by

invitation that was only extended to individuals with parental written permission. There was one instance where the permission was withheld by a parent of a student. In this situation, the student chose and was permitted to participate in the class activities but their responses were not included in the data collected and analysed.

All data from participants were de-identified. Paper-based and digitally voice recorded data is stored in a locked cabinet and will be destroyed after five years from the date of publication of the research. Data stored electronically is password protected and will be similarly destroyed after five years. The researcher is able to identify some participants from both the published and unpublished data. However, in the published data the participants are not identifiable by others.

3.11 Problems that arose during the study

One problem arose early during the initial pilot study when it became apparent that maintaining a distant and objective relationship between the researcher and the students was likely to impact on the quality and extent of the data collected. As the students were young children they were more familiar with a supportive, relaxed and conversational approach to discussion and learning. The researcher needed to adopt a similar interview style if the data collection was to be effective. As the researcher was known to most students it was thought appropriate that interviews should be conducted in a more relaxed and informal style while at the same time maintaining the awareness, on the part of the researcher, of the need to avoid

"leading" the students' responses. The researcher acknowledges the difficulty in maintaining a balance between encouraging student responses and the need to avoid "leading" them.

Also impacting on this problem was the limited time and access available for data collection due to the limitations imposed by the school. Despite these problems, a balance was achieved although in a few parts of the transcripts of interviews, some data were discarded but also some data were retained when the children maintained a consistent view. An example of this problem contained in an individual interview from the study which follows. In this instance the data were retained:

> GW: *What are some of the other problems with the oil? Think about the cars using it.*
>
> Larry: *They pollute a lot of the Earth.*
>
> GW: *How do they do that?*
>
> Larry: *By the gas, the pollution, coming out of them.*
>
> GW: *The pollution caused by what?*
>
> Larry: *The petrol.*
>
> GW: *Burning?*
>
> Larry: *The petrol.*
>
> GW: *Yes and what does that do when the pollution comes out?*
>
> Larry: *It goes up and it becomes greenhouse gases. There's the Earth and it makes it warmer.*
>
> GW: *Causes heating, doesn't it?*

> Larry: *Yes.*
>
> GW: *And why is that a problem?*
>
> Larry: *Because now it's getting hotter everywhere and the ice is all melting and water levels are rising. (Larry/m/Y6/I/A009/22.10.07)*

Another problem that arose during the data collection phase of the study was that there were three well publicised events that occurred. These events were typical of the geopolitical climate at the time of the data collection and may have influenced the responses of some of the students involved in the study.

The first of these events was the election campaign leading up to the Federal election in late 2007. During the campaign there was an increase in media coverage of issues such as global warming and climate change. The incumbent government was widely reported as not having ratified the Kyoto Protocol (UNFCCC, 1997) on Climate Change and received much negative publicity as a result.

> *The Kyoto Protocol on Climate Change (1997) has now been ratified by 160 nations and came into force in 2005. In the West the only states which have refused to sign are the United States, Australia, Monaco and Liechtenstein* (Jones, 2006, p. 521).

The second event was the publicity surrounding and the screening of the Al Gore film "An Inconvenient Truth" (Gore, 2007). This film provided further coverage of global warming and climate change issues. Although the film received a "PG" classification (parental guidance recommended) the researcher became aware that a small number of the older students in the study had seen the film.

The third event was the publicity and release of the Stern Review (Stern, 2007) which dealt with global warming and climate change issues. At the time Nicholas Stern visited Australia and participated in a number of widely reported interviews in which he was critical of the federal government's non-endorsement of the Kyoto Protocol and its position on Climate Change.

3.12 Referencing of Participants' Statements (Identifying Information)

As the data from the questionnaires, focus group discussions, and individual interviews were transcribed, the following identifying information was added: Student Pseudonym /Gender (m or f)/School Year/Questionnaire (Q) or Focus Group Discussion (FG) or Individual Interview (I) Number/Item Number/ Date.

This information is shown for each item of data included in the thesis and provides a link to the original data source that is only identifiable by the principal researcher (GW).

3.13 Transcription Notes

Transcription was done by the researcher (GW). As idiosyncratic spelling and grammar might detract from a student's intended meaning, spelling and grammar are shown correctly where possible; words omitted by the student are bracketed; and, words omitted by the researcher were replaced by ellipses (i.e. .....).

The names of all students and teachers have been de-identified by substituting pseudonyms.

As all the research data were collected by the principal researcher, he is identified as GW.

This chapter outlined the methodology used in this study. This included the qualitative methods used for collecting and managing the data and the interpretative methods used for reporting and analysing the data. It also addressed issues of trustworthiness, credibility and dependability. The following chapter describes and discusses the data collected. Following this there is a discussion of the conclusions drawn.

Chapter 4: Results and Discussion

> *We humans have been catching fish for over 10,000 years. And all that time, the ocean seemed to be big enough to give us all the fish that we could ever possibly want. But even though there's no lack of fish at the fish markets, and there are no long queues outside the fish shops, and there is no increase in the price of fish, it seems we are running out of fish.*
>
> *Between 1990 and 1996 the worldwide fish catch levelled out to a maximum of about 100 million tonnes per year. During those six years, we tripled the numbers of fishing ships. These ships are not little aluminium boats with two people in them, but floating fishing factories the size of jumbo jets. And, although we're catching the same weight of fish, we're catching more smaller fish and fewer bigger fish.*
>
> Kruszelnicki, K. (1996). *Pigeon Poo, the Universe & Car Paint and other awesome science moments*, p. 89.

4.1 Introduction

This study seeks to understand how students, in their final years of primary school, perceive environmental sustainability and how these perceptions are generated. The intention was to illustrate this by using a rich selection of quotations from the written and verbal statements of the students involved in the study. This chapter reports and discusses the results of individual student responses to the three written scenarios, focus group discussions and individual interviews. The student responses produced a body of text totalling 52,229 words and quotations selected from this were deemed by the researcher to be typical examples of the ideas being discussed. The data were brought together and sorted according to significant themes that emerged using methodology that was influenced by grounded theory as described in the previous chapter. These themes are analysed and discussed.

The data obtained from interviews and written statements supplied by classroom teachers, is reported and discussed in 4.2. Teachers contributed this information because they felt that it was relevant to the context of the study. Following this the themes relating to environmental sustainability that emerged from the student data are reported and discussed at 4.3. These were outlined on p. 124. Extreme views and confused views expressed by some students are also reported and their significance is discussed. Themes relating to the students' views on the management and use of natural resources are reported and discussed at 4.4. The relationship of student views to environmental worldviews is also considered. The final part of the chapter reports and discusses individual environmental action proposed by the students at 4.5. This discussion considers the students' perceptions of the links between local and global action; students' environmental concerns and their views on who they consider responsible for the environment; and, those influences that inform students' understandings of environmental matters.

4.2 Interviews of Class Teachers

Before reporting and analysing the data from the students involved in the study, it is pertinent to consider possible influences in relation to the context of the study that might impact on the student data. These might include perceptions of environmental sustainability present in: units of work completed by classes; class

discussions relating to topical issues; programs conducted in the school; and, individual teacher's perceptions of environmental sustainability. To do this the classroom teachers (6) of the students involved in the study were interviewed and asked to contribute their ideas about what they thought might be relevant to the context of the study. Significant influences are summarised and reported as follows:

Firstly, the school has a continuing involvement in the implementation of the (DET) Sustainable Schools Program and students were involved in trying to reduce the size of the school's environmental footprint. Related to this program, students would have been aware of, and may have discussed:

- The placing of solar panels on the library roof for electricity production.
- The collection of rainwater from roofs and its storage in tanks that in turn provided water to irrigate the school oval.
- Developing plans for a new shade cloth area in the playground.
- The purchase and planting of a Wollemi Pine (*Wollemia nobilis*) as the school's contribution to the protection of this species.
- The installation of energy-saving florescent globes in some classrooms.
- Participation in "Clean Up Australia" activities at school and related class discussions on recycling.

- The planting (by some students) of an Australian Native Garden at the western end of the school playground and participation in the continuing maintenance of this garden by weeding and picking up litter.
- Membership (by some students) of “The Green Team” (school environmental club) and participation in environmental enhancement activities in the school grounds such as: planting native trees and shrubs, spreading mulch, weeding gardens and removing litter.
- The cutting down of a large shade tree (Camphor laurel, *Cinnamomum camphora*) in the playground that occurred at the time the data were collected.

  The students had lots of suggestions as to where assembly lines should be located after the loss of this large shade tree and difficulty was experienced in finding another suitable area.

It is likely that these activities and the related discussions influenced some comments that students contributed to the data collected in the study. It is also possible that the related discussions in this school context generated more insightful comments than might have been collected in a different school context where the Sustainable Schools Program had not received the same emphasis in its implementation.

Secondly, student participation in morning news and current affairs discussions covered many topics and some of these topics are relevant to environmental

sustainability. In general, the topics were current in the media at the time the data for the study were collected.

Topics related to the environmental sustainability were:

- Recycled water.
- The proposed desalination plant for Sydney.
- The proposed Federal Government management of Murray/Darling river system.
- The drought and its effects on farmers and jobs.
- Local weather events.
- Global warming.
- El Niño.
- Deforestation around the world.
- The hunting of whales.

Some of these topics appear in the comments contributed by students during the collection of data for the study. For example, students made comments related to: shade, weather patterns, drought, deforestation and whale hunting. While the students' comments add insight to and enrich the data, it is not possible to determine if the related class discussions occurred before these topics influenced the data or if the data gathering activity influenced the class discussions.

Student comments about the lack of shade resulting from the clearing of the trees was an example of views that are possibly influenced by the recent removal of a very large, and historic, camphor laurel tree from the school playground. The comments illustrate the significant influence of local environmental issues on students' thinking as compared to their understanding of global environmental issues.

> *It would get very hot since there is no shade.*
> *(Olive/f/Y4/Q1/Item2/19.3.07)*
>
> *Not cut down as many trees so the animals don't have anywhere to live (and) so we have more shade to keep us healthy.*
> *(Effie/f/Y4/Q1/Item3/19.3.07)*

4.3 Themes relating to knowledge and understandings about environment and sustainability as expressed by the students

This section reports and discusses those environmental themes that emerged from the student data thereby providing an insight into the students' ability to articulate their views about the environment and sustainability. Individual students expressed ideas that were related to themes in a variety of ways, such as:

> Using ideas in a context that demonstrated an understanding of the concept or theme involved.
>
> Using ideas in a context that demonstrated a limited or developing understanding of the concept or theme involved.
>
> Using ideas in a context that demonstrated confusion or a lack of understanding of the concept or theme involved.

Making comments that demonstrated that the student had some understanding of the concept or theme involved without stating the actual concept or theme.

In 4.3.1 themes relating to ecological or scientific phenomena are reported and discussed; in 4.3.2 themes relating to the environmental phenomena are reported and discussed; and in 4.3.3 themes relating to the extreme and confused views are reported and discussed. These different themes provide insight into the varying student perceptions and understandings in relation to significant scientific and environmental phenomena and relationships that are important in articulating knowledge and understanding about environmental sustainability.

4.3.1 Ecological and scientific phenomena

Of significance are the themes relating to ecological and scientific phenomena that were used by the students. These are significant because they demonstrate that the students have an awareness of these phenomena and are able to refer to them appropriately when articulating a particular idea.

Themes that relate broadly to scientific phenomena and environmental issues were:

Fuels and Energy (including alternatives to fossil fuels and alternate actions)

Carbon Cycle

Food Chains and Food Webs

Pollution

Extinction

Fuels and Energy (including alternatives to fossil fuels and alternate actions) Many students (56) made comments about energy sources that might be either renewable or non-polluting alternatives to fossil fuels. These comments arose incidentally when they were asked about what could be done to reduce our dependence on oil and petrol to power motor vehicles. Solar power (used to produce electricity) was the most common energy source mentioned followed by wind, water (wave energy), animal, hydrogen, natural gas, hydro-electricity and ethanol. Comments were frequently embedded with ideas suggesting possible action. Examples of students' comments are:

> *Get solar powered or electric cars.*
> *Reduce the amount we're using.*
> *Use public transport. (Alan/m/Y4/Q2/Item3/26.3.07)*

> *We can buy solar power cars, use less energy, and when you have the choice to walk or drive the car choose walk so you are not using up your petrol so you don't have to get refills of petrol as often.*
> *(Emily/f/Y4/Q2/Item3/26.3.07)*

In these typical statements the students have referred to solar energy while commenting on possible actions that would reduce the use of fossil fuels (e.g. use public transport or walk).

Carbon Cycle

There were a large number of students (101) who commented on aspects of the "carbon cycle" although no student actually used the term. There were many comments about the carbon dioxide produced by motor vehicles accumulating in

the atmosphere. However, it is uncertain if some students recognise the parts of the carbon cycle or if they view it as a linear relationship. The following is a typical example:

> Sarah: *Well this (using petrol) here is affecting our environment.*
>
> GW: *How's it doing that?*
>
> Sarah: *By putting all this gas in the air and affecting the environment.*
>
> GW: *And do you know what the gas is that it puts into the air?*
>
> Sarah: *Carbon dioxide is it?*
>
> GW: *Yes. Do you know what the problem with carbon dioxide in the air is?*
>
> Sarah: *If it goes up into the air we have this big blanket over the Earth and it's making a bigger hole. Our hole is really big. My sister told me that when it gets big the Earth's going to explode.*
>
> GW: *I don't know whether that's true but it will have an effect on the Earth. What's the effect it is having?*
>
> Sarah: *It's getting smoggy. (Sarah/f/Y4/I/A006/22.10.07)*

In this example the student is uncertain of the effects of carbon dioxide in the atmosphere and this leads to the predicting of incorrect effects or relationships.

Many students (22) referred to the burning of (fossil) fuels and this contributing carbon dioxide to the atmosphere. Many students also appeared to be familiar with, and able to use appropriately, the chemical symbol for carbon dioxide (CO_2).

> *The fuel blows out lots of* CO_2 *gases which is bad for the environment. The plants hate it. (Kim/f/Y6/Q2/Item1/23.3.07)*

The more you burn fuels, more CO_2 *is released into the atmosphere. (Sybil/f/Y6/Q2/Item1/23.3.07)*

The comment “the plants hate it” demonstrates errors in understanding the effects of carbon dioxide and relationships contained in the carbon cycle.

Many students implied knowledge of a cycle when they referred to humans (and other animals) breathing in oxygen and breathing out carbon dioxide while the trees took in carbon dioxide and released oxygen. The implication was that humans and trees were in a reciprocal relationship. They were concerned that if the number of trees was reduced then the amount of available oxygen would be reduced (or totally removed) and that this might result in human deaths because humans wouldn’t be able to breathe properly. The following extracts from discussions are typical:

GW: *So if you cut down all the trees, apart from the newspaper problem and the paper problem, what other problems would there be?*

Ann: *You wouldn’t be able to breathe.*

GW: *Tell me more about that.*

Ann: *The trees breathe in carbon dioxide and breathe out oxygen. (Ann/f/Y6/I/A009/22.10.07)*

Chris: *Because the trees provide the oxygen.*

GW: *Go on. Tell me more.*

Chris: *If they cut down all the trees there won’t be any (oxygen).*

GW: *Tell us about how the trees might provide us with oxygen.*

Sasha: *They breathe in carbon dioxide and let out oxygen so the trees are helping us and we are helping trees because we breathe in oxygen and*

the trees breathe in carbon dioxide and we breathe out carbon dioxide. (Chris,Julian,Sasha,Sienna/mmff/Y5/FG/21.5.07)

Many students (40) associated the removal of trees as having a detrimental effect on the atmosphere. In some instances they stated that this would result in a limitation on the available atmospheric oxygen available for breathing and in other instances would result in a total lack of oxygen which would result in our deaths. Many students (45) repeated the idea that there is an essential reciprocal relationship between animals and plants as plants "inhale" carbon dioxide and "exhale" oxygen while animals "inhale" oxygen and "exhale" carbon dioxide.

The air is polluted because there are no more trees to suck in the carbon dioxide. (Jasmine/f/Y5/Q1/Item1/19.3.07)

There are no homes for Aussie animals and the air will become dirty. No paper can be used. The air will become polluted as there are no trees to suck in the carbon dioxide. (Martha/f/Y5/Q1/Item1/19.3.07)

While some comments acknowledged that continual cutting down of trees would be detrimental for the atmosphere their comments also recognized that there was a need to cut down some trees so long as they are replaced.

(Use) as much as they need and sometimes a little bit less because if we cut down all the trees we won't have enough fresh air to breathe and to admire. (Gretel/f/Y5/Q1/Item5/19.3.07)

Only a little bit should be used because otherwise there won't be any trees left and then there won't be any people because there is no oxygen for us to breathe in. (Belinda/f/Y5/Q1/Item5/19.3.07)

Some comments implied the need to share the resource fairly and when this was done a fractional amount was often indicated.

> *(Use) ½ of it because then we could breathe and we would have life. (Imogen/f/Y5/Q1/Item5/19.3.07)*

> GW: *How much should they be allowed to cut down? Only as much as what?*
>
> Jack: *Maybe leave half. Have half for just air and use the rest. (Jack/m/Y4/I/A001/22.10.07)*

While most students considered the role of trees as essential in absorbing carbon no mention was made of the oceans or the soil as important carbon sinks.

Most of the students considered the role of trees as essential in providing food and habitats for animals.

> *Too many trees are being cut down just to make newspapers and that means we can't breathe enough oxygen.*
> *Animals (the wild ones) don't have anywhere to live or get food like koalas have no gum leaves! (Marion/f/Y4/Q1/Item1/19.3.07)*

> *There are no homes for Aussie animals and the air will become dirty. No paper can be used. The air will become polluted as there are no trees to suck in the carbon dioxide. (Martha/f/Y5/Q1/Item1/19.3.07)*

Dire consequences would result with continued cutting down of trees according to some students.

> *The air is polluted because there are no more trees to suck in the carbon dioxide.*
> *We will die. (Jasmine/f/Y5/Q1/Item2/19.3.07)*

No one would be able to breathe so everyone would die and so that would be silly. (Lydia/f/Y5/Q1/Item2/19.3.07)

For many students the most significant thing was to leave some trees to supply oxygen, and remove carbon dioxide, for the survival of humans and to supply food and habitats for other animals.

Food Webs and Food Chains

Few students (2) articulated comments involving the food chain. While students at this age may be familiar with food chains, in the context of the questions asked food chains did not assume a high priority. Those comments made showed that the students had an awareness of food chains as a way of expressing the relationships between predators and their prey. The comments were:

All the fish would die out.
If one type of fish die(s) out most likely more will because of the food chain. (Sue/f/Y4/Q3/Item2/2.4.07)

If you catch one fish it could be a clownfish. If we caught a lot of clownfish what would bigger fish eat? It is kind of a food chain.
(Sheila/f/Y4/Q3/Item2/2.4.07)

These comments demonstrate an appreciation of single step relationships regarding food. Other comments also contained similar single step relationships such as: “leaves for koalas” and “fish for bigger fish”. However, extended sequences were not described suggesting a limited understanding of food webs and the complex relationships inherent in the sustainability scenarios.

Pollution

Views about pollution were expressed by many students (55) at all year levels with most students commenting on pollution in an appropriate context. There were some responses where the view was expressed in a manner that suggested an absoluteness or lack of subtlety. An example of this is:

> *The air is polluted because there are no more trees to suck in the carbon dioxide.*
> *We will die. (Jasmine/f/Y5/Q1/Item2/19.3.07)*

In numerous responses (28) students indicated an awareness of the burning of oil causing pollution in the atmosphere.

> *Lots of oil is being used all over the world and it's polluting the atmosphere. (Martin/m/Y4/Q2/Item2/26.3.07)*
>
> *More cars are going to use a lot of petrol and (the) air will get polluted. (Colin/m/Y4/Q2/Item2/26.3.07)*

Some students (14) demonstrated an understanding of the consequences of pollution especially atmospheric pollution from the burning of oil.

> *We might run out of oil which will mean no more cars. Using more oil will mean more cars, vehicles and trucks on the roads to cause pollution. Also the ice caps will melt. This will cause extinction to other animals. (Evette/f/Y4/Q2/Item1/26.3.07)*

A few students (4) expressed the possibility of dire consequences.

GW: *What are some of the other problems with the oil? Think about the cars using it.*

Larry: *They pollute a lot of the earth.*

GW: *How do they do that?*

Larry: *By the gas, the pollution, coming out of them.*

GW: *The pollution caused by what?*

Larry: *The petrol.*

GW: *Burning?*

Larry: *The petrol.*

GW: *Yes and what does that do when the pollution comes out?*

Larry: *It goes up and it becomes greenhouse gases. There's the Earth and it makes it warmer.*

GW: *And why is that a problem?*

Larry: *Because now it's getting hotter everywhere and the ice is all melting and water levels are rising. (Larry/m/Y6/I/A009/22.10.07)*

A few students (4) expressed the idea that running out of oil might be a good thing because we would then have less or no pollution.

We will run out of it and hardly (have) any cars. We would have to invent new cars but it would be good because there would be no more pollution. (Jerry/m/Y4/Q2/Item1/26.3.07)

Extinction

Views about extinction were referred to by numerous students (29) at all year levels. The different contexts suggested that the students understood extinction to mean the elimination of a species.

The students linked extinction exclusively to animal extinctions without making a similar link to plant extinctions.

