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Education for sustainability: An ethnographic study of 15 year-2/3 rural Western Australian children's attitudes on sustainability

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**EDUCATION FOR SUSTAINABILITY: AN
ETHNOGRAPHIC STUDY OF 15 YEAR-2/3 RURAL
WESTERN AUSTRALIAN CHILDREN'S ATTITUDES ON
SUSTAINABILITY**

By

Cara Payne
Bachelor of Education (Primary)

**This thesis is presented in fulfilment of the requirements for the degree of
Master of Education by Research**

**Faculty of Education and Arts
Edith Cowan University**

2014

Dedication

This thesis is dedicated to the children who I have taught and to my own. You are a constant source of inspiration.

Abstract

The study occurred in rural Western Australia in 2011, during UNESCO's *Decade of Education for Sustainability Development*, when sustainability became one of three cross-curriculum priorities of the Australian Curriculum. The study involved the development and implementation of a sustainability focused science program embedded in a class of 15 Year-2/3 primary participants. The study emphasised a qualitative approach, but also included embedded quantitative data analysis. The aim of the science program focussed on the enhancement of the children's attitudes towards sustainability, to equip them with the skills needed to change their behaviours in relation to practicing the principles of sustainability. The children's attitudes towards sustainability were assessed before and after engaging in the program. A range of observation techniques identified changes in attitudes and behaviours, including children's work samples, teacher reflections, interviews and vignettes constructed from the synthesis of this data. In addition, both pre and post program questionnaires were administered to further assess attitudinal changes. The research offers an insight into children's attitudes to sustainability, as well as junior primary science learning and teaching practices that encourage decision making for sustainable development.

The declaration page
is not included in this version of the thesis

Acknowledgments

I would sincerely like to thank my principal supervisor Dr Geoffrey W. Lummis and associate supervisor Associate Professor Karen Murcia for their inspiration, wisdom, advice, support, encouragement, guidance, knowledgeable input and precious time. You guided me through the 'unknown' and have helped me to achieve something very special. It is extremely appreciated.

I would also like to thank my family: my husband, Kasey Hasleby; my parents, Micheal and Erica Payne; and my parent in-laws, John and Maree Hasleby, for supporting me throughout the pursuit of this study. You have continually encouraged me to further my education and to work hard to achieve my goals. I truly value the love and support you have given. Thanks!

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Preface

The Purpose of the Research

The purpose of this 2011 study was to identify 15 Year-2/3 children's attitudes to sustainability, over the duration of a science program focused on environmental sustainability. The research was conducted in a small rural community inclusive of many Aboriginal families, investigated the implementation of a sustainability science-program and its influence on children's attitudes and behaviours to sustainability issues.

Research Development

The 2011 research process is highlighted in the research timeline in Appendix A.

The thesis is divided into six chapters. These are as follows:

Chapter One: Introduction

Chapter Two: Literature review

Chapter Three: Methodology

Chapter Four: Findings

Chapter Five: Discussion

Chapter Six: Conclusion

Features

In the thesis, the Department of Education of Western Australia (DoE WA) is also referred to as The Department of Education and Training of Western Australia (DETWA). This was DoE WA official title prior to 2009.

Pages xi- xii contains a glossary for this thesis. This thesis contains 266 pages and 88, 794 words. Chapters 1-6 consist of 206 pages and contain 74, 049 words. The remaining 60 pages consist of supporting documents and contain 12, 709 words.

Cara Payne

Glossary

Attitude: “An attitude is an evaluation of an object of thought. Attitude objects comprise anything a person may hold in mind, ranging from the mundane to the abstract, including things, people, groups and ideas” (Bohner & Dickel, 2011, p. 392).

Australian Curriculum: The new educational curriculum for all Australian students. It is currently being released in a series of stages and is not yet in full implementation. “The F-10 Australian Curriculum sets out the core knowledge, understanding, skills and general capabilities important for all Australian students” (ACARA, n.d., para 2).

Biodiversity: “Biological diversity, or biodiversity, is manifested at all levels of organization (genes, species, ecosystems and landscapes) and is seen in all forms of life, habitats and ecosystems (tropical forests, oceans and seas, savannah ecosystems, wetlands, dry lands, mountains, etc.)”. (UNESCO, 1995-2012, para 1)

Curriculum Council Western Australia: The School Curriculum and Standards Authority (established 1st March, 2012) replaced the Curriculum Council of Western Australia.