> *No more paper.*
> *Animals may become extinct. (Mark/m/Y4/Q1/Item 1/19.3.07)*

> *The problem is animals would lose their habitat and many may go extinct.*
> *We would have no more newspapers.*
> *We would have to wait the next ten years or so for the trees to grow back so it would be hard to get a lot of timber for tables, chairs, etc.*
> *(Shelia/f/Y4/Q1/Item 1/19.3.07)*

> *No more professional fishermen.*
> *The fish are becoming extinct.*
> *Some fish are dying off.*
> *There may not be any more fish to eat in Sydney. (Ita/f/Y4/Q3/Item1/2.4.07)*

An understanding of the concept of extinction was articulated by some students who were also typically forceful in stating their concern. Some comments indicate that the annual consumption of half of a particular resource makes little sense when it comes to considering the overall sustainability of the resource.

> *We should use only a little bit because we don't want them to get extinct. I know people want to eat a lot of fish but we can't eat all of them. If we have half this year what are we going to do next year?*
> *(Helen/f/Y4/Q3/Item5/2.4.07)*

> *No more fish because they're taking them all and they will become extinct. There would be no more professional fishermen. There would be no more fish and chips. (Jerry/m/Y4/Q3/Item1/2.4.07)*

Some students (23) were familiar with the issues of Japanese whaling and were concerned about both the hunting of “our” whales and the depletion of whale species.

> Angela: *I’ve heard that the Japanese are killing whales for so called scientific reasons and they’re coming into private land.*
>
> GW: *I think you mean land that’s in the waters of another country.*
>
> Angela: *Yes and they’re taking our whales. They’re killing them and just leaving them.*
>
> GW: *They’re not actually. They ship them back to Japan for people to eat.*
>
> Angela: *Yes.*
>
> GW: *So what’s wrong with them doing that? I mean we eat meat.*
>
> Angela: *They shouldn’t eat whales because there’re not very many of them in the world. (Angela/f/Y6/I/A009/22.10.07)*
>
> GW: *They used to hunt them (whales) or some countries used to hunt them.*
>
> Lewis: *Oh. Yes. The Japanese.*
>
> GW: *So why is that a problem?*
>
> Lewis: *Well it’s kind of the same as fishing. They’re taking away the numbers of how many there are. (Lewis/m/Y4/I/A001/22.10.07)*

There was a view that even though fish might become extinct, we would still somehow be able to obtain fish products such as Omega 3 capsules. It is unlikely that the students were aware that Omega 3 can be obtained from sources other than fish.

Sasha: *We also have the southern arctic blue-fin tuna which is used for Omega 3 which is healthy for us and if we don't have the fish….*

Julian: *We won't have a balanced diet.*

GW: *Are we still going to have Omega 3 though?*

Julian: *Yes.*

GW: *What are they making Omega 3 from?*

Chris: *Fish oil. (Chris,Julian,Sasha,Sienna/mmff/Y5/FG/21.5.07)*

Students view species extinction as bad both in itself, and bad as far as its consequences for humans (e.g. "no fish to eat" and "no Omega 3 capsules").

Summary and Discussion

Students spoke about scientific and ecological matters related to the following themes and in most instances referred to them in an appropriate context: carbon cycle, food chains, pollution, and extinction. In some instances, while not always stating them, the discussion generated indicated that the students were aware of examples of alternative fuels and energy. Students are aware of simple one or two step scientific or ecological relationships but may not have appreciated the complexity of the relationships inherent in the sustainability scenarios.

Many students associated the removal of trees as having a detrimental effect on the atmosphere. Some students stated that this would result in a limitation on the atmospheric oxygen available for breathing and in some instances would result in a total lack of oxygen which would result in our deaths. Many students repeated the

idea that the exchange of gases was an essential reciprocal relationship between animals and plants because plants “inhaled” carbon dioxide and “exhaled” oxygen while animals “inhaled” oxygen and “exhaled” carbon dioxide.

Students considered the role of trees as essential in providing food and habitats for animals and some students articulated an awareness of the sustainability needs of both plants and animals. Of significance is the idea that the students perceived the need to share fairly natural resources between humans and other animals.

There was a view that even though fish might become extinct, we would somehow still be able to obtain fish products such as Omega 3 capsules. It is unlikely that the students were aware that Omega 3 can be obtained from sources other than fish and there was no mention of alternative sources of Omega 3 in any of the student data.

Students were familiar with the Japanese whaling issue and were concerned about the hunting of “our” whales. On this topic it appeared that the students were concerned that someone else (Japan) could use something belonging to their nation (whales) without their agreement. It was as if their sense of “fairness” had been compromised and this concern appeared to be greater than that of concern for the sustainability of the whales. This concern was apparent in the tone of their comments and was not adequately conveyed in the written text.

At times some students' comments appeared to be based on limited scientific understanding which was then generalised uncritically to another situation (e.g. fish as a source of Omega 3 and the relationship between oxygen and carbon dioxide).

Of significance, for many students was the need for natural resources such as forests, fuels and fish to remain sustainable for the survival of humans and to supply food or habitats for other animals.

4.3.2 Environmental phenomena

Themes relating to environmental phenomena and sustainability issues were:

Renewable and Non-renewable Resources

Climate Change and Global Warming

Greenhouse Gases and Greenhouse Effect

Environmental Sustainability

Renewable and Non-renewable resources

Renewable and Non-renewable resources were referred to by many students (57) at all year levels and all the students' comments were used in an appropriate context that indicated understanding.

Numerous students (36) were aware of the fundamental differences in these types of resources and made it apparent in their comments without actually using the terms. In some instances, terms such as "unlimited" and "unrenewable" were substituted for renewable and non-renewable.

GW: *OK. So we can get more trees and we can get more fish if we leave them alone. This one's a bit different. Why's the oil a bit different?*

Jack: *Well because you can't get more oil.*

GW: *Why not?*

Jack: *Oil is just there and there is nothing to produce more.*

GW: *It comes out of the ground so after you mine it does anymore come back?*

Jack: *Not really. If you took all of it there would be nothing left. (Jack/m/Y4/I/A001/22.10.07)*

Renewable and non-renewable resources were often differentiated without referring to these terms.

GW: *If there's not enough of something you pay more for it. So that's the problem with the oil because there's less of it. Can we grow more oil?*

Angela: *No.*

GW: *Why not?*

Angela: *Because it's a mineral and you can't regrow it. (Angela/f/Y6/I/A009/22.10.07)*

Some students used a similar term that demonstrated their understanding of the different types of resources. Examples of this are:

Oil is an unrenewable resource. It is getting very expensive (because) it is running out (and causing a) greenhouse problem. (Ita/f/Y4/Q2/Item1/26.3.07)

Chris: *There's going to be no more oil in the whole world.*

GW: *Why do you say that?*

Julian: *It's not an unlimited resource. (Chris,Julian/mm/Y5/FG/12.5.07)*

In these responses the students may have been trying to recall the term "non-renewable" by substituting the words "unrenewable" and "unlimited".

Some students (14) demonstrated a limited understanding of the immediate consequences of using all of a non-renewable resource.

Craig: *Because oil is a fossil fuel.*

GW: *Which means?*

Craig: *You can't replace it.*

GW: *Right. So what's going to happen eventually with the oil?*

Craig: *It will run out and there'll be no oil. (Craig/m/Y6/I/A008/22.10.07)*

We will run out of it and it can't be renewed. So no one will drive any more. (Terry/m/Y4/Q2/Item1/26.3.07)

Climate Change and Global Warming

Climate change was discussed by a few students (3) while global warming was mentioned by a large number of students (90).

A few students (4) commented on climate change or global warming with their comments indicating limited understanding.

If there is no more oil there would be less taste in food.
If there is no more fuel there would be less cars or transportation.

And greenhouse gases so the world would get more hot.
(Effie/f/Y4/Q2/Item2/26.3.07)

The cars produce carbon dioxide into the air and carbon dioxide will affect the greenhouse.
This carbon dioxide makes the world hotter which relates to climate change. (Emily/f/Y4/Q2/Item2/26.3.07)

Climate changes because of the global warming.
(Samantha/f/Y6/Q2/Item2/23.3.07)

Some students (19) expressed awareness of the Earth becoming warmer. Typical comments were:

There is hardly any oil and fuel for cars but it has been warming up the universe and causing global warming. (Chelsea/f/Y5/Q2/Item1/26.3.07)

Global warming. The earth is warming up. Soon it will be averaging like 30 degrees C.
Think of the penguins!
Ice melt, sea level rise, death for little islands.
(David/m/Y6/Q1/Item2/9.3.07)

Some students (16) were aware of the link between global warming and the melting of the ice caps and glaciers although there was some uncertainty or confusion about how a reduction in sunlight (and therefore heat) might cause this as shown in this discussion:

GW: *Let's go back to what we talked about before. Why are these fumes or gases bad for the environment?*

Sasha: *Because they cause global warming.*

GW: *Tell us a bit more about that.*

Julian: *Carbon dioxide could be making holes in our ozone layer so the sun doesn't get through. And it's making the Earth heat up and all the ice is starting to melt. (Sasha,Julian/fm/Y5/FG/26.3.07)*

Numerous students (31) expressed an awareness of the link between car exhausts and increasing carbon dioxide levels in the atmosphere.

> *Since there are more people there are more cars.*
> *When they burn the fuel the carbon dioxide makes global warming.*
> *(Sienna/f/Y5/Q2/Item2/26.3.07)*

Some students (12) expressed an awareness of the link between global warming and sea level rise although some thought that this would also make it difficult to breathe.

> *We couldn't breathe.*
> *No food.*
> *Global warming causes sea level to rise and (ice to) melt.*
> *(Jana/f/Y5/Q1/Item2/19.3.07)*

A few students (4) linked global warming to holes in the ozone layer.

> *One day when there's a lot more holes in the ozone layer all the ice caps will have melted and there'll be a global flood. (Julian/m/Y5/FG/26.3.07)*

Some students (10) expressed confusion and possible dire consequences that might result from global warming.

> *Glaciers (Sasha probably means icebergs) will become very dangerous because they don't melt in the water. Ships will crash into them like the Titanic did and people on the ships could die. I went to New Zealand and the natural glaciers are about as high as this building if you stretch it over. And my dad told me in the car the other day it's not even as high as this building any more. He said it was from global warming.*
> *(Sasha/f/Y5/FG/26.3.07)*

Maybe we will die because the seas are getting hotter and hotter. And the ice will melt. (Natalie/f/Y4/Q2/Item1/26.3.07)

Greenhouse Gases and Greenhouse Effect

Some students (27) expressed views about greenhouse gases while other students (15) commented on the greenhouse effect.

Most of these students thought that carbon dioxide was the main or only greenhouse gas and that greenhouse gases had the effect of heating up the atmosphere. A small number of students (3) expressed a view without demonstrating understanding of the relationship between greenhouse gases and global warming.

Greenhouse gases in the atmosphere. (Larry/m/Y6/Q2/Item2/23.3.07)

(Use) less (oil) because it makes greenhouse gases. (Larry/m/Y6/Q2/Item5/23.3.07)

A few students (8) made a link between greenhouse gases and carbon dioxide frequently using the chemical symbol CO_2.

Oil is running out and we can't get it back. Cars make carbon dioxide as well as factories. That has an effect on greenhouse gas. (Martin/m/Y4/Q2/Item1/26.3.07)

There are more people and more cars.
We are adding CO_2 to the world greenhouse gases – global warming.
There are less service stations. (Lydia/f/Y5/Q2/Item2/26.3.07)

Some students (15) demonstrated the awareness that motor vehicles are contributing carbon dioxide to the atmosphere.

Cars and factories are causing greenhouse gases so in about a decade's time it will make the earth hotter. Every day more than 1,000 (new) cars are brought to our roads which is causing more and more problems. (Alissa/f/Y4/Q2/Item1/26.3.07)

A few students (6) were able to expand on this issue and were aware of some of the consequences of increasing carbon dioxide emissions.

GW: *What are some of the other problems with the oil? Think about the cars using it.*

Larry: *They pollute a lot of the Earth.*

GW: *How do they do that?*

Larry: *By the gas, the pollution, coming out of them.*

GW: *The pollution caused by what?*

Larry: *The petrol.*

GW: *And what does that do when the pollution comes out?*

Larry: *It goes up and it becomes greenhouse gases. There's the Earth and it makes it warmer.*

GW: *And why is that a problem?*

Larry: *Because now it's getting hotter everywhere and the ice is all melting and water levels are rising. (Larry/m/Y6/I/A009/22.10.07)*

Most of the students were able to state some of the possible consequences of increasing levels of carbon dioxide in the atmosphere such as the Earth becoming hotter, ice melting, the sea level rising, and humans being affected.

GW: *What are some of the problems that cars create?*

Ann: *The cars create greenhouse gases which cause global warming.*

GW: *Tell me what you know about that.*

Ann: *Greenhouse gases form the hole in the ozone layer. If the ozone layer breaks everyone will get sunburnt and the ice might melt.*

GW: *Do you really think that?*

Ann: *It might because if all of it forms it will be extremely, extremely, extremely hot.*

GW: *So why does it melt?*

Ann: *Because the sun is so hot and we are so close to the sun and there's nothing to protect us.*

GW: *So if it gets too hot what is going to be some of the effects on the Earth?*

Ann: *People will be getting a lot more skin cancer and we'll need to spend more on medical research.*

GW: *I think you mentioned global warming. What does that cause?*

Ann: *It causes the ice to melt and that means the water level will rise.*

GW: *Water levels where?*

Ann: *The water in seas and dams.*

GW: *So how does that become a problem?*

Ann: *Because if you have a seaside house it could come all the way up to your house and it will be flooded. You'd have to move out. For example in China it could be really, really bad. People would have to move out. (Ann/f/Y6/I/A009/22.10.07)*

When the greenhouse effect was mentioned by some students (15) it was evident in the discussions that the students were aware of the idea but were still confused as to its meaning.

Oil is an unrenewable resource. It is getting very expensive (because) it is running out (and causing a) greenhouse problem. (Ita/f/Y4/Q2/Item1/26.3.07)

The ice caps will melt and the water will rise, therefore the islands will sink and there will be floods all because of the greenhouse effect of the fuel. (Irene/f/Y4/Q2/Item2/26.3.07)

While some students expressed a view about the results of the greenhouse effect, a few students (4) linked it to causing holes in the ozone layer or simply stated that they did not know or were unsure of what it caused.

Julian: *After it's (oil) used it lets off carbon dioxide gas and it floats around the atmosphere.*

GW: *Why is that a problem?*

Carl: *Because the ozone layer can get holes in it and lots of oxygen will escape and eventually the world will get too hot and all the ice would start melting in Antarctica.*

Julian: *It makes holes in our ozone layer so the sun could get through.*

GW: *So what has carbon dioxide got to do with that?*

Julian: *It kind of melts our ozone layer.*

GW: *Carbon dioxide does?* Pause.

Sasha: *It's the gases that melt the ozone layer but I'm not sure what carbon dioxide does. (Julian,Carl,Sasha/mmf/Y5/FG/26.3.07)*

Some students (19) were aware that there was a link between the greenhouse effect and carbon dioxide accumulating in the atmosphere although they were unable to clearly express what this link could be.

The cars produce carbon dioxide into the air and carbon dioxide will affect the greenhouse.

This carbon dioxide makes the world hotter which relates to climate change. (Emily/f/Y4/Q2/Item2/26.3.07)

More cars mean more CO_2*, oil runs out, and global warming and greenhouse effect. (Carl/m/Y5/Q2/Item2/26.3.07)*

The greenhouse effect gets CO_2 *in it and that the oil can't be reused. (Ruth/f/Y6/Q2/Item2/23.3.07)*

Environmental sustainability

While no student used the terms "sustainable" or "sustainability" there were numerous comments articulated that suggest that individual students had ideas about environmental sustainability. Some responses (18) showed an understanding of sustainability in that the students were aware of the need to maintain a natural resource at an appropriate level rather than permit its continued use and decline.

We should use half of the forest. And then when you chop one down replant something there like another tree because then we reuse it and then it regrows. (Julian/m/Y4/Q1/Item5/19.3.07)

Use half and then leave it to grow back then use the other half and so on. I say half because then you still have (some) left and then you plant some more use the other half plant some more then use the ones you planted and so on. (Alissa/f/Y4/Q1/Item5/19.3.07)

There were numerous instances where students articulated a view that implied that there was a need to share non-renewable resources and maintain renewable resources. An example of this is shown in the following exchange during an individual interview.

GW: *What starts any plant growing? What's the bit that starts the growth off?*

Lewis: *Trees.* Pause. *Seeds.*

GW: *So if you cut down all the trees what would happen to the seeds?*

Lewis: *Well. There wouldn't be any seeds.*

GW: *So let's go back to the question. Why is it important to keep some of the trees?*

Lewis: *So we can have more over time.*

GW: *More what?*

Lewis: *More trees.*

GW: *So if that was a forest in Australia, how many should we cut down?*

Lewis: *Not many. Only a few.*

GW: *Only a few so what can happen?*

Lewis: *So more can grow and then we can come back next year.*

(Lewis/m/Y4/I/A001/22.10.07)

An awareness of the conditions required for the sustainability of both plants and animals was articulated by some students. This is shown in the following two interviews with the same student.

GW: *See if this was the last forest in the world and you cut the whole thing down, could you get more trees?*

Craig: *If there's seeds on the ground (you could).*

GW: *So what do the trees need to be able to do?*

Craig: *Maybe to produce their seeds.*

GW: *To have their seeds.*

Craig: *And they fall on the ground and grow.*

GW: *So what are we trying to do with the trees themselves?*

Craig: *Grow them.*

GW: *So that?*

Craig: *We can get more forests. (Craig/m/Y6/I/A008/22.10.07)*

GW: *OK. So that poor man's out of a job now. He can't catch any more fish. There's not enough to make it worthwhile. So what can they do?*

Craig: *They can stop fishing for a while and let the fish repopulate. Same as the forest. (Craig/m/Y6/I/A008/22.10.07)*

Some responses suggested that students were developing an understanding of sustainability.

We should use the same amount as we do now except we need to plant more trees so we can all have some of the stuff we need. (Jane/f/Y4/Q1/Item5/19.3.07)

Use a few trees so more trees can grow back and then we can cut down a few more but there's still some left for the animals and our air. (Ita/f/Y4/Q1/Item5/19.3.07)

Students did not use the words "sustainable" or "sustainability" and their awareness of the meaning of these terms was explored in some of the individual interviews. The following exchange is typical.

GW: *So what do you think environmental sustainability means?*

Amy: *Keep the animals there.*

GW: *Does the environment just mean the animals? What do you think the environment means?*

Amy: *Plants and animals and living things. Because if they take all the trees down they won't be able to grow back. If they take a limited amount they will be able to grow back. They can cut them and then go to a different area and cut them there. (Amy/f/Y5/I/A006/26.4.07)*

Some responses from students indicated that they had an understanding of the need to replace the natural resource. Comments contained notions of reproduction recognizing the need for animals and plants to reproduce in order to maintain sustainability.

GW: *Let's think about the trees themselves. If this was the last forest in the world and you have that situation, could you regrow them?*

Angela: *You probably could.*

GW: *How?*

Angela: *Like every tree you cut down you should probably plant another one.*

GW: *But imagine this was done and you've got no trees left. Could you regrow the trees?*

Angela: *Probably not because you don't have any of the seeds from the trees. (Angela/f/Y6/I/A009/22.10.07)*

GW: *Why do you need trees to make more trees?*

Jack: *Because you get the seeds from one tree and then you plant that one. If you can't get the seeds from that tree you can't grow any more. (Jack/m/Y4/I/A001/22.10.07)*

GW: *How would putting them (fish) back help?*

Paul: *So we don't run out.*

GW: *Why would we run out if we didn't put them back?*

Paul: *Because you're taking too much.*

GW: *What do the fish need to do?*

Paul: *Fish need to breed.*

(Paul/m/Y5/l/A007/26.4.07)

Summary and Discussion

Students referred to the following environmental matters: renewable and non-renewable resources, climate change, global warming, greenhouse gases, and greenhouse effect. In most instances referred to them in an appropriate manner and context. They also made incorrect statements that drew inappropriate conclusions (e.g. global warming and climate change being linked to holes in the ozone layer). Environmental sustainability, while not mentioned by name, was referred to in student discussion using relevant principles and applications that contained some sophistication indicating a developing understanding of the idea.

Some students thought that continued cutting down of trees would be detrimental for the animals and the atmosphere. However, their comments recognized that there is a need to cut down some trees so long as they are replaced. Other comments contained notions of reproduction recognizing the need for animals and plants to reproduce in order to maintain sustainability. This idea suggests that their notion of sustainability is related to the need to maintain the natural environment in order to ensure the continued survival of humans.

The consequences of using all of a non-renewable resource was articulated by some students while a few students expressed the idea that running out of oil might be a good thing because we would then have less or no pollution. This idea also suggests recognition of the fact that non-renewable resources are finite.

Many students expressed an awareness of the link between motor vehicle exhausts and increasing carbon dioxide levels in the atmosphere. Some students made a link between greenhouse gases and carbon dioxide frequently using the chemical symbol CO_2. Some students were able to expand on this issue and were aware of some of the consequences of increasing carbon dioxide emissions. The students did not comment on the contribution of other CFCs (chlorofluorocarbon pollutants) or methane to either the greenhouse effect or global warming. This may imply that the students were unaware that there are other greenhouse gases that may contribute to global warming and suggests that they assume that carbon dioxide is responsible for all global warming. A few students thought that dire consequences would result with continued increases in greenhouse gases. These findings suggest that the students assume that because carbon dioxide is a component of motor vehicle exhausts, then carbon dioxide must be responsible for all global warming issues. They appear to make this broad generalisation based on an over emphasis on one component of greenhouse gases and apply it in an uncritical manner. This is in agreement with the conclusions of Harris and Blackwell (1966).

Most of the students were able to state some of the possible consequences of increasing levels of carbon dioxide in the atmosphere such as the Earth becoming hotter, ice melting, the sea level rising, and humans being affected. Some students were aware of the link between global warming and the melting of the ice caps and glaciers although there was some uncertainty about how this happened. A few students appeared to be confused over the then current drought resulting in less available water, while at the same time expressing the view that global warming is melting ice and adding to the water in the oceans. Some students expressed an awareness of the link between global warming and sea level rise due to melting ice although there was no evidence of knowledge about the expansion of water due to warming.

Some students thought that global warming would also make it difficult to breathe. While this idea is difficult to explain, it is possible that it is a confused extension of the idea that too much carbon dioxide will make breathing difficult. They don't realise that the amount of carbon dioxide involved is a tiny fraction. Some students did not express a clear understanding of what the results of the greenhouse effect might be. While some stated that they did not know what caused this link, other students associated global warming with holes in the ozone layer. They were unable to offer explanations for this and may have been making unsubstantiated links between the two phenomena.

Some students expressed concern for the possible affect of global warming on animals and linked extinction exclusively to animal extinctions without making a similar link to plant extinctions. Some students articulated an understanding of the concept of extinction and were forceful in stating their concern. They viewed extinction as “bad” but did not link it to broad environmental principles such as the need to maintain biodiversity.

It becomes apparent that the students’ views on sustainability are not fixed and can change depending on the context at the time. In addition, the students are inclined to use limited understandings of specific scientific phenomena and to apply these uncritically, or superficially, or inappropriately, to other situations irrespective of whether that may be justified or not. This finding is not surprising given that the science involved in environmental issues and sustainability is complex and the students are at an early stage in developing their scientific understandings.

4.3.3 Extreme Views and Confused Views

Some students expressed extreme or confused views that appeared to be mainly the result of their applying broadly a simplistic interpretation of scientific phenomena to a context that involved complex interacting scientific phenomena. Some of the views expressed also appeared to have been influenced by sensationalised media reporting. This may be evidenced in expressions of scientific inaccuracies and statements or views that would be difficult to justify. A range of these are listed and discussed here. They were not broadly represented in

the data and in most instances are associated with broad generalisations based on limited or simplistic scientific understandings.

Extreme views are those that contain an idea that extends beyond available evidence or inappropriately extends a principle to draw a conclusion that exceeds what is scientifically reasonable. The researcher (GW) acknowledges that in the selection and nomination of examples of extreme views there may be a degree of partiality.

There were 55 responses involving extreme views with the views expressed varying from mild concern to quite extreme.

Examples of views expressing mild concern include:

> *There wouldn't be any good air. (Amelia/f/Y4/Q1/Item2/19.3.07)*

> *It will affect some other sea creatures.*
> *It means the only place you would be able to see fish is probably the aquariums. (Jerry/m/Y4/Q3/Item2/2.4.07)*

Examples of views that are extreme and associated with high levels of concern include:

> *The trees are all gone so there's no more paper (or) timber, no more wood and less oxygen, no more shade, lot of species would be extinct. (John/m/Y4/Q1/Item 1/19.3.07)*

> *Having no trees is destroying the earth. (Evette/f/Y4/Q1/Item 1/19.3.07)*

> *You would die because there is no oxygen anywhere. (Jake/m/Y4/Q1/Item2/19.3.07)*

Pollution will (be)come more noticeable because there won't be as much fresh air. Everyone will move out of Australia. Population will increase by millions in other countries. (Julian/m/Y5/Q1/Item1/19.3.07)

There were many examples (46) of the view that the destruction of the forests would result in a depletion or total removal of available oxygen and as a result we would die because we would not be able to breathe.

If you cut (down) the trees it would cause oxygen problems to Australia and to all of the other countries. (Harvey/m/Y4/Q1/Item 1/19.3.07)

There are too many trees getting cut down to use.….for newspapers. If we keep doing this some people aren't going to breathe very well because trees breathe in carbon dioxide and breathe out oxygen. We give them the carbon dioxide and they give us the oxygen. (Carl/m/Y5/Q1/Item1/19.3.07)

Confused views are those that outline incorrect relationships among scientific ideas creating muddled propositions.

There were 74 responses involving confused views.

The ice caps will melt and the water will rise, therefore the islands will sink and there will be floods all because of the greenhouse effect of the fuel. (Irene/f/Y4/Q2/Item2/26.3.07)

Julian: *After it's used it lets off carbon dioxide gas and it floats around the atmosphere.*

GW: *Why is that a problem?*

Chris: *Because the ozone layer can get holes in it and lots of oxygen will escape and eventually the world will get too hot and all the ice would start melting in Antarctica.*

Julian: *It makes holes in our ozone layer so the sun could get through.*

GW: *So what has carbon dioxide got to do with that?*

Julian: *It kind of melts our ozone layer.*

GW: *Carbon dioxide does?* Pause.

Sasha: *It's the gases that melt the ozone layer but I'm not sure what carbon dioxide does. (Julian,Chris,Sasha/mmf/Y5/FG/26.3.07)*

In the following sequence the students expressed concern about the diminishing supply of petrol being more serious than of vehicles adding more carbon dioxide to the atmosphere. For this reason they felt that the reduction of the number of motor vehicles was a good thing. There was also the view that carbon dioxide is a "bad" (maybe an evil) thing.

GW: *The oil's going to run out?*

Chris: *Yes.*

GW: *So does that matter?*

Julian: *Yes because then there will be no more cars that actually run on petrol.*

Sasha: *So actually it would be good still.*

GW: *Not having the cars? Why do you think it's a good thing?*

Julian: *It's a good thing to not have cars that run on petrol. It's good to have cars that run on electric fuel or gas.*

GW: *Why?*

Julian: *Because it's a lot less worse for the environment.*

GW: *But if there are cars on the road, electric and petrol cars, why is one worse for the environment than the other?*

Sasha: *Because the steam (Shasha probably means discharged gases) is much smaller. It's got coal and stuff that will affect the atmosphere much more.*

GW: *What's coming from the cars?*

Sasha: *The actual fumes. The gas.*

GW: *What's the gas?*

ALL: *Carbon dioxide. (Sasha,Sienna,Julian,Chris/ffmm/Y5/FG/21.5.07)*

In this discussion, the students identify carbon dioxide as a "bad" thing and it suggests that they are unaware of the essential role of carbon dioxide in the atmosphere.

There was a view (as discussed earlier) that even though fish might become extinct, we would still somehow be able to obtain fish products such as Omega 3 capsules.

None because fish is disgusting to eat and they are dying and you can buy Omega 3 tablets instead. (Annabelle/f/Y6/Q3/Item5/30.3.07)

In this instance, it is uncertain whether the student is aware that Omega 3 can be obtained from sources other than fish.

Dire consequences or basic misunderstandings were evident in some responses.

Don't use cars because animals will die on the ice. (Arthur/m/Y4/Q2/Item5/26.3.07)

Only a little bit should be used because otherwise there won't be any trees left and then there won't be any people because there is no oxygen for us to breathe in. (Belinda/f/Y5/Q1/Item5/19.3.07)

Summary and Discussion

Extreme or confused views appeared to be mainly the result of individual students expressing a simplistic interpretation of scientific phenomena and applying it broadly in contexts that involved other complex scientific ideas. At times they may also have been influenced by sensationalised reporting of environmental issues in the media. The views expressed varied from mild concern to quite extreme concern. On many occasions individual students robustly articulated their concern indicating a degree of absoluteness. This concern was apparent in their tone of voice and is not adequately conveyed in the written text.

Examples of extreme or confused views are seen in the students' comments about links between motor vehicle exhausts and increasing greenhouse gases in the atmosphere with comments implying that carbon dioxide was solely responsible for this and was therefore "bad". The students appear to be unaware that carbon dioxide is an essential ingredient for all life on Earth. Some students were also confused about linking carbon dioxide to holes in the ozone layer. These confused views suggest that they use one scientific fact (e.g. motor vehicles contribute carbon dioxide to the atmosphere) and then assume that all carbon dioxide must be "bad" and responsible for all that is "bad" in the atmosphere. Students did not comment on the contribution of other CFCs (chlorofluorocarbon pollutants) or methane to either the greenhouse effect of global warming (See previous discussion p.165).

Related to this is the link that the students made about the destruction of the forests and the depletion or total removal of available oxygen which as a result would cause humans and other animals to die because they would not be able to breathe (See previous discussion p.150).

Students expressed confusion about the diminishing supply of petrol being more serious than that of vehicles adding more carbon dioxide to the atmosphere. The focus of their concern appeared to relate mainly to the need to retain some petrol for their individual use (or use by their peer group) in the future. For this reason they expressed awareness that a reduction in the number of motor vehicles would be a good thing because more of the petrol would be conserved. This view might also be seen as unrealistic given human desire for more motor vehicles and the related increasing consumption of petrol.

For some students, an extreme view means simplifying what would be a major environmental disaster (e.g. the extinction of all fish) to focus on some small personal impact (e.g. Omega 3 capsules being unobtainable) which in reality has an effect that is negligible. Other students were able to focus on major environmental issues and were far less concerned about the small impacts that these issues would have on them personally.

When the students express extreme or confused views it suggests that they may be making a simplistic interpretation of a scientific phenomenon and applying it

broadly to contexts that involved other complex scientific ideas. While this has the effect of generating scientific inaccuracies and statements or views that are difficult to justify, it does provide insight into the way the students perceive and articulate environmental concerns. Their understandings appear to be at a formative stage and the ideas that they express may change depending on the context (see discussion in 4.4).

4.3.4 Sustainability Themes

This section reports on the students' views of environmental sustainability in relation to the management and use of natural resources. The environmental behaviours or actions that humans propose are related to individual environmental attitudes towards the environment (Fien, 1993). Environmental attitudes are underpinned by environmental worldviews (Stern et al., 1993; Fien, 1993). A discussion of environmental worldviews was included at 2.6 and it is these worldviews that are considered in discussing the students' environmental behaviours or proposed actions.

The stimulus material used in the study determined that most discussion tended to be about three natural resources, viz. forests, oil and fishing. At times when discussions were wider-ranging other natural resources were also discussed. These included: solar power, coal and whales. These other natural resources were introduced into the discussion by students.

The views of the students in relation to the management and use of natural resources were categorised as follows:

Apathy or ambivalence.
Use of mantras.
Influence of individual worldviews.
Sharing fairly.
Being responsible and maintaining a balance in usage.

Apathy or Ambivalence

It is significant there were no responses made that would fit these categories. It indicates the seriousness with which the students expressed their views about environmental concerns.

Use of Mantras

Mantras involve the use of a well known “catch-phrase”. Students’ responses coded as examples of this theme generally made uncritical use of a mantra without supporting statements. There were 49 responses involving the use of mantras. The most commonly used mantra was:

Reduce, Reuse, Recycle (46) although there were variations on this mantra.

If you have to cut down a tree replant one.
Environmental R’s: Reduce, reuse, recycle, replant, replace.
(Jasmine/f/Y5/Q1/Item3/19.3.07)

Plant as much as you chop down.
Pick up rubbish.

4R's: Reduce, reuse, recycle, replace. (Marius/m/Y5/Q1/Item3/19.3.07)

Other mantras included:

Save the Whales (2)

When the fish numbers go down it relates to the whale problems in the world so that is why people are setting up this business for SAVE THE WHALES!!! (Emily/f/Y4/Q3/Item2/2.4.07)

Clean Up Australia (1)

Save the trees (1)

The mantra "Reduce, reuse, recycle" and its variations appears to be well known and well used by the students. This may be because its focus is local rather than global and the students are able to adopt it and relate to its implied local action. The other mantras listed above appear not to have had the same influence on the students. This may be because they do not have the same local focus and imply more of a global concern to the issues raised and hence the students are uncertain about how to act in relation to them. This appears to suggest that the students are better able to identify and act on local issues rather than on global issues. It is interesting to note that at no time did any student express the mantra "think globally and act locally", although the proposition seemed implicit in most of the actions recommended by students.

Influence of individual worldviews

The theme of consumption based on needs considers the needs of humans, animals and plants. Meeting human needs is a homocentric response while

meeting the needs of animals and plants is a biocentric response. Addressing the combined needs of humans, animals and plants suggests an ecocentric response because it considers the needs of the planet. Students articulated these responses in different ways in different contexts although homocentric views predominated even though they were very often linked to ecocentric or biocentric views.

There were 211 individual responses that expressed a **homocentric view**. Given that there were 146 students involved in the study, some individual students made a homocentric response on more than one occasion. The responses represented students at all three year levels. Year 4 students made 66 responses, Year 5 students made 63 responses and Year 6 students made 82 responses.

Most of the homocentric views recognised that there was a need to limit environmental exploitation in order to maintain environmental sustainability. The students often elaborated environmental views that emphasised the need for sustainable use of resources but this was typically in a context of ensuring that the needs of humans are met now and in the future. Imbedded in these comments are notions of environmental sustainability in order to perpetuate human survival. Examples of typical responses include:

> *Use half and then leave it to grow back then use the other half and so on. I say half because then you still have (some) left and then you plant some more use the other half plant some more then use the ones you planted and so on. (Alison/f/Y4/Q1/Item5/19.3.07)*

With the fish we could make a protected bit and keep the fish in there so they can reproduce and then there'd be more fish and we'd keep them and they could breed the fish faster. Then if there's enough, if we let them out they'd be able to reproduce faster than we can actually catch them. (Owen/m/Y5/I/A004/4.4.07)

Some students (24) articulated an understanding that some resources such as oil and other fossil fuels are non-renewable and are therefore unsustainable. In these responses, most sought to limit the use of the non-renewable resource so that it was conserved and thus would not be depleted as quickly thereby making it available for humans for a longer period of time. Many of these responses recognized the need to explore and develop alternative sources of fuel or energy.

That the prices of petrol are going up because we are running out and people cannot afford it.
You cannot grow more oil (like you can grow) plants.
(Emily/f/Y4/Q2/Item1/26.3.07)

People should use a third of (the) oil each 2 years so we can use a lot for the next coming years.
Once we run out we should try to run on something else.
(Shelia/f/Y4/Q2/Item5/26.3.07)

Some students (13) articulated a view that resources like fish are renewable and should only be exploited by humans to the extent that they remain sustainable for the benefit of humans as well as for sustaining the fish in perpetuity. This view recognizes that fish are a renewable resource and that the environment requires human management if it is to remain sustainable.

GW: *How many fish should we be allowed to take?*

Sarah: *People like fish because of the oil and stuff but if we took out most of the fish then it wouldn't be very good.*

GW: *Why not?*

Sarah: *Because if we took them out for a quick feed then they wouldn't have time to breed and the numbers would go really down low. You probably wouldn't be able to fish anymore because they'd be that low and then it would also affect us in a way.*

GW: *It would affect our food supply.*

Sarah: *Yes. (Sarah/f/Y4/I/A006/22.10.07)*

There are very few fish left in Pittwater because fishermen haven't let fish regroup and breed. (David/m/Y6/Q3/Item1/30.3.07)

There were some comments on the need to develop alternative ways to provide for the sustainability of the fish so that the supply of fish for humans remained sustainable. In the following typical comment there appears to be elements of both homocentric and ecocentric responses implying that if one is addressed the other will also be addressed.

We can take care of fish and have a fish nursery and once they have bred numerous fish they put them back. (Judy/f/Y4/Q3/Item3/2.4.07)

There were comments that demonstrate an understanding of the need to place limits of the amount of fish caught in order to sustain the fish population. Limits were often expressed as a fraction and appeared to relate to the idea of being "fair" to all concerned (including the fish) and "sharing" the resource as well as providing for the sustainability of fish stocks.

(Use a) little amount so fish can breed and then we can take a little more. (John/m/Y4/Q3/Item5/2.4.07)

In some responses students arbitrarily suggested that only a half, or a quarter, of the resource should be used. While they understood the need to place limits on the use of the resource, they were unable to satisfactorily quantify this or suggest those factors that might be involved in such quantification.

(Use) as much as you need. But plant a tree for every other tree you cut down.
(Use) a ¼ of the trees because the others can put seeds down. (Eliza/f/Y5/Q1/Item5/19.3.07)

I think we should take a quarter of the plants and trees because if we cut down the trees slowly …. the trees …. will regrow because of the seeds that (are)….released. Then we could all have healthy forests and at the same time we can enjoy the paper. (Rosie/f/Y5/Q1/Item5/19.3.07)

Limiting the amount of the resource taken was seen as important when the resource was diminished. Where the resource was plentiful it was seen as acceptable to take some to satisfy human needs.

GW: *So if there were plenty of whales it would be OK (to catch some). Is that right?*

Jack: *Yes because if there were plenty of whales it would be the same as fishing. You could just take some. The other ones will produce more.*

GW: *So are we trying to limit the number of whales that they take or are you trying to say stop it altogether?*

Jack: *Just limit it because they eat it. (Jack/m/Y4/I/A001/22.10.07)*

Some students (7) gave responses that indicate that they think that the destruction of the forests would result in a depletion or total removal of available oxygen and as a result humans would die because they would not be able to breathe.

> GW: *So if you cut down all the trees, apart from the newspaper problem and the paper problem, what other problems would there be?*
>
> Ann: *You wouldn't be able to breathe.*
>
> GW: *Tell me more about that.*
>
> Ann: *The trees breathe in carbon dioxide and breathe out oxygen. (Ann/f/Y6/I/A009/22.10.07)*

The following discussion extends the idea about the need for trees as they are essential for the survival of humans and other animals. It thus contains a mix of homocentric and biocentric views.

> GW: *(Is there) anything else that would be a problem?*
>
> Ann: *There'd be no more furniture because most furniture is made out of wood.*
>
> GW: *What about the other animals and plants that are in the forest?*
>
> Ann: *They wouldn't have any more habitats.*
>
> GW: *So what might be the result of that?*
>
> Ann: *The animals would die and we'd have nothing to eat.*
>
> GW: *You made a point about it affecting the air. How would that affect the animals and humans?*
>
> Ann: *We wouldn't be able to breathe and also the animals wouldn't be able to breathe and we'd have nothing to eat and then we'd all die. (Ann/f/Y6/I/A009/22.10.07)*

When many students (70) expressed a **biocentric view** it was often linked to a homocentric view. In this view they were concerned that the sustainability of the resource was necessary to meet the needs of plants and animals although in this study students placed the focus mostly on animals (to the exclusion of plants). This view was repeatedly expressed at all age/year levels indicating that many of the students saw that resource depletion would have a detrimental effect on animals as opposed to plants.

Typical biocentric responses were:

> GW: *What else would it (cutting down the trees) affect besides the newspaper and the oxygen?*
>
> Barbara: *It would affect the animals because they wouldn't have anywhere to live. Most animals live in trees. (Barbara/f/Y5/I/A007/22.10.07)*

> *It (cutting down the forest) affects the wildlife because the animals can't live without the trees. They need shade and stuff. (Sienna/f/Y5/FG/26.3.07)*

The recent removal of a large camphor laurel tree from the school playground appeared to have influenced the environmental views of some students.

> Sasha: *By the time you cut down a million trees more trees are grown. Sometimes animals like to live in dead trees.*
>
> Julian: *Sometimes you should cut down more trees that are really bad for the environment like camphor laurels. They poison the ground so nothing will grow in the soil ever again. They should only take branches that have fallen off trees. They should only take trees that don't have any hollows.*
>
> GW: *And that's OK?*

Julian: *If they're dead trees and they've not got hollows then nothing is living in them.*

GW: *What might be living in them?*

Sasha: *Ants. (Sasha,Julian/fm/Y5/FG/26.3.07)*

Some students expressed the thought that the cutting down of trees would affect the animals as there would be a change in the amount of air available for breathing. The comments contained a mix of biocentric and homocentric views.

Everyone should plant at least one tree a year so we could have lots of trees but people don't do (that). They just want either a new house or a newspaper but they should really be thinking about how many trees are being cut down a year and how they could help. It is starting to get really serious because if (we) keep doing what we're doing then all the animals in the world will lose their habitat and we won't be able to breathe. (Alissa/f/Y4/Q1/Item2/19.3.07)

Meeting the needs of animals was of particular concern if the animals were perceived as "cute" and furry. Again, comments often contained both biocentric and homocentric responses.

Too many trees are being cut down just to make newspapers and that means we can't breathe enough oxygen.
Animals (the wild ones) don't have anywhere to live or get food like koalas have no gum leaves! (Martha/f/Y5/Q1/Item1/19.3.07)

The melting of polar ice was of concern because of the effect it would have on animals.

Because there's animals that live in that ice like polar bears, living creatures, seals, whales, penguins and fish. That's our most valuable thing because fish get caught to eat. (Chris/m/Y5/FG/26.3.07)

Most students referred to animals and were less likely to spontaneously refer to plants. With further probing questions some students expressed awareness that the environment included both plants and animals.