Environmental sustainability: “Environmental sustainability involves making decisions and taking action that are in the interests of protecting the natural world, with particular emphasis on preserving the capability of the environment to support human life” (NSW Government Trade and Investment, n.d., para 1).

Education for sustainability/ learning for sustainability: “Education for Sustainability (also known as Education for Sustainable Development) is an internationally recognised educational approach that moves beyond just imparting knowledge about the environment – educating *about* sustainability – to building people’s capacity for transformational change – educating *for* sustainability. It focuses on motivating and engaging people to help create a better future” (ARIES, 2004-2012, para. 1).

Mixed methods: A mixed methods research approach “focuses on collecting, analysing, and mixing both qualitative and quantitative data in a single study or series of studies. Its central premise is that the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone” (Creswell, 2006, p. 5)

Social constructivist theory: Researchers Fler and Robbins (2006), Skamp (1998) and Bell (1993) expand upon the work of Lev Vygotsky emphasising the use of social interaction strategies, such as group work, support constructivist learning. Constructivist theory relates to learning that involves the learner actively generating their own knowledge by linking their prior knowledge to new experiences. This approach is central to the Australian Academy of Science’s resource *PrimaryConnections*.

Stimulus images: A series of pictures consisting of photographs, cartoons and digital images. These images were used in the sustainability science-program to encourage children to discuss and reflect on particular sustainability issues to which they related.

Sustainability: UNESCO (1995-2010, para. 1) defines sustainability as “seeking to meet the needs of the present without compromising those of future generations”.

Sustainability science-program: The science *sustainability*-program that was developed specifically for use in this study. It is based on the Schoolyard safari program from The Australian Academy of Science (2012) resource, *PrimaryConnections*.

List of Acronyms

AaTSI:	Aboriginal and Torres Strait Islander
ACARA	Australian Curriculum and Assessment Reporting Authority
AC: Science	Australian Curriculum: Science
ARIES	Australia Research Institute in Education for Sustainability
AuSSI	Australian Sustainable Schools Initiative
BSCS	Biological Science Curriculum Study
CASS	Children's Attitudes to Sustainability Survey
CCPT	Child-Centred Played Therapy
CIRRA	Child Interpersonal Relationship and Attitudes Assessment (Holliman & Ray, 2013)
DEH	Department of Environment and Heritage
DESD	Decade of Education for Sustainable Development
DoE WA	Department of Education Western Australia
DSEWPac	Department of Sustainability, Environment, Water, Populations and Communities
NAPLAN	National Assessment Program- Literacy and Numeracy
UNESCO	United Nations Educational Scientific and Cultural Organisation
WA CF	Western Australian Curriculum Framework
ZPD	Zone of Proximal Development

Chapter One

Introduction

The Research Rationale and Context

The research (2011) coincides with the United Nations Education, Scientific and Cultural Organization's (UNESCO) Decade of Education for Sustainability Development (2005-2014). UNESCO (1995-2010) explains:

Education for Sustainable Development means including key sustainable development issues into teaching and learning ... [requiring] participatory teaching and learning methods that motivate and empower learners to change their behaviour and take action for sustainable development. [It] ... promotes ... imagining future scenarios and making decisions in a collaborative way. (para. 1)

Junior primary school teachers are an essential part of the transformation to a sustainably aware society, because they have the capacity to assist younger children's understandings and attitudes that position sustainability as part of interconnected systems taught in both primary Science, as well as the Humanities and Social Sciences.

Sustainable development, in all of its aspects, is identified as an important element in the development of countries worldwide. The Australian Learning and Teaching Council (2010) highlight this when they state: "Sustainability ... will be a key driver in shaping how we live and work in the 21st century" (para. 1). UNESCO (1995- 2012a) recognised the significant role that education plays in working towards sustainable development and have made it a priority: "Education for Sustainable Development allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future" (para. 1).

The Australian Research Institute for Environment and Sustainability (ARIES, 2009) suggests that traditional teaching methods should be changed to promote learning for sustainability. The Learning for Sustainability Approach developed by ARIES has similarities to the educational framework developed by the federal and state governments as a part of the Australian Sustainable Schools Initiative (AuSSI). Both programs involve action learning and the development of skills necessary for children to reflect and make evidence based, responsible decisions about the way they live.