> GW: *So what do you think environmental sustainability means?*
>
> Amy: *Keep the animals there.*
>
> GW: *Does the environment just mean the animals? What do you think the environment means?*
>
> Amy: *Plants and animals and living things. (Amy/f/Y5/I/A006/26.4.07)*

The students' worldviews appear to be flexible depending on the context being discussed. They articulated a biocentric view when referring to native animals. In other contexts they are just as likely to express a different view. When students considered the management of the natural resource to meet the needs of future generations their responses displayed a homocentric view. However, in this context their responses were often concerned with their own (or their peer group's) use in the future, not necessarily for the needs of future generations of humans. This suggests that an **egocentric view,** serving their own needs, may often be guiding their thinking about sustainability. An egocentric view can also be thought of as a category of a homocentric view.

There were 58 responses involving an egocentric view. Typical examples are:

> GW: *How much of the oil should we take away?*

Barbara: *About a quarter so that .....when we grow up we can still drive our cars. (Barbara/f/Y5/I/A007/22.10.07)*

I think we should use a little bit (of the oil) so we can drive cars for longer. (Lesley/f/Y4/Q2/Item5/26.3.07)

When some students expressed the egocentric view that the resources needed to be left for the individual student's own future use (or that of their peer group) rather than for future generations in general, genuine sustainability of the resource was not the main consideration. However, this does indicate that the students are positioning themselves as the next generation for whom sustainability of natural resources is necessary. They appeared to be concerned with the need to share the resource fairly between humans both now and in the future so that there would still be some of the resource available for them to use when they became adults. This was particularly evident in the use of hydrocarbons with some students expressing outrage that the continuing depletion of fuels might mean that they would not be able to drive cars when they became adults. They thought that current adults were being unfair (or even greedy) if there were none of these fuels left for them to use in the future. This view was expressed by a small number of students. The outrage was evident in their manner of expression with "we" clearly referring to the individual student and their peers.

Don't drive your car everywhere because we will run out of oil and we will never be able to drive cars anymore. (Terry/m/Y4/Q2/Item3/26.3.07)

In contrast to the egocentric views other responses commented on the need to limit the use of natural resources so that the needs of future generations of humans could be provided for.

> *(Use) half as much (of the oil) because otherwise future generations will get nothing. (Kath/f/Y6/Q2/Item5/23.3.07)*

This suggests that given the same context, some students choose an egocentric response while other students choose a homocentric response and some students choose a mix of worldviews when responding to the same context. In order to develop an understanding of environmental sustainability students would need to move from an egocentric worldview to a homocentric worldview and apply this consistently to a range of contexts.

Some responses (33) showed an awareness of the need to act responsibly and not waste the natural resource. The idea of avoiding the generation of unnecessary waste in this context involved an **ecocentric** view and included notions of sharing combined with worldviews. Many of these responses implied the need to manage the natural environment to achieve environmental sustainability. Typical responses were:

> *Only use as much as you need because if you take more than you need there will be less trees and you might not end up using it all. (Eve/f/Y4/Q1/Item5/19.3.07)*

> *(Use) as much as we need because if you take too much then there is no more trees left or (use) as much as you can replace. (Jasmine/f/Y5/Q1/Item5/19.3.07)*

Some statements expressed the need for conserving (or not wasting) oil for the purpose of making it last longer and these contain both ecocentric and homocentric views. These statements do not directly recognize that oil is a non-renewable resource.

> *To use not as much petrol and keep on letting the price go up. Not using as much and leaving it for a while. (Luke/m/Y4/Q2/Item3/26.3.07)*
>
> *(Use) not much so we don't run out or use too much. (Nancy/f/Y4/Q2/Item5/26.3.07)*

Some statements express the need for conserving (or not wasting) oil for the purpose of reducing global warming.

> *We should use 15 litres every two days so we don't get too much and we don't get pollution. (Mary/f/Y4/Q2/Item5/26.3.07)*
>
> *Use as less as possible and ….if you do that it won't affect the greenhouse gases as much as it does now. (Alissa/f/Y4/Q2/Item5/26.3.07)*

It was not unusual for responses to express elements of homocentric, biocentric and ecocentric views in relation to the protection of all living things. The views expressed refer mainly to animals and to a lesser extent, plants.

> *We might run out of oil which will mean no more cars. Using more oil will mean more cars, vehicles and trucks on the roads to cause pollution. Also the ice caps will melt. This will cause extinction to other animals. (Evette/f/Y4/Q2/Item1/26.3.07)*

Some responses suggest a belief that producing carbon dioxide is good because plants need it as part of the carbon cycle. The following comment includes both a

homocentric view and an ecocentric view as the student is aware of some aspects of economics involved in both the consumption and conservation of oil.

> *If we don't want the prices to go up so much don't waste the petrol. Don't drive as much. Walk or ride your bike. Do something that doesn't waste all the oil. And don't put so much carbon dioxide in the air even though plants need it. But don't waste it all. (Helen/f/Y4/Q2/Item3/26.3.07)*

Homocentric, biocentric and ecocentric views were not seen as mutually exclusive but as representing different aspects to be emphasised depending on the context of the discussion. However, homocentric views predominated and are well represented in the student data.

Sharing Fairly

Limiting the amount of a natural resource used can be related to either notions of replacement and sustainability and also to the idea "sharing" or being fair to all involved. The idea of "sharing fairly" seemed to be fundamental to the children's notion of using a natural resource. The following is an example of limiting the amount of the natural resource for reasons of replacement and sustainability related to sharing the resource.

> GW: *How much do you think they should cut down? You don't have to give me a number. You could give me an amount or a fraction.*
>
> Helen: *Definitely not all of it. Probably like a little less than half. Not too much.*
>
> GW: *So you're saying there needs to be a limit on the amount they cut down. Why do you need to limit it?*

> Helen: *Other things live there so you can't just take it away from them. (Helen/f/Y4/I/A001/22.10.07)*

The idea of sharing the natural resource was sometimes implied rather that stated directly. The following is an example of limiting the amount of the natural resource for reasons of sharing and being fair to all.

> *We should use enough of the forest to make newspapers, tables, chairs, etc. That would be about a quarter and the other three quarters should be for the animals. (Sheila/f/Y4/Q1/Item5/19.3.07)*

Most students' responses to "sharing" display a homocentric view in regard to exploitation of the natural environment although some of the responses acknowledge the need to conserve, or protect, or sustain the natural environment and therefore they have something of an ecocentric view as well. Some of these responses were concerned with conserving or sustaining the resource by suggesting only a half, or a quarter, or some other fraction should be used.

> *We should use half the amount we're using because if we use none we would have no timber and paper and if we use all then there is no oxygen and if we use half we got timber and paper and oxygen. (Alan/m/Y4/Q1/Item5/19.3.07)*

> *I think we should only take 20% of a forest because we need paper but if we use all of the trees for paper then we won't have a clean Earth or any shade. (Elizabeth/f/Y4/Q1/Item5/19.3.07)*

Some students' responses (29) indicated sharing to meet current needs of both humans and other living things. The idea of "sharing" in this context involves both a homocentric view and a biocentric view.

> *I think we should be using half of it* (the trees) *because then we would get half and the animals would get half. (Colin/m/Y4/Q1/Item5/19.3.07)*
>
> *We should only use a quarter* (of the trees) *so we can have enough paper and timber but we can also have enough oxygen and the animals have enough space. (Sarah/f/Y4/Q1/Item5/19.3.07)*

While sharing to meet human needs was seen as important by some students, sharing to meet the needs of both humans and animals was seen as important by other students.

> *I think it is bad to cut down trees because we'll have no paper and it's bad for the animals because they won't have anywhere to live or any food and it's bad for the environment. (Helen/f/Y4/I/A001/22.10.07)*

Some responses proposed actions that reflect a biocentric view or perspective involving some compensation or restitution for the animals. The idea of "sharing" the forest with the animals was also expressed.

> *Give back the animals' homes. (Angus/m/Y4/Q1/Item3/19.3.07)*
>
> *We should only use a quarter so we can have enough paper and timber but we can also have enough oxygen and the animals have enough space. (Sarah/f/Y4/Q1/Item5/19.3.07)*
>
> *We should only use not even half.*
> *We should only use that much because we need oxygen and paper and we need to keep our animals in their habitats.*
> *We should keep that much because if we waste it all we won't have any of those things, and our animals will become extinct.*
> *(Helen/f/Y4/Q1/Item5/19.3.07)*

Most of the students' responses commented on the need to reduce the amount of the resource currently being used to avoid waste or to avoid being greedy.

GW: *How much do you think they should be cutting down?*

Chris: *Half and half.*

Julian*: Not as much as we're using but as much as we actually need. (Chris,Julian/mm/Y5/FG/26.3.07)*

We should only use half. If we don't use any there won't be any public transportation any more. We should use that much because we don't want to waste it all but we want to use some. (Helen/f/Y4/Q2/Item5/26.3.07)

With trees people could use as many as you want but you have to replant them and plant twice as many to replant the ones that people didn't plant when they took them.
With oil you have to take half and leave it alone and take less. (Grace/f/Y6/Q2/Item5/23.3.07)

Some students, when asked how much of the resource people should be allowed to take, offered responses that were based on satisfying human needs consistent with a homocentric view. In most instances this was supported by a concern for conserving or sustaining the natural environment.

GW: *How much coal do you think people should be allowed to take out of the ground?*

Paul: *Not too much. A reasonable amount just to keep their lives working.*

GW: *Why do you think that?*

Paul: *Because if you take too much coal out of the ground there's going to be none left. (Paul/m/Y5/I/A007/26.4.07)*

GW: *How much of the oil should we take away?*

Barbara: *About a quarter so that other people after us can still have it. And when we grow up we can still drive our cars.*
(Barbara/f/Y5/I/A007/22.10.07)

The students' views appear to be derived from the notion of being "fair" and "sharing" but whether this applied to humans, or animals, or plants, or to the environment as a whole varied depending on the context being discussed.

Being responsible and maintaining a balance in usage

Some students (37) expressed an awareness of the conflict in maintaining a homocentric view and an ecocentric view. Their responses display the conflict between the need to use the natural environment for human needs while at the same time recognizing the need to implement strategies to sustain the natural environment. Typical responses were:

> *You should use about half the trees because we need wood, timber and paper but we need oxygen, animals and less pollution. (John/m/Y4/Q1/Item5/19.3.07)*
>
> *I think we could use half of it (the trees) because in the cartoon there are no trees but in another way if I said none that means there will be no paper and timber and so on. (Marion/f/Y4/Q1/Item5/19.3.07)*

Some students (14) saw sustainability as a problematic notion wherein endeavouring to satisfy competing needs resulted in a statement of proposed action that appeared unclear. This suggests that the students believe that there is an optimum amount of a natural resource that can be used but exactly what that amount is remains unclear.

> *We should cut down some trees because if we didn't we won't have any paper and if we did cut down a lot we won't have enough oxygen. (Angus/m/Y4/Q1/Item5/19.3.07)*

Some responses (8) expressed the view that the cutting down of more trees would result in a reduced amount (or the complete removal) of the oxygen available for breathing. This theme was also reported and discussed in relation to the carbon cycle (see 4.3.1) and when themes relating to extreme and confused views were reported and discussed at 4.3.3.

> *We should use half the amount (of trees that) we're using because if we use none we would have no timber and paper and if we use all then there is no oxygen and if we use half we got timber and paper and oxygen. (Alan/m/Y4/Q1/Item5/19.3.07)*
>
> *We should only use a quarter (of the trees) so we can have enough paper and timber but we can also have enough oxygen and the animals have enough space. (Sarah/f/Y4/Q1/Item5/19.3.07)*

Summary and Discussion

Students' responses generally showed an awareness of the need to act responsibly, to not waste the natural resource, and to reduce the amount of the resource currently being used. While some students' responses made uncritical use of a mantra, or predicted dire consequences, or contained basic misunderstandings, there were no comments expressing a "don't care" or an ambivalent attitude which is significant as it demonstrates that all the students were serious and concerned about issues relating to the environment and sustainability.

Some students articulated an understanding that some resources like oil and other fossil fuels are non-renewable and are therefore unsustainable. In these responses most sought to limit the use of the non-renewable resource so that it was conserved and thus would not be depleted as quickly. Many of these responses

recognized the need to explore and develop alternative sources of fuel or energy. Some statements express the need for conserving (or not wasting) oil for the purposes of making it last longer or for reducing global warming. These statements did not directly recognize that oil is a non-renewable resource.

Some students commented that once we had used all of a non-renewable natural resource, oil in this instance, there would no longer be a problem with greenhouse gas emissions because as the oil was non-renewable the problem would then no longer exist. There was also a belief that producing carbon dioxide was good because plants needed it as part of the carbon cycle.

Some students articulated an understanding that resources like fish are renewable and should only be exploited to the extent where they remain sustainable. There were also comments that indicated an awareness of the need to actively manage resources for human consumption. There were comments that demonstrated understanding of the need to place limits on the amount of fish caught in order to sustain the fish population which in turn would support the continued availability of fish for humans. This view recognizes that fish are a renewable resource and that their environment requires human management if the fish are to remain sustainable.

Some students commented that some of the resource needed to be left so that there was enough to maintain the animals. This was repeatedly expressed at all

age/year levels indicating that many of the students saw that resource depletion would have a detrimental effect on animals as opposed to plants. The exploitation of a resource was of particular concern when it affected animals (e.g. koalas and penguins) that were perceived to be “cute” and/or furry. Some students expressed concern for the melting of polar ice solely because of its effect on animals.

Responses were concerned with conserving or sustaining the resource by suggesting only a half, or a quarter or some other fraction should be used. It was as if there was a finite amount of the resource which could be cut up and shared like a cake. While they understood the need to place limits on the use of the resource, they were unable to satisfactorily quantify this or suggest those factors that might be involved in such quantification that might relate to the continued sustainability of the resource. Fundamental to the students’ concerns was the need to share natural resources in a balanced and responsible manner. Some students, when asked how much of the resource people should be allowed to take, offered responses that were based on satisfying homocentric needs. In many instances this was also supported by a concern for either conserving or sustaining the natural environment or its plants and animals indicating that biocentric and ecocentric views were also important guiding principles for them.

Some students’ comments displayed a homocentric response to exploitation of the natural environment although many of the responses acknowledged the need to

conserve, or protect or sustain the natural environment to ensure human survival. Where this occurred a biocentric or ecocentric view was often also evident.

Students' responses while displaying a homocentric view towards the exploitation of the natural environment, acknowledge the need to conserve and sustain the natural environment for use in the future**.** Some of these responses were mainly concerned with the students' own future use (or that of their peer group), not necessarily the needs of future generations of humans and therefore contained views that were egocentric. This indicates that the students are positioning themselves as the next generation for whom sustainability of natural resources is necessary. Some responses commented on the need to limit the use of natural resources (oil in this instance) so that the needs of future generations of humans could be provided for. Generally the students' responses in relation to the use of natural resources ranged across the spectrum from egocentric to homocentric to biocentric to ecocentric and varied depending on the context.

Many students' responses expressed the need to share the natural environment with both humans and other living things. While sharing to meet human needs was seen as important by some students, sharing to meet the needs of both humans and animals was seen as important by other students.

In general, the students do not appear to express consistent worldviews. Their worldviews appear to be flexible and they are able to articulate multiple worldviews

depending on the context being discussed. Their worldviews appear to be significantly influenced by the idea of being “fair” and “sharing” irrespective of whether it is sharing amongst humans or sharing amongst all living things.

Some students were aware that there could be a conflict between meeting human needs now and with long term environmental sustainability and articulated opposing views of possible action without expressing a preference one way or the other.

The idea of the need to conserve natural resources was expressed on numerous occasions without making the link to the need for the resource to remain sustainable although the sustainability notion was implied but not directly stated.

Limiting the amount of the resource taken was seen as important when the resource was diminished. Where the resource was plentiful it was seen as acceptable to take as much as was needed without setting a limit. It was as if they did not anticipate that a currently plentiful natural resource might need to have limits set on its exploitation.

Some responses from students indicated that they understood the need to replace or sustain renewable natural resources. Some students’ responses displayed a conflict between the need to continue exploiting the natural environment for human

needs while at the same time recognizing the need to implement strategies to sustain the natural environment.

The views of the students are consistent with the values and ethical principles signified by being respectful, sharing fairly, not being greedy or wasteful, and seeking to establish a balance in nature where human lifestyle is sustained by the natural environment and where the natural environment is sustained by humans.

4.4 Environmental actions

This section reports and discusses environmental action proposed by individual students and the extent to which they are in agreement with the views that they have expressed. Environmental sustainability is not a passive phenomenon. Rather it demands individual action. The factors involved in determining environmental action or proposed action are reported and discussed in 4.4.1 and consideration is given to the extent to which the students feel that local action is able to impact on global environmental issues. Determining who students perceive as responsible for the environment is reported and discussed in 4.4.2 and in 4.4.3 those factors that inform the students' understandings of environmental matters are reported and discussed.

4.4.1 Environmental action proposed by students

There were 351 responses involving this theme. Many of the views expressed involve the idea of behaving responsibly in the consumption of natural resources.

These views implied that action was necessary for reasons of either conservation or sustainability. As discussed previously in 4.4, many responses stated that only half, or some other fraction of the natural resource, should be used. This suggests that the students are aware of the need to conserve some of the resource but do not always articulate sustainability as a reason for doing this although the notion was implied.

> *Cut down half of the forest and leave the other half so we can have more trees and we will just try and use less paper and everything else. (Neil/m/Y4/Q1/Item5/19.3.07)*
>
> *I think we should only take 20% of a forest because we need paper but if we use all of the trees for paper then we won't have a clean Earth or any shade. (Elizabeth/f/Y4/Q1/Item5/19.3.07)*

These responses suggest that the students are aware of the need to place limits on how much of a natural resource is used but just how much these limits should be is unknown.

An understanding of conservation was implied in some responses such as:

> *The people should use half as much of (the) trees (as) they are using because soon we will be running out of trees. (Harvey/m/Y4/Q1/Item5/19.3.07)*
>
> *We could put the newspapers back in the recycle bin and they can be used again without getting the trees that way. (Chris /m/Y5/FG/26.3.07)*

The idea of the need to conserve natural resources (trees in this instance) was expressed on numerous occasions without making the link to the need for the resource to remain sustainable. In the following typical exchange when the student

is asked to explain why the trees are needed, the sustainability notion is implied although not directly stated.

> GW: *So what are we trying to do when we limit the number of trees that people can cut down?*
>
> Larry: *We're trying to stop big companies taking them down so they don't become extinct.*
>
> GW: *How does limiting the number do that?*
>
> Larry: *Because if you don't limit the number they can just cut down all the trees. By limiting it they are only allowed to cut out about half.*
>
> GW: *And that allows the trees to do what?*
>
> Larry: *Grow back. (Larry/m/Y6/I/A009/22.10.07)*

Students viewed conservation as about making something last if not indefinitely then for as long as it can be managed. This is in contrast with their notion of sustainability which they saw as requiring a capacity for reproduction. This was shown in the use of words such as "replant", "regrow", and "replace" in the following responses which imply notions of sustainability:

> *We should use half of the forest. And then when you chop one down replant something there like another tree because then we reuse it and then it regrows. (Jerry/m/Y4/Q1/Item5/19.3.07)*

> *I think we should take a quarter of the plants and trees because if we cut down the trees slowly …. the trees …. will regrow because of the seeds that (are)….released. Then we could all have healthy forests and at the same time we can enjoy the paper. (Rosie/f/Y5/Q1/Item5/19.3.07)*

> GW: *So how much do you think they should be made to leave?*

Angela: *Probably to do with a quarter.*

GW: *So what can happen?*

Angela: *So that the others (trees) can grow up and replace the quarter you already cut down. (Angela/f/Y6/I/A009/22.10.07)*

Some responses stated that only half, or some other fraction of the oil should be used. However they did not seem to recognize that this view makes little sense in the case of a non-renewable resource like oil. As the oil reserve is a finite amount, using a fraction of it only reduces the rate of consumption until there is none left so the response really relates to conservation rather than sustainability.

People should still use oil but not all of it because if we only use half of it we don't run out and will always have some.
(Martin/m/Y4/Q2/Item5/26.3.07)

(Use) only about 5% more and then use only hybrid, diesel and solar powered cars. (Toby/m/Y5/Q2/Item5/26.3.07)

Some students expressed awareness that the oil is a non-renewable resource and that there was a need to conserve some of the oil while alternative sources of energy are developed.

Use our last oil resources in factories to make solar powered cars and get every other electric thing to work on solar power.
(Owen/m/Y5/Q2/Item5/26.3.07)

You shouldn't use a lot of oil because it's not renewable.
Sugar cane can be used but don't use it all unless you plant more.
(Carla/f/Y6/Q2/Item5/23.3.07)

Students expressed awareness that fish are a renewable resource but there was still a need to conserve some of the fish to permit sustainability although the link between conservation for sustainability was not always clear.

> *We should take half so that they can breed and there will be more fish. (Malcolm/m/Y4/Q3/Item5/2.4.07)*
>
> *Enough to feed our family once a month. And make sure you don't have no left overs.*
> *To make sure fish don't get extinct as well as oil and whales. (Alan/m/Y4/Q3/Item5/2.4.07)*
>
> *¼ every year so they can grow, reproduce and keep on living. (Ita/f/Y4/Q3/Item5/2.4.07)*

A variety of strategies were suggested to limit or reduce the amount of fish being caught. They all imply the need to act responsibly in order to conserve or sustain the natural resource.

> *Import fish.*
> *Limit fishing.*
> *Don't eat fish as much.*
> *Let fish breed before you catch them.*
> *Make fishing licences more expensive.*
> *Make commercial fishermen's nets have holes for little fish to get out. (Angela/f/Y6/Q3/Item2/30.3.07)*

Some other suggested specific strategies were:

Changing consumption patterns:

> (Eat) *none every second week and some every odd week because then more will be born and have a little bit of time to grow up. (Alissa/f/Y4/Q3/Item5/2.4.07)*
>
> *Get ½ fish every day or just on Sunday. (Rachel/f/Y4/Q3/Item5/2.4.07)*
>
> *May be we could just have fish on maybe Monday, Sunday and Wednesday. (Eleanor/f/Y5/Q3/Item5/2.4.07)*

Fish farms:

> *You should only take a little bit so they can limit the catchment of the fish. Do more fish farms but still have fish in the ocean. (Emily/f/Y4/Q3/Item5/2.4.07)*

Fish farms and limiting fish catches:

> GW: *How can you get the fish back to where they were?*
>
> Larry: *Well there's fish farms now and they can let fish out and they can let them reproduce and also they could just not take so many. (Larry/m/Y6/I/A009/22.10.07)*

Releasing small fish:

> *Get just some fish, like 10 fish. Do not get baby fish. (Natalie/f/Y4/Q3/Item5/2.4.07)*

Fish protection zones:

> *With the fish we could make a protected bit and keep the fish in there so they can reproduce and then there'd be more fish and we'd keep them and they could breed the fish faster. Then if there's enough, if we let them out they'd be able to reproduce faster than we can actually hatch them. (Owen/m/Y5/I/A004/4.4.07)*

Charging more for fishing licences:

> *Limit the amount of fish caught.*
> *Make licences expensive. (Jesse/m/Y6/Q3/Item5/30.3.07)*

Importing fish and changing fishing techniques:

> *Import fish.*
> *Make commercial fishermen's nets have holes for little fish to get out. (Angela/f/Y6/Q3/Item2/30.3.07)*

Investing in fish conservation:

> *If we want to go fishing we should use 4% of the fish profits to save the fish. (Emma/f/Y6/Q3/Item5/30.3.07)*

Many students expressed actions that supported reduced use of resources or favoured the use of environmentally “clean” resources. These imply the idea of acting responsibly towards the environment.

> *Buy electric cars or hybrids.*
> *Put solar panels on your car.*
> *Turn sugar cane into ethanol. (Chris/m/Y5/Q2/Item3/26.3.07)*
>
> *Buy electric cars that use garbage for fuel and it uses solar panels on the roof. (Carl/m/Y5/Q2/Item3/26.3.07)*
>
> *Walk everywhere.*
> *Use solar and hybrid cars.*
> *Use bikes more often.*
> *More use of public transport.*
> *Use water and wind for power (also solar). (Toby/m/Y5/Q2/Item3/26.3.07)*
>
> *We could walk, run, bike ride scooter, roller blade, jog, skip.*
> *(Use of) electric cars or solar powered things also will probably help.*
> *Try ethanol (and) synthetic oils. (Iris/f/Y5/Q2/Item3/26.3.07)*

Many responses (229) identified or separated local and/or global environmental issues and suggested possible action although students appeared to respond best to local environmental issues.

> GW: *What can you do about these problems?*
>
> Sasha: *We can walk to school instead of driving.*
>
> GW: *How does that help?*
>
> Sasha: *Because it means that there will be less people driving which means the environment is probably going to be the same as it is now but you can help it by walking to school.*
>
> GW: *What else can you do?*

Julian: *If you live far away from school you can catch a bus or something and not get your parents to drive you.*

Sasha: *I'm trying to stop my mum from driving me to school.*

GW: *So you're actually doing something. Do you think that makes a difference with the big problems in the world with oil?*

Chris: *If we all do it, it will.*

Sasha: *Every little bit helps.*

GW: *What sort of things might you do at school that help the environment?*

Chris: *Clean Up Australia Day.*

Julian: *Don't use as much electricity.*
(Sasha,Julian,Chris/fmm/Y5/FG/26.3.07)

Many responses indicate that students can make links from the specific environmental concern to broader related environmental issues. However, some of these links were tenuous or unrealistic or expressed a dire consequence.

No more petrol.
No more cars that run on petrol.
Too much carbon dioxide in the weather change getting so hot water will overflow some places of the world from the ice caps that are melting because it is getting too hot. (Neil/m/Y4/Q2/Item2/26.3.07)

There would be no pollution in the air (because) there would be no cars in the world. There would be no boats or planes. We would reach a point (where petrol is) too expensive to get and the rich people could only get it. (Jerry/m/Y4/Q2/Item2/26.3.07)

When there's no more oil, aeroplanes, helicopters and many more vehicles will not be used. Travelling overseas will be very hard without ships, kayaks and canoes can suffer winds, storms will kill many people. (Evette/f/Y4/Q2/Item2/26.3.07)

Many responses were able to suggest local actions to limit global environmental issues but very few made clear links to any notions of sustainability as reasons for doing this although the link was implied.

> *We can change it by riding our bikes, walking, or scootering to school or basically everywhere you go if it's not too far away. (Alison/f/Y4/Q2/Item3/26.3.07)*
>
> *Don't catch so many fish because if we catch too many they will go extinct. And we shouldn't catch them to eat them. Well we can but if we eat too many they will go extinct. (Helen/f/Y4/Q3/Item3/2.4.07)*
>
> *We could make more marine parks to save the fish.*
> *Catch fish in other parts of Australia rather than do most of it in Sydney. (Emily/f/Y4/Q3/Item3/2.4.07)*

Summary and Discussion.

Many responses stated that only some fraction of a natural resource should be used. This suggests that the students are aware of the need to conserve some of the resource but did not always articulate sustainability as a reason for doing this although the notion may be implied. There was an awareness that conservation implied human management to make something last as long as possible while sustainability implied human management to ensure that renewable resources were reproduced.

Students expressed awareness that the oil is a non-renewable resource and that there was a need to conserve some of the oil while alternative sources of energy are developed. In stating that only some fraction of the oil should be used they did not seem to recognize that this postpones rather than solves the problem. As the oil

reserve is a finite amount, using half only reduces consumption until there is none left so the response relates to conserving the resource rather than long term sustainability.

Many responses indicated awareness that fish are a renewable resource but there was still a need to conserve some of the fish to permit sustainability. A variety of strategies such as releasing small fish, fish protection zones, charging more for fishing licenses, importing fish, changing fishing techniques, and investing in fish conservation were suggested to limit or reduce the amount of fish being caught.

Many students expressed actions that supported reduced use of natural resources or favoured the use of environmentally “clean” resources involving energy from solar, wind or water sources.

Many responses identified or separated local and/or global environmental issues and suggested possible action. The responses indicate that students can make links from specific environmental concerns to broader related environmental issues. However some of these links were tenuous or unrealistic or expressed a dire consequence. Many responses were able to suggest local actions to limit global environmental issues but very few made links to notions of sustainability as reasons for doing this although this relationship may be implied.

4.4.2 Students' perceptions of who should take responsibility for the environment

There were 147 responses that commented on either responsibility for the environment or responsibility for environmental concerns. A portion of the analysis of these responses is based on whether individual students used first, second or third person pronouns ("I", "we"/"you"/"they"). While the researcher acknowledges that such an analysis may be limited and open to alternative interpretations, it does indicate some trends that contribute to the discussion on environmental responsibility.

Very few students (2) expressed a predominantly personal responsibility for appropriate action. Their statements used the pronoun "I".

> *If it was the last forest in the world I would talk to the governor in that country about stop cutting trees down. Otherwise there would be no more rainforests in the world with trees. (Marion/f/Y4/Q1/Item2/19.3.07)*

> *I could recycle the bottles and paper.*
> *I could when I print stuff on the computer and I don't want it I could not chuck it in the bin (but) reuse it. (Jerry/m/Y4/Q1/Item3/19.3.07)*

Many students (67) expressed a predominantly shared or corporate responsibility for appropriate action. Their statements used the pronouns "we" or "everyone".

> *We should not cut down as many trees. Plant more trees. (Angus/m/Y4/Q1/Item3/19.3.07)*

We could recycle the paper and not throw it in the garbage bin. We could use both sides of the paper. We could use less.
(Colin/m/Y4/Q1/Item3/19.3.07)

It's basically everyone. Everyone needs to help the fish even though we didn't do it. Particularly like picking up rubbish. You do it even though you didn't put the rubbish there in the first place. (Owen/m/Y5/I/A004/4.4.07)

Well everyone should reduce the amount of paper they use, reuse the paper that has already been used instead of wasting it and recycle it so we can use it all over again.
Also everyone should plant at least one tree a year.
(Alison/f/Y4/Q1/Item3/19.3.07)

Many of the responses using first person pronouns were made by students in Year 4. Some of these students are the group that is most represented in the school environmental group, "The Green Team." This group is involved in practical activities such as tree planting, recycling paper, caring for the school gardens (weeding, spreading mulch, etc). This may suggest that involvement in an environmental group supports students' attitudes of personal or group responsibility for the environment.

Many students (52) implied that responsibility for appropriate action lay with "others" such as industry or governments. Their statements used or implied the pronouns "they" or "you".

Reduce the amount of paper you use and reuse it.
(Martin/m/Y4/Q1/Item3/19.3.07)

They (governments) could make only a maximum number of fishing licences and they could make a maximum number of fish to catch on one fishing licence. They could simply make it a law that no fish could be caught. (Owen/m/Y5/I/A004/4.4.07)

GW: *Who should make up the rules about cutting down trees?*

Helen: *The government.*

GW: *Anybody else? What's to stop people just going and chopping down trees? If there weren't rules.*

Helen: *How come they don't do it?*

GW: *That's a problem because you're dealing with people, aren't you? And people don't always do the right thing.*

Helen: *I think people need to realize that's what they're doing. (Helen/f/Y4/I/A001/22.10.07)*

GW: *And what sort of rules should there be to allow that to happen?*

Craig: *No more whaling.* Pause.

GW: *Japanese wouldn't be happy with that because they like to eat the whale meat.*

Craig: *They would have to live with it.*

GW: *So is there something you can do which is a bit less than saying no more altogether?*

Craig: *Not really.*

GW: *OK. So who should make up rules like that?*

Craig: *The whale protection.* Pause. *I forget what it's called, the initials. (Craig/m/Y6/I/A008/22.10.07)*

A few students (4) responded that the Japanese were responsible for the reduction in the number of whales.

GW: *Who do you think is responsible for this problem with the whales?*

Amy: *The Japanese. (Amy/f/Y5/I/A006/26.4.07)*

Angela: *I've heard that the Japanese are killing whales for so called scientific reasons and they're coming into private land.*

GW: *I think you mean land that's in the waters of another country.*

Angela: *Yes and they're taking our whales. They're killing them and just leaving them.*

GW: *They're not actually. They ship them back to Japan for people to eat.*

Angela: *Yes.*

GW: *So what's wrong with them doing that? I mean we eat meat.*

Angela: *They shouldn't eat whales because there're not very many of them in the world. (Angela/f/Y6/I/A009/22.10.07)*

Some responses (20) indicated action but did not specify who was responsible for the action so did not clearly indicate any personal responsibility for action**.**

Plant more trees.
Cut less trees down.
Make furniture so that it doesn't use much wood.
(Alan/m/Y4/Q1/Item3/19.3.07)

Stop throwing out paper.
Grow more plants.
Stop stepping on plants. (Marion/f/Y4/Q1/Item3/19.3.07)

During discussions some students realized the difficulties in making industries responsible for determining the rules relating to consuming natural resources.

GW: *So who should make up the rules about how much (oil) they are allowed to take?*

Jack: *Maybe an oil company.*

GW: *But what are the oil companies trying to do?*

Jack: *They are trying to get money.*

GW: *It's all about money?*

Jack: *Yes. They would probably be selling it for so much money. You can't give them any more.*

GW: *If they had their way they'd make it more expensive?*

Jack: *Yes. They'd probably make it up to $2 (a litre).*

GW: *So who should make up the rules about this?*

Jack: *The world organization. I don't know what it's called.*

GW: *Do you know who makes up the rules in our community? Who makes up the rules in Australia?*

Jack: *The health minister and that.*

GW: *Sometimes it's the government?*

Jack: *Yes. Sometimes it's the government. Sometimes they'll make a rule for petrol and stuff. (Jack/m/Y4/I/A001/22.10.07)*

In some instances some students (5) recognized that the issue of responsibility for using natural resources was a complex matter and lay with both the individual and others.

GW: *Keep the numbers so that they don't lose so many. Who'd make the rules about that?*

Helen: *Well. The government has probably made rules about it.*

GW: *Can ordinary people like ourselves do something about it because many of us go fishing at times? What would be the rules for us?*

Helen: *To not fish as much.*

GW: *What do you mean by that?*

Helen: *If you fish like every day because you live near a river or something you should not do that.*

GW: *You mean not catch as many?*

Helen: *Well you can't really.*

GW: *Some days you go fishing you don't catch any. Other days you catch a lot.*

Helen: *Yes but like when I go fishing for like hours and stuff you should not do that anymore. Make it for an hour instead if say five.*
(Helen/f/Y4/l/A001/22.10.07)

Some students (5) recognized that the issue of responsibility was complex and demonstrated in their responses that responsibility could rest in several areas depending on the situation. This is illustrated in the following exchange.

GW: *Well you've got to make up some rules about all that. Who should be making up the rules about that?*

Lewis: *The Council (local government).*

GW: *What about the people going fishing?*

Lewis: *They should set themselves how many they'll fish when they go fishing.*
(Lewis/m/Y4/l/A001/22.10.07)

Some students (5) saw that responsibility lay across a number of areas depending on the issue being addressed.

GW: *Well who's responsible for limiting the number of fish people get?*

Amy: *The government.*

GW: *What about other people?*

Amy: *The fishermen.*

GW: What could you do?

Amy: *I could catch only big fish and not the little fish. (Amy/f/Y5/I/A006/26.4.07)*

GW: *Who's responsible for making these rules up about the environment?*

Paul: *The government.*

GW: *Do people like ourselves have any responsibility?*

Paul: *Yes. We don't use as much electricity. Use more solar to generate electricity and don't use as much coal. (Paul/m/Y5/I/A007/26.4.07)*

Summary and Discussion

A few students expressed a personal responsibility for appropriate action. Their statements used the pronoun "I". Many students expressed a shared or corporate responsibility for appropriate action. Their statements used the pronouns "we" or "everyone". Many students indicated that responsibility for appropriate action lay with "others" such as industry or governments. Their statements used the pronouns "they" or "you".

The researcher recognizes that students' choice of pronouns such as "I", "we", "everyone", "they", and "you" may not be a consequence of a consistent point of view and an unreliable indicator of where individual students apportion environmental responsibility. However, it may be significant that very few students used the first person "I" and most used the corporate "we" or "they" or "you".

A few students responded that the Japanese were responsible for the reduction in the number of whales. As previously reported in 4.3.1 they felt that the Japanese hunting “our” whales was unacceptable and this appeared to be a stronger sentiment than the need for sustainable management of the whales. They were also repulsed by the thought of Japanese people eating whale meat and this may suggest an aspect of cultural difference and intolerance.

Some responses indicated action but did not specify who was responsible for the action so did not clearly indicate any personal responsibility for environmental action.

During discussions some students realized the difficulties in making industries responsible for determining the rules relating to taking natural resources. In some instances students recognized that the issue of responsibility for using natural resources was a complex matter and lay with both the individual and others. Some students saw that responsibility lay across a number of areas depending on the issue being addressed.

The Year 4 students are the group that is most represented in the school environmental group, “The Green Team”, and this involvement appears to support students’ attitudes that individuals and the groups that they belong to are responsible for the environment and environmental concerns. It also appears to

encourage students to believe that local action can impact on global environmental issues.

4.4.3 Factors that inform students' understandings of environmental matters

The data for this question were collated largely from the questionnaires that were completed for the three scenarios. In the questionnaire the final question asked: "From where do you find out about environmental issues?" There were 959 responses to this question. These responses were grouped in the following categories:

School/teachers	242
Books/magazines	164
TV/TVNews	161
Computer/Internet	127
Family/mum/dad	100
Newspapers	72
Direct Observation	32
Radio	31
Videos/DVDs/Movies	14
Friends	10
Environmental Scientists/Rangers	6
Total Responses	**959**

Figure 4.1: Sources of Environmental Information for Primary School Students.

Summary and Discussion

The students in the study drew their understanding of environmental issues from a wide range of sources. Among these sources the main contributors were school, books, magazines, the internet, television and home. The role of the school and the teachers was particularly significant. The implementation of the DET Sustainable Schools Program (NSW DET, 2001b) in this setting is likely to have been a factor in contributing to the students' perceptions of environmental sustainability.

This chapter outlined and discussed the data collected in the study. This included themes relating to the students' knowledge and understandings about ecological and scientific phenomena, environmental phenomena, and environment and sustainability. Themes relating to extreme or confused views and individual environmental action proposed by the students were also reported and discussed. Following this, students' perceptions of responsibility for the environment and factors that inform students' understandings of environmental matters were reported and discussed. The following chapter clarifies findings from the data analysis and discusses the contributions of the study to existing literature relating to young children's perceptions of environmental sustainability (previously outlined at 2.5).

Chapter 5: Conclusions and Implications

Now that you're here,
The word of the Lorax seems perfectly clear.
UNLESS someone like you
Cares a whole awful lot,
Nothing is going to get better.
It's not.

Dr Seuss (1957) *The Lorax*, p. 58.

5.1 Introduction

In this chapter the contributions of this study to the current understandings of children's perceptions of environmental sustainability are reported and discussed. This entails a consideration of cause and effect (proximate and ultimate; simple and complex); the socio-economic dimensions inherent in children's understandings of sustainability; children's proposed actions to address environmental problems; catastrophic views expressed by children in relation to environment and sustainability; children's worldviews and how they impact on their views of sustainability; and influences on children's perceptions of environmental sustainability.

5.2 Understanding Primary School Students' Perceptions of Environmental Sustainability

Children's notion of the environment is central to understanding their perceptions of environmental sustainability. In previous research (Bonnet & Williams, 1998; Carroll, 2002; Keliher, 1997; Payne, 1998; Rejeski, 1992; Walker et al., 2000; Wals, 1992) it has been reported that children saw the "environment" as the "natural environment" which might not include humans. Walker (1995) suggested

that this may have been influenced by the use of the term “the environment” in curriculum documents and pedagogy implying and sustaining the notion that environments were limited to the natural environment. This study has reported on children’s perceptions of environmental sustainability and used scenarios with inherent human impacts in relation to sustainability in the use of natural resources rather than examining the curricula and pedagogy that influence the students’ perceptions. Student focus group discussion about human use of natural resources and the related sustainability issues indicated that the students were aware that humans had a role in generating problems impacting on environmental sustainability. Previous studies (Bonnet & Williams, 1998; Carroll, 2002; Keliher, 1997; Payne, 1998; Rejeski, 1992; Walker et al., 2000; Wals, 1992) that were concerned mainly with young children’s perceptions of the environment, reported mixed findings about young children linking humans to the natural environment and sustainability issues. The children tended to describe the environment as a place that might include humans (Rejeski, 1992; Walker et al., 2000; Wals, 1992) or might not (Bonnet & Williams, 1998; Carroll, 2002; Keliher, 1997). When the intent of the study was to determine children’s perceptions of people in relation to the natural environment, the children are able to associate humans with environmental change and sustainability issues.

This study shows that most of the children expressed views about sustainability. Their comments tend to involve proximate causes rather that ultimate causes; appropriate local actions in contrast to global actions to address sustainability

issues; and, homocentric worldviews rather than ecocentric worldviews. Socio-cultural, political and economic causes of sustainability issues relate mainly to ultimate causes and comments relating to these influences are rare in the student data.

The use of the second item of stimulus material (the sign advertising the prices of automotive fuels outside a service station, see Attachment 2) encouraged students to comment on the social and economic implications involved and the local impact for them of the cost of fuels. However, the students' comments remained largely on the availability of oil and the consequences of its reduced availability rather than on the socio-cultural, political or economic aspects implicit in the scenario.

In previous studies (e.g. Walker et al., 2002) researchers reported that young children saw the environment as an object and the researchers argued that there was a need to develop an understanding of the relationships between all living things and the human effects on the natural environment. This study indicates that the students are aware that human actions do affect the natural environment. However, there continues to be a need for a broader focus on the interrelatedness of all living things and the role that social and economic phenomena play in environmental and sustainability thinking.

Environmental sustainability has been broadly defined as:

> *A dynamic balance among many factors, including the social, cultural and economic requirements of humans and the imperative need to safeguard the natural environment of which humanity is part* (UNESCO, 1997, Item 32).

This study indicates that the social, cultural and economic factors are least understood and rarely expressed by the students in their discussion of sustainability. Environmental issues and their possible resolutions cannot be effectively addressed unless these factors are understood.

5.2.1 Cause and effect: proximate and ultimate; simple and complex

Students in the study expressed an awareness of a variety of environmental issues. They tended, however, to refer to causes based on broad simplistic scientific and ecological understandings that sometimes produced confused and inaccurate views. This concurs with the findings of Wals (1994) who also reported that some young children expressed simplistic ideas about the causes of pollution in the natural environment. Unlike previous studies (e.g. Bonnet & Williams, 1998; Carroll, 2002; Walker et al., 2002; Wals, 1992; Yencken et al., 2000) the students were able to associate the actions of humans with environmental issues.

The students' understandings of cause and effect in relation to environmental issues may be understood in terms of "proximate cause" and "ultimate cause" (Mayr, 1988, p.28). Mayr used these two terms to describe the complex behaviour of animals in biological studies. Such studies of living things are complex because living things themselves are complex. Biological scientists often need to deal with at least two levels of analysis. One is the "why" an organism does what it does and

the other is the "how" of the behaviour. Mayr (1988) recognized this difficulty over 30 years ago and defined two terms, "proximate cause" and "ultimate cause", to illustrate the problem.

Mayr (1988) explains proximate and ultimate cause in relation to the migration of birds:

> *There is an immediate set of causes of migration (of a bird), consisting of the physiological condition of the bird interacting with photoperiodicity and drop in temperature. We might call these the proximate causes of migration. The other two causes, the lack of food during winter and the genetic disposition of the bird, are the ultimate causes* (Mayr, 1988, p.28).

In their explanations the students in the study tended to infer proximate (or immediate) causes as the means of interpreting scientific and environmental phenomena possibly as a way of simplifying the complex understandings involved. This tended to produce a simple but limited explanation of cause and effect such as:

> *The air is polluted because there are no more trees to suck in the carbon dioxide. (Jasmine/f/Y5/Q1/Item1/19.3.07)*

The students were aware that motor vehicles were a significant contributor of carbon dioxide to the atmosphere and that the increasing number and use of motor vehicles was exacerbating this issue. This supports earlier research (Harris & Blackwell, 1966) where students expressed an awareness of the link between motor vehicle exhausts and increasing carbon dioxide levels in the atmosphere.

> *Children assume that as* CO_2 *is a component of vehicle exhausts they (can then) use this in an uncritical way assuming that* CO_2 *is responsible for all the global environmental problems* (Harris & Blackwell, 1966, p. 45).

However the students in the study seemed to be better informed and aware that global environmental problems had a range of causes and not just that of the contribution of carbon dioxide from motor vehicles. This is possibly a product of the study's use of a range of stimulus materials involving forests, fuels and fishing, and its focus on the environmental and sustainability issues related to these.

The students applied proximate causes in interpreting scientific understandings when it came to considering the role of trees in absorbing CO_2. They were unaware that the oceans and the soil are more significant absorbers of CO_2 than trees (Plimer, 2009). There was a general simplistic view that humans breathe in oxygen and breathe out CO_2 while trees absorb CO_2 and release oxygen and therefore trees and humans were seen to be in some mutually dependent relationship. There were many examples of this view and it was felt that the destruction of the forests might result in not merely the depletion but a total removal of available oxygen and as a result we would die because we would not be able to breathe.

> GW: *So if you cut down all the trees, apart from the newspaper problem and the paper problem, what other problems would there be?*
>
> Ann: *You wouldn't be able to breathe.*
>
> GW: *Tell me more about that.*

> Ann: *The trees breathe in carbon dioxide and breathe out oxygen. (Ann/f/Y6/I/A009/22.10.07)*

The students' use of proximate causes in interpreting scientific, ecological and environmental phenomena seems to be a strategy used to make sense of the complex nature of environmental studies and sustainability issues. Because environmental education is multi-disciplinary involving science, technology, sociology and economics the understandings required to fully comprehend environmental and sustainability issues are complex. Students attempt to simplify these by applying broadly a limited range of scientific understandings. They find it difficult to draw on many knowledge disciplines and as a result their understanding of sustainability issues is limited.

The students in the study applied proximate cause without clearly demonstrating an awareness of the ultimate causes that may also be involved. The ultimate causes may be multi-disciplinary and complex as are the scientific phenomena and environmental issues that they are endeavouring to understand. Ultimate cause refers to that cause or causes that are typically interpretative, complex and overarching (Mayr, 1988). It is difficult to determine these from the student data because the students tended to refer mainly to simple proximate cause and effect scenarios. In the following example from the student data:

> *We might run out of oil which will mean no more cars. Using more oil will mean more cars, vehicles and trucks on the roads to cause pollution. Also the ice caps will melt. This will cause extinction to other animals. (Evette/f/Y4/Q2/Item1/26.3.07)*

the student relates the burning of oil to pollution, melting ice-caps and extinctions but the links between the various events are somewhat tenuous and are not supported by a necessary depth to the discussion.

The students were aware of their human dispositions as consumers of the natural resources used in the scenarios (forests, fuels and fish) and this may be thought of as awareness of ultimate causes. However their comments tended to be simplistic and limited to their consumption of the natural resource. Reference to economic, political and socio-cultural factors relating to the use of motor vehicles and the burning of fossil fuel remained at a simplistic level without indicating the inclusion of extended, multi-lined or even networked ultimate cause.

These primary school children's understanding of the causes of environmental problems may be illustrated using the following example relating to global warming and shown in Figure 5.1. In the figure Direct Proximate Causes refer to causes that are immediate and easily recognised by primary school children. Indirect Proximate Causes refer to those causes that are related to the environmental problem but may not be identified as the immediate cause of it and may include some socio-cultural phenomena. Both Direct Proximate Causes and Indirect Proximate Causes tend to involve mainly scientific, ecological and environmental phenomena. Ultimate Causes refer to causes that are typically interpretative, complex and overarching and as such are not generally identified by primary school children in

their comments about the causes of environmental problems. They refer mainly to the socio-cultural causes that underlie environmental problems.

Primary School Children's Views of Proximate and Ultimate Causes in relation to Global Warming.

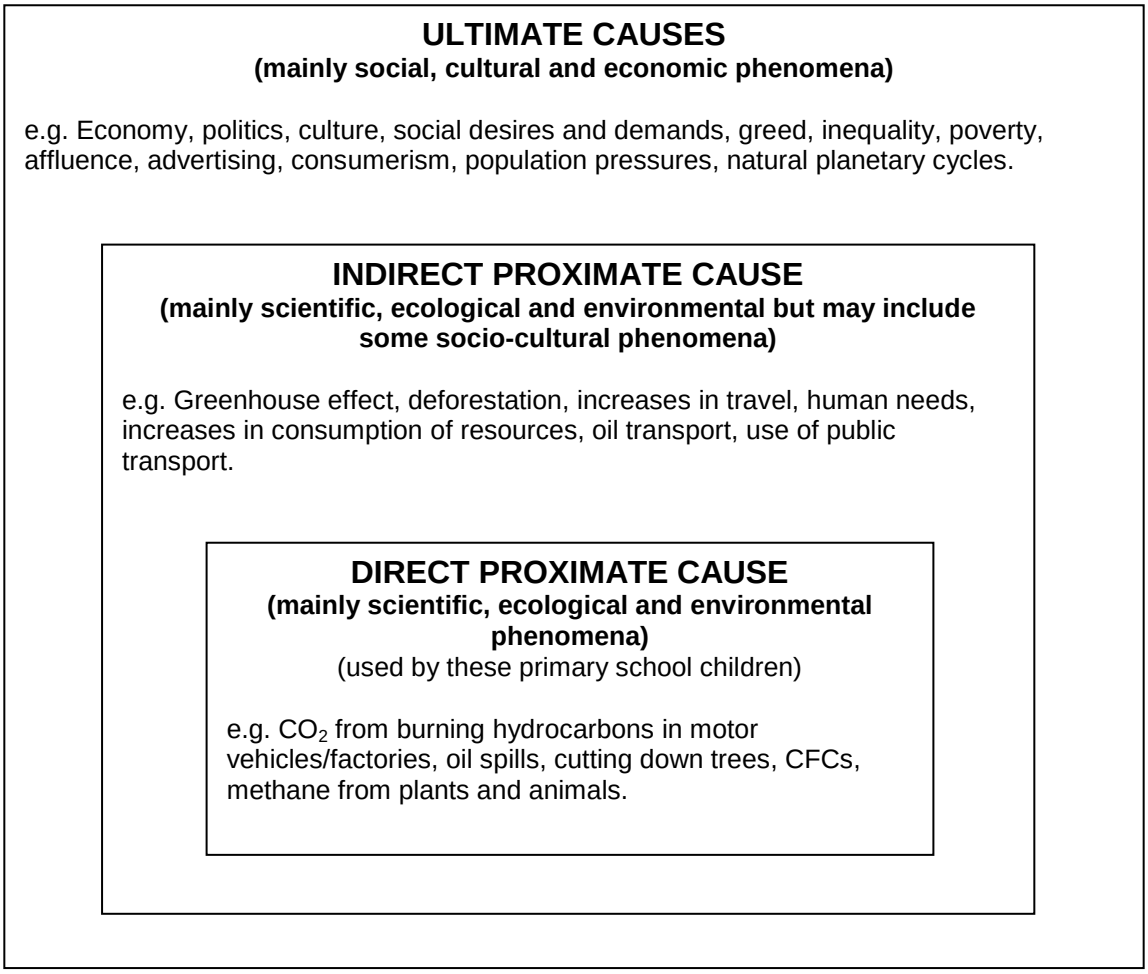


Figure 5.1: Example of primary school children's use of direct proximate cause as applied to their explanations of the causes of global warming.

The students perceive the causes of environmental issues and their related social issues mainly in terms of direct, proximate cause rather than ultimate cause(s) and this results in their suggesting proximate, simple, local solutions. As a result they tend to express simplistic understandings of ecological/environmental phenomena and the related socio-economic factors. It is these socio-economic factors that they tend to ignore because these are more distant from the effects and it is more difficult to directly map the links between causes and effects. These are the ultimate causes and effects and young children find them difficult to perceive. In reference to the earlier Figure 2.2 shown in Chapter 2, it is the right hand side of the figure, the economic, social and cultural elements of environmental education, that seem to receive limited expression from the students. This limited understanding may be a function of their education and/or their intellectual development and warrants further investigation.

5.2.2 The Socio-economic Dimension

The students appeared to have a developing understanding of scientific phenomena relating to the environment (e.g. food webs, pollution, extinction and greenhouse gases), and they are aware of and can discuss environmental issues (e.g. resource depletion, global warming and climate change), but they lack the broader understanding of social, cultural and economic issues (e.g. over-population, poverty and social equity) that are essential to the development of a broad view of the factors involved in many sustainability issues.

Walker (1995, 1997) reported that environmental education in NSW classrooms tended to revolve around environmental issues rather than addressing their causes. As the students mostly referred to proximate cause(s), contributing comments to discussions that were informed by their scientific, ecological and environmental understandings, it seems that the complexity of understandings required to address ultimate causes (those of a predominantly social, cultural and economic nature) resulted in limited expression of socio-cultural understandings. So while the students were better informed about scientific, ecological environmental phenomena, their understandings continue to be lacking in critical, reflective analysis of human socioecology. This concern was also reported by Fien (1997), Robottom (1993) and Watson (2002).

It is difficult to have an awareness of the impact of humans on environmental and sustainability issues without a broader understanding of social, cultural and economic issues involved. The focus of environmental education appears to remain largely on the understanding of scientific, ecological and environmental phenomena and environmental issues. This concern was expressed by Fien (1997) who argued that environmental education needed to abandon its preoccupation with the natural environment and to incorporate the concept of sustainable development, including the issues of human rights, gender, race and social equity as well as nature conservation. Based on the evidence of this study, this concern appears to remain. It may remain for two main reasons:

Firstly, the DET Sustainable Schools Program (2001b) while being activity based appears to be implemented in a way that mainly focuses on Fien's (1997) "People and Nature" (Ecological Sustainability). The "People and People" (Social Justice) focus appears to be limited (See Figure 2.2). This may in part be due to an orientation of the curriculum to an ecocentric worldview while primary school students' focus, while varied, was commonly a homocentric worldview. This suggestion is explored further in 6.3.

Secondly, the teachers of the students in the study may have inadvertently placed a lesser emphasis on social and cultural issues when teaching sustainability education. At the time of the data collection phase of the study, the teachers of the students were unaware of the document, "Global Perspectives, A Statement on Global Education for Australian Schools" (Curriculum Corporation, 2002) although it had been in existence for some four years. This document sees global education as:

> *transformative and aims to promote values, such as commitment to opposing poverty and injustice, affirming human rights and cultural diversity, seeking a peaceful and just world and working towards environmental sustainability* (p.6).

Given that the teachers were possibly unaware and therefore uninformed of this document, it is not surprising that the students were not articulate about broader social and cultural issues in expressing their knowledge and views in relation to environmental problems. This is not to say that the classroom teachers had not addressed social and cultural issues with their students in other ways, but it seems

to support the assertion that teachers are less likely to refer to social and cultural issues in their teaching about environmental sustainability.

It may be that the “Global Perspectives” document may not have received the support necessary for its effective implementation, or it may relate to the “piecemeal” nature of the sustainability education curriculum documents in general. What does become apparent is that comments and discussion relating to social and cultural factors impacting on sustainability are somewhat limited in the student data.

Carspecken (1996) commented that social critical theory or critical ethnography, requires that along with the understanding of environmental issues there is an awareness of the related social and cultural issues involved and commitment to action to redress both sets of issues. It would seem that the teaching about sustainability issues continues to remain problematic as indicated by the limited student comments in discussions relating to social and cultural factors in the data.

5.2.3 Proposed Actions

Perhaps the most significant finding from this study in respect to the students’ concern for the environment and sustainability was their expression of the need to share natural resources fairly and in a balanced and responsible manner. Their

concerns for environmental sustainability are well informed by a strong ethical stance of sharing responsibly and a willingness to take action.

In contrast to the findings of Yencken (2000) where children felt a lack of empowerment, the students in this study generally held the view that local action could impact on global sustainability issues. Students in the study believed that their local actions were very important in resolving global sustainability problems. Local actions which they believed would have an impact on global sustainability issues were suggested by students although they were unable to say how this might occur. The suggested local sustainability actions tended to be simplistic and some demonstrated the influence of slogans and mantras such as refuse plastic or reuse paper or recycle paper or walk rather than drive. When the students attempted to apply suggested local sustainability solutions to global sustainability issues, the consideration of the complexity of the bigger issues tended to overwhelm the suggested simplistic solutions resulting in confused or inadequate responses. There also appears to exist a paradox in regard to power with the students having a sense of power to improve the environment through local action but at the same time having a sense of powerlessness as they realise that their capacity to make changes depends on others.

The data collection phase of the study initiated discussion about environmental sustainability by using stimulus material relating to three natural resources (The 3 “Fs”: forests, fuels and fishing). For the two natural renewable resources (forests

and fishing) students were able to suggest actions relating to maintaining the sustainability of the resource for the use of future generations of humans. However, the non-renewable natural resource (fuels) presented the students with a dilemma because expressing ideas about perpetual sustainability of the resource was not an option as the resource is being progressively depleted. The students' responses expressed ideas related to conservation of the resource, or using strategies to slow down the use of the resource so that there would be some of it left for future generations of humans. They also expressed concern about the need to find alternative sources of energy (solar, wind, water, etc) which suggests that they are aware of the need to set limits on the use of non-renewable natural resources. Their awareness that some natural resources are non-renewable demonstrates an important understanding about sustainability.

However, notions of sustainability extend beyond sustaining an available natural resource. The students also viewed sustainability as relating to lifestyle and the supply of the things that humans need and want. Viewed in this way sustainability is not about ensuring that fossil fuels are available for future generations but rather about ensuring that alternatives are found to ensure that our lifestyle, and that of future generations is sustained.

As previously discussed, the students' concern for the environment and their suggested solutions for sustainability issues were best expressed when discussing local environmental issues and this is in agreement with the findings of other

researchers (Bonnet & Williams, 1998; Carroll, 2002; Walker et al., 2002; Wals, 1992, 1994; Yencken et al., 2000).

The students in the study appear to be able to identify and separate local and global sustainability issues. While they were able to propose appropriate action to address a local sustainability issue, in more complex global contexts suggested actions tended to be simplistic, unrealistic or expressed dire consequences. Although they suggested local actions to limit global sustainability issues, very few students gave sustainability as reasons for doing this, although for some it may have been implied. However, their suggested local actions were sometimes simplistic demonstrating the influence of environmental slogans and mantras such as refuse plastic or reuse paper or recycle paper. While local action was suggested they generally were unable to say how this might impact on global sustainability issues. For example, some students suggested that by recycling paper or using both sides of a sheet of paper they would be saving trees and reducing carbon dioxide emissions. However, the linking of this action to a global effect was tenuous and uncertain due to the complex nature of the global issue and the scale of the solution needed to deal with it.

These findings support those of Jensen (2002) who reported that young children's difficulties in grasping complex ecological facts, their limited understanding of strategies for change, and their limited awareness of an alternative vision, were all factors that impacted on proposing appropriate environmental action. This

suggests that while the students believe that their actions are able to have a broad positive effect (and even a positive global effect), they are not fully aware of the complex nature of the environmental problems for which a solution is sought. For example, they believe that walking more and driving less will help to reduce greenhouse gases, which it will, but they lack a sense of scale of the problem and the minuteness of their individual contribution. On the other hand, some students expressed the idea that if they all acted then it would make a difference.

Proposed student action appeared to be influenced by a perceived need to behave responsibly towards the consumption of natural resources. Responsibility implied sharing the resources fairly among all humans and other living things as well as not wasting the resource. The actions that are proposed seem to be influenced by the students' knowledge of environmental, ecological and scientific phenomena. This is typically associated with their proposed behaviour to act in a manner that is directed towards either conserving or sustaining the natural resource.

5.2.4 A Catastrophic View

As previously discussed, a few students expressed confused views or extreme views. Confused views often seemed to be the result of broadly applying simplistic understandings of scientific or ecological phenomena. Extreme views often seemed to show the influence of sensationalised media reports where a student had generalized broadly from one simplistic idea. As Plimer (2009) comments:

> *The modern media barrage has conditioned us to think that we are approaching an unprecedented catastrophic warming and that we humans can actually change climate* (Plimer, 2009, p. 98).

Responses that may have been influenced by media reports and class discussions at the time of the data collection were those that related to the hunting of whales. A few students responded that the Japanese were responsible for the reduction in the number of whales.

> GW: *Who do you think is responsible for this problem with the whales?*
>
> Amy: *The Japanese. (Amy/f/Y5/I/A006/26.4.07)*

This suggests that the students are making value judgements that are being influenced by the media and class discussions when their environmental values and attitudes are not based on a clear understanding of the scientific, environmental, social, cultural and economic factors involved. This is discussed further in the next section.

5.2.5 Worldviews and Sustainability

Attitudes towards the environment and sustainability are based on the worldview held and expressed by individuals (Fien, 1993; Stern et al., 1993). The students in this study suggested possible actions to redress environmental issues in a variety of contexts. In doing this their responses ranged across a continuum from egocentric to homocentric to biocentric to ecocentric and a range of these responses was evident for most contexts. An example of this can be seen in the students' responses to whale hunting. Some students expressed the egocentric

worldview that the whales were “ours” and that other nations (e.g. Japan) had no right to hunt them; some students expressed the homocentric worldview that some whales could be hunted to meet the needs of humans for whale products although some students were repulsed by the thought of eating whale meat; some students expressed the biocentric worldview that whales needed protection and conservation in order to sustain whale species; and some students expressed the ecocentric worldview that whales needed protection and conservation along with all living things in order to maintain sustainability in general. In some contexts individual students expressed several different worldviews. This is illustrated in the following example from an individual interview where the student first expresses an egocentric worldview followed by a biocentric worldview. The inconsistency suggests that the students’ worldviews are not fixed but change.

> Angela: *I’ve heard that the Japanese are killing whales for so called scientific reasons and they’re coming into private land.*
>
> GW: *I think you mean land that’s in the waters of another country.*
>
> Angela: *Yes and their taking our whales. They’re killing them and just leaving them.*
>
> GW: *They’re not actually. They ship them back to Japan for people to eat.*
>
> Angela: *Yes.*
>
> GW: *So what’s wrong with them doing that? I mean we eat meat.*
>
> Angela: *They shouldn’t eat whales because there’re not very many of them in the world. (Angela/f/Y6/I/A009/22.10.07)*

While there was a range of responses using different worldviews, the most common worldview was a homocentric one wherein sustainability was important in meeting the needs of humans. Other worldviews were expressed and some of these shifted depending on the context of the discussion. The “free-market school” and the “no-problem school” (as outlined in 2.6) were not evident with most students believing that some amount of human intervention was necessary in order to achieve sustainability of natural resources. Most of their responses were consistent with the “responsible planetary management school” (as outlined in 2.6). The “spaceship-Earth school” and the “stewardship school” (as outlined in 2.6) were also evident but to a lesser extent. This is not surprising given that a homocentric worldview was most common with the students relating sustainability of the natural environment as being important for the maintaining of human lifestyles while at the same time sustaining natural resources.

This study has found that many students frequently expressed a **homocentric** worldview. They also demonstrated awareness of environmental sustainability by quantifying how much of the resource should be used by the current human generation and that no waste should occur so that the resource was conserved or sustained for future generations of humans. In contrast to this was the homocentric worldview of some students who expressed the view that some of the resource needed to be left for their and/or other people’s purposes. Their main focus was on conserving the resource so that it would be available for their own use (and that of their peer group) in the future rather than for the use of future generations of

people. This can also be expressed as an **egocentric** worldview which remains as category of a homocentric worldview. For students expressing this view perpetual sustainability of the resource, while important, was not their immediate consideration. The sustainability of the resource was only desirable for meeting their individual needs and those of their peer group as the next generation of humans. This egocentric worldview was more apparent in the digital recordings where the students' voices accentuate the use of the generic "we" clearly referring to either them or their peer group rather than to future generations of people.

When students claimed that the use of the resource should be shared, they often referred to a need to be fair to both people and other animals. This worldview expresses elements of both a homocentric worldview and a biocentric worldview. When students expressed a **biocentric** worldview they appeared to be endeavouring to share the resource fairly between humans and animals.

> *I think we should be using half of it* (the trees) *because then we would get half and the animals would get half. (Colin/m/Y4/Q1/Item5/19.3.07)*

Most students in the study viewed environmental sustainability as important in providing for their own future needs, the needs of their peer group, and the needs of future generations of humans.

Students appeared to be concerned with the need to share the resource fairly between humans both now and in the future so that there would still be some of the

resource available for them to use when they became adults. This was particularly evident in the use of hydrocarbons with some students expressing outrage that the continuing depletion of fuels might mean that they would not be able to drive cars when they became adults. They thought that current adults were being unfair if there were none of these fuels left for them to use in the future.

Many students expressed a biocentric worldview saying that some of the resource needed to be left so that there was enough to maintain the animals. In these instances their focus was mainly on providing for the needs of animals more so than plants. This was a finding in other studies (e.g. Bonnet & Williams, 1998; Wals, 1992, 1994). It may be that students identify more easily with animals than plants as living things like themselves. Animals that might be considered "cute and furry" were particularly deserving of their consideration. Some examples are:

> *Too many trees are being cut down just to make newspapers and that means we can't breathe enough oxygen.*
> *Animals (the wild ones) don't have anywhere to live or get food like koalas have no gum leaves! (Marion/f/Y4/Q1/Item1/19.3.07)*
>
> *Global warming. The earth is warming up. Soon it will be averaging like 30 degrees C.*
> *Think of the penguins!*
> *Ice melt, sea level rise, death for little islands.*
> *(David/m/Y6/Q1/Item2/9.3.07)*

When students expressed an **ecocentric** worldview they were demonstrating an understanding of environmental sustainability and the awareness that replacement of a resource is essential to the continued sustainability of the resource and the

natural environment. The emphasis seemed to be on conserving the resource for the sake of the natural environment rather than for human use.

> *I think it is bad to cut down trees because we'll have no paper and it's bad for the animals because they won't have anywhere to live or any food and it's bad for the environment. (Helen/f/Y4/I/A001/22.10.07)*

Some students repeatedly referred to statements such as "Reduce, Refuse, Reuse, Recycle" but rarely explained how these ideas might affect environmental sustainability. This concurs with the conclusions reported by Bonnet and Williams (1998) who noted that the children regarded recycling as a positive action but were unable to link this with possible benefits for the environment. It may be that the use of mantras substitutes for informed deeper knowledge about sustainability. These may provide a clear guide for action if not a theoretical basis for thinking about sustainability. Students may resort to mantras when their environmental values are not based on a clear understanding of the scientific, environmental, social, cultural and economic factors involved.

For discussion purposes, it may be useful to illustrate the worldviews of primary school children using Figure 5.2 which follows. Young children may express elements of egocentric or homocentric or biocentric or ecocentric worldviews and these may vary inconsistently within their discussions. While their worldviews range across all four categories, the most common worldview identified from the data was a homocentric one that permits human impact on the environment provided that environmental sustainability for the benefit of humans is maintained.

There may also exist a continuum beginning with an egocentric worldview and progressing to a homocentric worldview and then to an ecocentric worldview. This study suggests that some children may follow this continuum which may or may not include expressing a biocentric worldview which may be seen as a sub-strand of a homocentric worldview. These speculative comments suggest a need for further investigation into the worldviews held by young children. It may be possible to further develop survey instruments, similar to those used by Manoli et al. (2007), that would target young children and allow their worldviews to be mapped further thus providing additional insight into their thinking about sustainability.

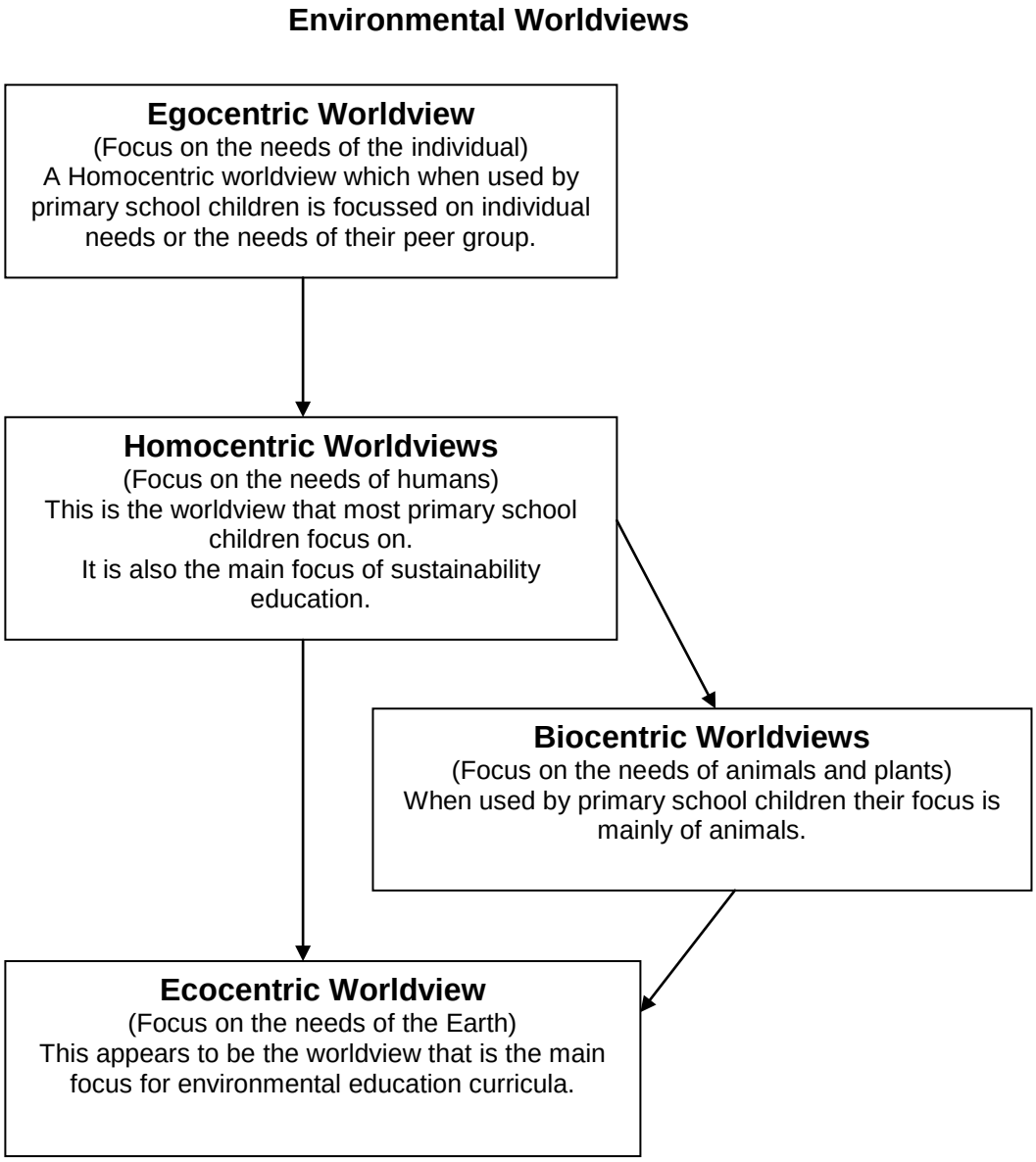


Figure 5.2: The range of worldviews (Dunlap & Van Liere, 1978; Fien, 1993; Stern et al., 1993) in which the researcher (GW) suggests a continuum from egocentric to homocentric to biocentric to ecocentric. Primary school children position themselves mainly with a homocentric worldview as indicated by the data in the study.

While primary school students express mainly a homocentric worldview, some sustainability curricula appear to mainly contain an ecocentric worldview and this

may be in conflict with the homocentric worldview that was most commonly identified in the student data. This concern is discussed in 6.3.

This study indicates that students, in their final years of primary education, hold profound views about the environment and environmental sustainability. These views tend to be mainly homocentric although they do include some egocentric, biocentric and ecocentric views depending on the issue being discussed. They are very concerned about sustainability problems and the ways that these are likely to impact on their personal lives and on humanity in general. They articulate possible solutions and tend to apply these broadly with apparent limited understanding of the complex social, cultural and economic factors that are involved.

5.2.6 Influences on children's perceptions of environmental sustainability

The students in the study drew their understanding of the environment and sustainability issues from a wide range of sources. Among these sources the main contributors were home and school. Other significant contributors were books, magazines, the internet, and television. As the school was implementing the Sustainable Schools Program as part of the DET Environmental Education Policy (NSW, DET, 2001a), this program was also likely to have been a significant influence.

These findings concur with the conclusions of Musser and Diamond (1999) and Walker et al. (2000) who both reported that children's attitudes develop from a wide

variety of influences other than parents (siblings, grandparents, teachers, media, books, etc). Their studies showed that there was a relationship between children's attitudes and their participation in relevant environmentally friendly activities. The student data indicated that many Year 4 students responded with suggestions for action using first person pronouns. As some of these students are in the group that is best represented in the school environmental club ("The Green Team"), it supports the view that involvement in an environmental group supports students' attitudes of personal or group concern and responsibility for the environment, especially the local environment. This is consistent with the findings of Musser and Diamond (1999) who reported that there was a positive relationship between children's attitudes towards the environment and their participation in relevant environmentally friendly activities. As the Sustainable Schools Program (NSW DET, 2001b) involves practical interaction with the environment, this aspect appears to be important in the development of an understanding of, and an attitude towards, environmental sustainability.

Young children are also guided by strongly held ethical principles such as sharing fairly, not being greedy, and being responsible. These ethical principles impact on the notions of environmental sustainability that they hold and express influencing their views on social justice and environmental stewardship. This is expressed in their desire to maintain a balance in the consumption of natural resources to meet different demands; to be involved in local environmental action; and to conserve

natural resources and where possible to manage those resources responsibly so that they remain sustainable.

This chapter has discussed the conclusions and implications of the study in relation to students' perceptions of environmental sustainability with reference to the existing literature. The students in the study most frequently express notions of sustainability that are underpinned by homocentric views of sustainability; proximate cause and effect scenarios; and, proposed actions based on sharing natural resources fairly while maintaining the environmental balance and behaving responsibly.

In Chapter 6, Section 6.2, the key findings of this study are outlined as a prelude to the development of a framework of primary school children's perceptions of environmental sustainability. Then, the thesis concludes with an analysis of the implications of this framework for sustainability curricula.

Chapter 6: An Emerging Framework of Primary School Students' Notions of Environmental Sustainability

> *A peculiar thing about the Puddin' was that, though they had all had a great many slices off him, there was no sign of the place whence the slices had been cut.*
>
> *"That's where the Magic comes in," explained Bill. "The more you eats the more you gets. Cut-an'-come-again is his name, an' cut, an' come again, is his nature. Me an' Sam has been eatin' away at this puddin' for years, and there's not a mark on him."*
>
> Lindsay, N. (1918). *The Magic Pudding*, p. 23.

6.1 Introduction

This study explored the perceptions of environmental sustainability held by a group of NSW students in their final three years of primary school education. To initiate discussion about environmental sustainability the study used stimulus material relating to three natural resources (The 3 "Fs": forests, fuels and fishing). In particular, it sought to explore the students' understandings and views on environmental sustainability and to consider whether these understandings and views were consistent or inconsistent with the actions the students proposed. Related to this, the study explored the extent to which the students believed that local action was able to impact on global sustainability issues. It also explored to whom the students attributed environmental responsibility; their reasons for this; and, what informed the responses of students.

This chapter presents and discusses an emerging framework of primary school children's notions of environmental sustainability which outlines the components that shape the understandings of young children in relation to environmental sustainability. Following this the implications of the study for sustainability curricula are discussed.

6.2 Key Findings of the Study and an Emerging Framework of Primary School Students' Notions of Environmental Sustainability

This chapter uses the data reported in Chapter 4, and presents an emerging framework of primary school students' notions of environmental sustainability which is summarised in Figure 6.1. The framework reports the key findings of the study which are as follows:

Primary school students' perceptions of environmental sustainability are not fixed (or they are under construction) and vary according to the context of the environmental issue under consideration.

Their understandings of ecological and scientific phenomena are limited because these are complex areas of knowledge and the students' understandings need further time and maturity to develop. As a result they will sometimes tend to focus on one specific ecological and scientific understanding, or sometimes "proximate cause" rather than "ultimate causes" (Mayr, 1988), and apply this uncritically to a

range of other situations. This sometimes results in the articulation of extreme or confused views.

Their understandings of environmental phenomena are also limited again because these are complex areas of knowledge and the students' understandings need further time and maturity to develop. As a result they will sometimes tend to focus on one aspect of an environmental phenomenon, or sometimes on "proximate cause" rather than "ultimate causes" (Mayr, 1988), and apply this uncritically to a range of other situations. This sometimes results in the articulation of extreme or confused views.

Primary school students' perceptions of environmental sustainability and their proposed actions also vary according to their individual worldviews. These worldviews are not fixed, or they are "unstable", and vary according to the context of the environmental issue. They may fluctuate along a continuum from egocentric to homocentric to biocentric to ecocentric according to the context of the environmental issue being considered. The worldview that is prominent among primary school students is a homocentric one in which "responsible planetary management" is advocated to satisfy environmental sustainability in support of the continuation of human life on Earth.

Primary school students have limited understanding of the complex areas of economic growth and development, cultural differences and social issues such as poverty and social inequality. As a result they will sometimes tend to focus on one specific economic, cultural or social understanding, and apply this uncritically to a range of other situations. This also sometimes results in the articulation of extreme or confused views.

Because environmental actions (or proposed actions) are an outcome of core understandings related to environmental sustainability they cannot be separated from an individual's personal views. Primary school students' actions are influenced by strongly held ethical principles of sharing fairly or not being greedy; maintaining a balance in the consumption of natural resources to meet different demands; being involved in local environmental action; and conserving natural resources and where possible managing those resources responsibly so that they remain sustainable. Primary school students relate best to local environmental issues where the factors involved are more easily identifiable. When they attempt to express views about global environmental issues they seek to simplify very complex issues and their resulting views may appear simplistic and difficult to justify.

Primary school students' actions are also influenced by environmental information mainly from their schools, their homes, the literature that they read, and the media.

As the media has a tendency to sensationalise environmental issues it is not surprising that students sometimes express extreme or confused views.

The students in the study mainly expressed a homocentric view (and on some occasions an egocentric view) on environmental sustainability. That is for them, a sustainable future for humans is the most important thing and it is dependent on the complex sustainability of all ecosystems.

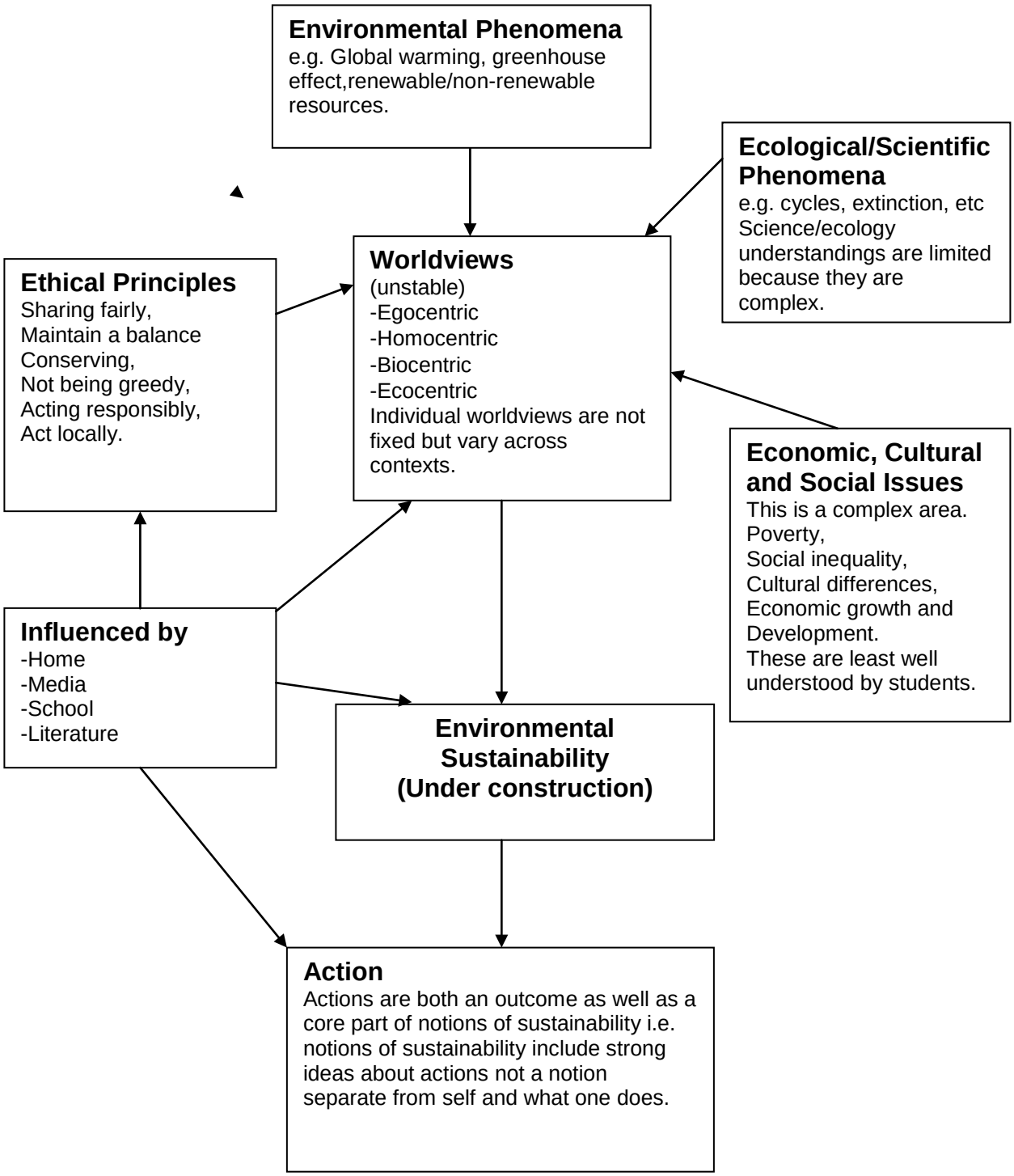


Figure 6.1: An Emerging Framework of Primary School Students' Notions of Environmental Sustainability (as derived from the study).

6.3 Implications for Sustainability Curricula

This study provides a view of students' perceptions of environmental sustainability developed by students in their final years of primary education. These are the perceptions that many students will take into post primary education and adult life. They provide the basic knowledge, understandings, skills, attitudes, values and behaviours that prepare them for life in a world of changing environments.

Walker and Brady (2002) reported that the production of curriculum documents, policy statements and resource material were not consistently based on the environmental understandings of students. A better understanding of students' perceptions of environmental sustainability would support improved teaching and learning in environmental education. This study makes a contribution in providing an insight into primary school students' perceptions of environmental sustainability which is essential if policy formation and curriculum development for sustainability education are to be better informed.

One model for sustainability education can be developed using the eight values for a curriculum focus for environmental education that were proposed by Fien (1997). These were shown in Figure 2.2 and are reproduced as follows as Figure 6.2: Figure 6.3 is informed by these values and provides a possible model for future directions for sustainability education K-6 and K-12.

'People and Nature' **Ecological Sustainability**	**'People and People'** **Social Justice**
Ecological sustainability	Human needs
Biodiversity	Intergenerational equity
Ecological impact of humans	Human rights
Interspecies equity	Responsibility and empowerment

Figure 6.2: Eight values as a curriculum focus for environmental education (Derived from Fien, 1997).

The model that follows expands on the previous figure and acknowledges the need for teaching-learning experiences to have a significant practical or "hands-on" component in all areas. It also indicates those areas that appear to be least evident in the student data and those areas where there appears to be a deficit as indicated by the student data. Significantly it is in the area of social and cultural understandings that there appears to be a deficit in the understanding of education for environmental sustainability.

The model may be shown using the following figure in which the left-hand column restates the eight values that Fien (1997) provided as a curriculum focus for environmental education while the central column states examples of curriculum content and the right-hand column assesses the extent to which this content appears to be evident in the data derived from the study.

'People and Nature' Ecological Sustainability	**Examples of Content Emphasis**	**Extent to which evident in the student data**
Ecological sustainability	Scientific phenomena, ecology, global warming and climate change.	Apparent. Discussed by many students.
Biodiversity	Biological phenomena, Interspecies relationships, food chains and food webs.	Apparent. Discussed by many students.
Ecological impact of humans	Worldviews, environmental problems and action-based solutions, proximate and ultimate cause(s) and effect(s)	Mainly limited to understanding environmental problems but not their possible solutions.
Interspecies equity	Equity issues and solutions, nature conservation, endangered species and species extinction.	Mainly limited to understanding threatened species but inadequately addressing the causes that threaten them.
'People and People' Social Justice	**Examples of Content Emphasis**	**Extent to which evident in the student data**
Human needs	The physical, social, cultural and economic requirements of humans.	Evident but mainly limited to explaining physical needs related to quality of environment.
Intergenerational equity	Sustainability and safeguarding the natural environment for future generations.	Evident but sometimes limited to students' own generation.
Human rights	Worldviews, social justice (human rights, gender, race and social equity).	Little evidence. When addressed not necessarily related to the environment.
Responsibility and empowerment	The individual and group action needed to address environmental problems and to maintain environmental sustainability.	Have a sense of responsibility. Actions suggested related to specific environmental context.

Figure 6.3: The eight values as a curriculum focus for environmental education (derived from Fien, 1997 and shown in the left-hand column); examples of curriculum content (shown in the central column); and, the extent to which this content appears to be evident in the data from the study (shown in the right-hand column).

The findings of this study suggest that a review of policy and curricula relating to sustainability education should consider the following:

1. **Promoting the links between primary schools and secondary schools in relation to sustainability education**

Existing research (Phipps, 1991; Spork, 1992; Walker, 1995; Walker, 1997) and anecdotal evidence (Smith, 2006) indicates that the most significant work in sustainability education in NSW is being done at the primary school level. It is essential that sustainability education is effectively implemented over a K-12 continuum. This will require a review of curricula relating to sustainability education K-6 and K-12 and given that primary schools appear to have been more effective in implementing sustainability education, addressing the action-based component in partnership with secondary schools may be a strategy that has merit.

The data from this study suggests that sustainability education is relevant for primary school students and it follows that that educators have a responsibility to see that this is nurtured over a K-12 continuum.

2. **Emphasis and commitment to sustainability education**

Currently environmental education is viewed as a cross-curriculum perspective with particular relevance to “Human Society and Its Environment” (HSIE) and “Science and Technology”. In order to achieve greater effectiveness in the teaching of Environmental Education and Environmental Studies, Sustainability Education

needs to become the curriculum focus with “Human Society and Its Environment” (HSIE) and “Science and Technology” as sub-strands of this.

Given that global warming may be the greatest challenge confronting our planet (Schultz, 2006); that extreme weather events and battles over resources highlight the urgent need to find sustainable solutions; and that climate change issues are the result of an ever-increasing world population and its ever-increasing need to consume natural resources (Sayle, 2006); it is important that our students become aware of these challenges and their causes so that they can make informed choices in the development of practices that support environmental sustainability. Sustainability education at all levels has a responsibility to foster this and it may be more likely to be achieved if HSIE and “Science and Technology” become tools for teaching about environmental sustainability.

The new national curriculum documents do not appear to do this with Wooltorton et al. (2010) recently commenting that:

> *It is disappointing to see sustainability (education) is marginalized in the new national curriculum, rather than being the organising logic as it should be……The Australian curriculum should be framed with preferable futures in mind, knowing that a simple projection of present trends such as rising carbon emissions, biodiversity loss and human inequity is not what Australians want for their children. And yet this is the future we will get, unless the curriculum is organised using a different logic to the one reflected in the national curriculum documents. The new curriculum is based upon a business-as-usual logic with the same implicit assumptions that have caused the local and global socio-environmental problems* (p. 25).

The data from this study confirms that sustainability education is relevant for primary school students and it follows that sustainability education would be a logical basis on which to organise teaching related to science, the environment, and studies of socio-cultural phenomena.

3. Action-based sustainability education and its student focus

"The Environmental Education Policy for Schools" (NSW, DET, 2001a), and its support document "Implementing the Environmental Education Policy in your school" (NSW, DET, 2001b) focuses on three areas: the curriculum, the management of school resources, and the management of school grounds (NSW, DET, 2001a). Currently NSW primary school students monitor the school's consumption of resources (e.g. electricity and water) and have an "action-based" role in managing the school grounds. This is done on the assumption that the action-based involvement of students will promote care and concern for environmental sustainability. While students are involved in the strategies that seek to do this, Wickman and Ostman (2002), reported that the strategies that are used are more often those initiated independently by the school principals, executive school staff and teachers. Many of the environmental projects undertaken in schools are actually teacher inspired projects. These projects are focused on the symptoms of an environmental problem rather than finding the cause. Wickman and Ostman (2002) commented that when students clean up litter, for example, they become passive beings with little opportunity for independent thinking. It

follows that there is a need for students to have a greater role in initiating and taking ownership of school action-based strategies.

This study indicates that the students related best to local environmental situations and were able to suggest local solutions to address local environmental problems that were within their comprehension. This finding concurs with that of Stokes (2009) and suggests that educators need to maintain the focus at the primary school level on local and school action-based strategies rather than introducing young children to broader global environmental issues where the causes and the solutions are more complex. However, there are both risks and benefits that flow should this be done. The benefits are that the children would be better informed about local sustainability issues. The risks are the perpetuation of a view of environmental sustainability that emphasises local over global, proximate over ultimate causes, and simple over complex.

4. The curriculum for sustainability education and socio-cultural issues

All the eight values identified by Fien (1997) as providing a curriculum focus for environmental education need to receive equal status. These were described earlier and are represented in Figures 6.2 and 6.3. There needs to be the awareness among educators that the economic, social and cultural issues in sustainability education need a major re-conceptualization if they are to be adequately addressed. This concern was expressed by Lundegard and Wickman

(2007) when they commented that there was a need to link sustainability education to the underlying interpersonal human issues that could be understood best as human conflicts of interests. This concern remains and is supported by the findings of this study. It is the study of these conflicts of interests that could then be the initial focus for effective sustainability education. These comprise the socio-cultural factors that need to be understood in the model of sustainability education shown in Figure 6.3.

5. Action competence and sustainability education

Teaching about sustainability should not only be analysed in terms of how it reproduces existing social practices, but also in terms of its potential to nurture moral courage and constructive opposition. This is the “action competence” and a conflict of interest perspective advocated by Morgensen (1996), Breiting (1994) and Schnack (1996, 1998) in Chapter 2. This action competence approach provides students with insight into the social, cultural and economic issues and conflicts of interests that underlie environmental sustainability. The approach implies a desire to solve the problem by taking action to achieve change (Wickman & Ostman, 2002).

For students to acquire action competence they need to be aware of the controversy and conflicts of interest that underlie environmental problems. Questions of environment and sustainable development are not about relations between humans and nature, but rather about the conflicts of interest between

(and within) human beings (Schnack, 1998). Scott and Gough (2003) suggest identifying a set of tensions and paradoxes relating to environmental initiatives such at the juxtaposition of: change versus continuity; empowerment versus prescription; “me” versus “we”; present versus future generations; human versus nature; local versus global; and, rich versus poor and very poor. Students need to be involved in informed and democratic discussion about environmental problems so that a range of different arguments are expressed, agreement and disagreement are encouraged, and conflicts of interests are understood so that the result is student awareness and empowerment (Benhabib, 1992). The data from this study suggest that this is particularly relevant for primary school students in their exploration of local issues relating to environmental sustainability.

6. Socio-cultural issues and sustainability education

While sustainability education programs have a focus on teaching about scientific, ecological and environmental phenomena, students will remain largely unaware of the complex social, cultural and economic issues involved in environmental sustainability. As a result their understanding of such issues as global warming and climate change will lack the human socio-cultural dimension. The complex issues of global warming and climate change and the related issue of a rapid and exponential increase in the Earth’s human population, have their origin in this dimension. More people make greater demands on the Earth’s natural renewable and non-renewable resources. While these issues featured prominently in students’ comments and discussions there appeared to be a limited understanding of the complex human socio-cultural causes involved. As many students are

already aware of such issues as global warming and climate change, the means of initiating this may be to refer to these issues as “human-induced global warming and climate change issues”. By emphasising the socio-cultural dimension, the focus on sustainability issues is linked more closely to their ultimate causes.

7. Interrogating the facts relating to global warming and climate change

When the student data were collected in 2007, the media trend was to sensationalise the reporting of global warming and climate change as matters of established certainty and this was reflected in the comments of the students in the study. It was also a time during which global warming and climate change did not assume a high significance for the incumbent Federal Liberal government. With the change of this government at the end of 2007 the debate among scientists as to whether or not global warming and climate change were occurring became more prominent. Teachers of sustainability education need to be aware that arguments supporting human-induced global warming and climate change and the contrary arguments that these phenomena are part of natural planetary cycles are subject to a continuing debate in which the scientific basis of global warming and climate change are not yet settled. Teachers need to maintain a “healthy scepticism” and interrogate the facts, and to encourage their students to do likewise. It is important to remember that the debate is a continuing one and that education has a responsibility to equip children to consider alternative views from sources with different vested interests in a highly charged political debate. Understanding even limited key elements of the science is important but knowing

the science alone is insufficient to arm young people and future generations to engage with contentious issues in a modern democracy.

8. Homocentric and ecocentric worldviews and sustainability education

The data from this study suggest that environmental education and sustainability education appear to be underpinned by different worldviews. Sustainability education at the primary school level appears to mainly involve a homocentric view. Maintaining sustainability of the natural environment is essential for maintaining a certain level of human lifestyle and young children are able to relate to this. Much teaching in environmental education appears to have an ecocentric view and primary school children appear to not as easily relate to this broader view. There may also be a generational difference with environmental education curriculum writers using an ecocentric focus which may be at odds with the predominant local and homocentric focus of the young children for whom they are writing. While both views are not synonymous or interchangeable, the consideration of both are necessary in meeting the needs of young children.

This study has investigated senior primary school students' perceptions of environmental sustainability and analysed the data gathered with reference to the existing literature. The students in the study most frequently express notions of sustainability that are underpinned by homocentric views; proximate cause and effect scenarios; and, proposed actions based on sharing natural resources fairly

while maintaining the environmental balance and behaving responsibly. The actions of young children are guided by strongly held ethical principles such as sharing fairly, not being greedy, and being responsible. These ethical principles impact on the notions of environmental sustainability that they hold and express influencing their views on social justice and environmental stewardship. This is expressed in their desire to maintain a balance in the consumption of natural resources to meet different demands; to be involved in local environmental action; and to conserve natural resources and where possible to manage those resources responsibly so that they remain sustainable so that human lifestyles can be maintained in perpetuity.

Appendices.

Appendix 1: Stimulus Material Scenario 1.

Appendix 2: Stimulus Material Scenario 2.

Appendix 3: Stimulus Material Scenario 3.

Welling, K. (2005). *Retreat Listing a Rarity*, in The Manly Daily, Saturday 15 October, 2005, p. 28.

Manly Daily Sat 15OCT05

Retreat listing a rarity

REVOLVING DOORS

KATHRYN WELLING
PROPERTY EDITOR

❑ JOHN Alldritt is something of a legend on the western foreshores.

His family have owned property in Coasters Retreat since the land was first divided up in 1926 and he is the last commerical fisherman still earning a living from the fish in Pittwater.

At least he was earning a living until about 18 months ago when fish supplies became seriously depleted.

"I could predict what I would catch each night years ago, and would pull in between 35 and 400 boxes, now I would be lucky to catch enough to cover my fuel costs," he said.

The 60-year-old fisherman has been fishing in Pittwater for 37 years and is reluctant to sell up his idyllic home on waterfront reserve that was built by his grandfather.

"If the fish numbers were the same as they were two years ago I wouldn't be selling the house," he said.

But with his livelihood decimated and all the other professional fisherman surrendering their licences to the government John is philosophical and knows it is the end of an era.

His home at lot 6 Coasters Retreat is on 1100sq m of land in the tightly-held western foreshore retreat. There are two fibro cottages on the block and while they are old they have been well-loved and are in good order.

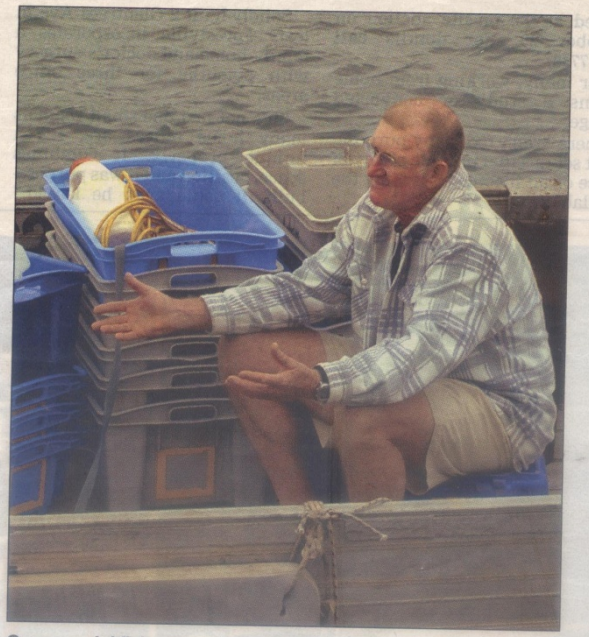
John lives in the second cottage which has a bedroom and a study, a bathroom, a living room, a kitchen and an outdoor deck. The first cottage has two bedrooms, a living room, bathroom, and a full-length deck. Both are incredibly quiet and tranquil and 10m from the water's edge.

Ross Ewington, of L.J.Hooker Mona Vale, said the 50-odd homes in Coasters Retreat very rarely changed hands and if they did they did so quietly by word of mouth often passing from one friend to another.

"Lot 8 sold two years ago for $1.3 million at the peak of the market," he said.

John's two cottages could suit two families wanting a weekend escape or they could make way for a more substantial family home. About eight families permanently live at Coasters Retreat, near The Basin, but most homes are kept as holiday pads.

The Alldritt property is on the market for between $1 million and $1.1 million. It is 10 minutes by boat from Palm Beach and Coasters Retreat is a picturesque bay with sandy beaches, waterfall and wooded hills – one of the most sought-after on the western foreshores. Phone Ross for details on 9979 8000.



Commercial fisherman John Alldritt is selling his property because he says there are not enough fish in Pittwater.

The view from John Alldritt's Coasters Retreat home (above) and inside (below).

Appendix 4: Open-Ended Questionnaire used for all three stimuli material scenarios.

QUESTIONNAIRE

Code: _____ Class: _____Date: _____

What are the local environmental issues?

What are the related global environmental issues?

What local action could you take to limit the impact of these global environmental issues?

What natural resource(s) is being used?

_____

How much of this resource should people use? Give reasons for your answer.

From where do you find out about environmental issues?

Appendix 5: Parental Consent Form.

Faculty of Education
City campus Broadway
PO Box 123
Broadway NSW 2007 Australia
Tel +61 2 9514 3900
Fax +61 2 9514 3939
Kuring-gai campus
PO Box 222
Lindfield NSW 2070 Australia
Tel +61 2 9514 5621
Fax +61 2 9514 5556
www.education.uts.edu.au/
UTS CRICOS Provider Code 00099F

University of Technology, Sydney

UNIVERSITY OF TECHNOLOGY, SYDNEY
PARENTAL CONSENT FORM **14MAR07**

I_____(parent/guardian's name) agree to my child's participation in the research project *Investigating students' perceptions of environmental sustainability* being conducted by doctoral student Graham Weeks of the University of Technology, Sydney. I agree to the publication of the research project's findings providing that my child's participation is not identifiable.

I understand that my child's participation in this research will involve discussion and responding in writing to different environmental scenarios on three separate occasions that will each last no longer than 40 minutes. My child may also be asked to be part of a focus group discussion that will aim to clarify children's written responses where necessary. I am aware that these focus groups may be digitally voice recorded but that these recordings will only be used to maintain the accuracy of notes. The recordings and all other data will be stored in a secure filing cabinet for five years after which they will be erased.

I am aware that I can contact Graham Weeks at xxxxxxxxxx Public School, phone xxxxxxxxxx or Associate Professor Aubusson, Room K.2.428, Kuring-gai Campus, UTS, phone: (02) 9514 5264 if I have any concerns about the research. I also understand that I am free to withdraw my child's participation from this research project at any time I wish and without giving reason. Such withdrawal will not affect my child's academic progress and they will still be able to participate in relevant tasks without being part of any project data collection.

I have discussed this letter with my child and my child is willing to participate in the research.

_____ ___/___/___

Signed by Parent/Guardian

_____ ___/___/___

Signed by Child

Appendix 6: Teacher's Consent Form.

Faculty of Education

City campus Broadway
PO Box 123
Broadway NSW 2007 Australia
Tel +61 2 9514 3900
Fax +61 2 9514 3939

Kuring-gai campus
PO Box 222
Lindfield NSW 2070 Australia
Tel +61 2 9514 5621
Fax +61 2 9514 5556

www.education.uts.edu.au/

UTS CRICOS Provider Code 00099F

University of Technology, Sydney

UNIVERSITY OF TECHNOLOGY, SYDNEY
TEACHER'S CONSENT FORM **14MAR07**

I_____(teacher's name) agree to participate in the research project *Investigating students' perceptions of environmental sustainability* being conducted by doctoral student Graham Weeks of the University of Technology, Sydney. I agree to the publication of the research project's findings providing that my participation is not identifiable.

I understand that my participation in this research may involve discussion and responding in writing to different environmental scenarios on three separate occasions that will each last no longer than 40 minutes.

I may also be interviewed and that these interviews may be digitally voice recorded but that these recordings will only be used to maintain the accuracy of notes. All data and recordings will be stored in a secure filing cabinet for five years after which they will be erased.

I am aware that I can contact Graham Weeks at xxxxxxxxxx Public School, phone xxxxxxxxxx or Associate Professor Aubusson, Room K.2.428, Kuring-gai Campus, UTS, phone: (02) 9514 5264 if I have any concerns about the research. I also understand that I am free to withdraw my participation from this research project at any time I wish and without giving reason.

.

_____ ___/___/___

Signed by Teacher

Attachment 7: UTS Human Research Ethics Committee Approval.

PO Box 123
Broadway NSW 2007
Australia
Tel. +61 2 9514 2000
Fax +61 2 9514 1551
www.uts.edu.au

University of Technology, Sydney

17 August 2006

Associate Professor Peter Aubusson
KG02.04.28
Faulty of Education
UNIVERSITY OF TECHNOLOGY, SYDNEY

Dear Peter

UTS HREC REF NO 2006-195 – AUBUSSON, Associate Professor Peter, BUCHANAN, Dr John (for WEEKS, Mr Graham EdD student) - "NSW primary school students and their perceptions of environmental sustainability"

Thank you for your response to my email dated 18 July 2006. Your response satisfactorily addresses the concerns and questions raised by the Committee, and I am pleased to inform you that ethics clearance is now granted.

Your clearance number is UTS HREC REF NO. 2006-195A

Please note that the ethical conduct of research is an on-going process. The *National Statement on Ethical Conduct in Research Involving Humans* requires us to obtain a report about the progress of the research, and in particular about any changes to the research which may have ethical implications. This report form must be completed at least annually, and at the end of the project (if it takes more than a year). The Ethics Secretariat will contact you when it is time to complete your first report.

I also refer you to the AVCC guidelines relating to the storage of data, which require that data be kept for a minimum of 5 years after publication of research. However, in NSW, longer retention requirements are required for research on human subjects with potential long-term effects, research with long-term environmental effects, or research considered of national or international significance, importance, or controversy. If the data from this research project falls into one of these categories, contact University Records for advice on long-term retention.

If you have any queries about your ethics clearance, or require any amendments to your research in the future, please do not hesitate to contact the Ethics Secretariat at the Research and Innovation Office, on 02 9514 9615.

Yours sincerely,

Professor Jane Stein-Parbury
Chairperson
UTS Human Research Ethics Committee

Production Note:
Signature removed prior to publication.

Attachment 8: Department of Education and Training Approval.

PLANNING AND INNOVATION

NEW SOUTH WALES
DEPARTMENT
OF EDUCATION
AND TRAINING

Early Childhood and Primary Education
Secondary Education
Technical and Further Education
Vocational Education and Training
Higher Education
Adult and Community Education

Graham Weeks
74 McCarrs Creek Road
CHURCH POINT NSW 2105

Dear Mr Weeks

SERAP Number: **06.363**

I refer to your application to conduct a research project in NSW government schools entitled *NSW Primary School Students and their perceptions of environmental sustainabilty*. I am pleased to inform you that your application has been approved. You may now contact the Principals of the nominated schools to seek their participation.

This approval will remain valid until 9 August 2007.

This approval covers the following researchers and research assistants entering schools for the purposes of this research:

Name	Approval Expires
Graham Weeks	24 August 2007

You should include a copy of this letter with the documents you send to schools.

I draw your attention to the following requirements for all researchers in NSW government schools:

- School Principals have the right to withdraw the school from the study at any time. The approval of the Principal for the specific method of gathering information for the school must also be sought.
- The privacy of the school and the students is to be protected.
- The participation of teachers and students must be voluntary and must be at the school's convenience.
- Any proposal to publish the outcomes of the study should be discussed with the Research Approvals Officer before publication proceeds.

When your study is completed please forward your report marked to General Manager, Planning and Innovation, Department of Education and Training, GPO Box 33, Sydney, NSW 2001.

Yours sincerely

Production Note:
Signature removed prior to publication.

Dr Christine Ewan
General Manager, Planning and Innovation
27 November 06

• Level 6, 35 Bridge Street • GPO Box 33 • Sydney NSW 2001 Australia •
• *telephone* 02 61 2 9561 8744 • *facsimile* 02 61 2 9561 8941 • www.det.nsw.edu.au •

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