The Study

The ethnographic study was embedded in the teacher/researcher government primary class of 15 participants in a Year-2/3 group situated in rural Western Australia (Oceanside Clearwater Creek). The ages of the children ranged from seven to eight years. At the time of the study the researcher had lived and taught in the community for seven years, and had established an appreciation of the people in the community, their backgrounds and attitudes. Therefore, the researcher/teacher anticipated that the 15 children would come from varied backgrounds with a potential range of attitudes and behaviours towards sustainability.

The study was initiated by the teacher/researcher's professional reflection to identify the Year-2/3 children's attitudes towards a range of sustainability concepts through participation in a sustainability science-program. Whilst the study was centred in qualitative methodology it allowed for "the collection of more comprehensive evidence" (Creswell, 2006, p. 18) through the use of mixed methods of data collection. The research included the collecting and analysing children's work samples, children's science journal reflections, informal interviews, formal interviews, vignettes, teacher anecdotal notes, teacher observations and other reflections. In addition, children's responses were secured using a Likert survey questionnaire.

Ethnographic mixed methods approach

Spratt, Walker and Robinson (2004) explain that: "Using multiple approaches can capitalise on the strengths of each approach and offset their different weaknesses. It could also provide more comprehensive answers to research questions, going beyond the limitations of a single approach" (p. 6). Creswell (2006) says that a combination of qualitative and quantitative data sources, "provides a better understanding of research problems" (p. 5). It is for this reason that a mixed methods approach centred in the qualitative was used in this study. In addition, the research is bound by a particular context and time (i.e., Year-2/3 children in a particular rural setting).

A qualitative approach was applied where teacher observations and children's work samples were used to collect qualitative data related to attitude and behavioural change. Children were also involved in interviews after the implementation of the sustainability science-program and informally throughout the program. These methods assessed their attitudes and ascertained if attitude changes lead to changes in behaviours. An embedded quantitative approach was engaged to support the qualitative data, and consisted of pre and post program survey questionnaire to further assess the

Year-2/3 children's attitudes to sustainability, as well as adding to the process of triangulated data. The triangulated data sources were used to determine any shifts in children's attitudes to sustainability during their experience of the sustainability science-program. Other potential influencing variables on attitudes to sustainability occurred in and around the children's lives and were documented in order to place the findings of the study into the broader social context.

The Oceanside Clearwater Creek Community

It has been recognised that mixed method research is not easy (Creswell, 2006) and that it "requires clear presentation" (Creswell, p. 10) of the research in order for the reader to fully understand the different methods used. It is therefore important to provide background information regarding the context of the community involved in the study. The following narrative provides an insight into the Oceanside Clearwater Creek community. Throughout the following description of the community, pseudonyms are used to protect the anonymity of people. Some references are not included in the end-text referencing section, because the titles would identify the Western Australian community.

The Year-2/3 children live in a small coastal country town that, at the 2006 census, had a population of approximately 800 people according to the Australian Bureau of Statistics (2008a) (ABS). The town is located near a large regional centre. The population of the whole shire is circa 3000 people (ABS, 2008a). Families have traditionally come from farming or fishing backgrounds, with some government employment positions; for example, police, education, shire and health. These occupations have changed over the years to include fewer farming and fishing, some farm related businesses and mining. However, farming and farm related industries still provide employment for many families in and around the town.

The information from the 2006 census showed that the sheep, beef cattle and grain farming industry provides one fifth of the employment in the shire (ABS, 2008a). It also showed that agriculture and fishing support services provided employment for one in 20 people living in the town (ABS, 2008, Industry Employment section). Several families from the town and the shire commute daily to the larger regional centre for work. There have also been many retirees move to the area. The 2006 census data showed the town itself to have over a third of the population over 55 years.

Farming families traditionally made large contributions to the community, particularly by being actively involved in sporting clubs within the town, which includes the teacher/researcher's own subjectivity. They also hold many prominent positions, for example: Justices of the Peace and Shire Councillors. The generation consisting of circa 50-60 years old contributed largely to community groups and facilities. These and other groups now find it difficult to find community support, be it in the form of committee membership, participation, as well as attendance at fundraising events. This lack of overall support is in part due to the current demands on people's time, for example, both parents in a family working to support their family. In addition, these groups from within the town who need more support often advertise their needs in the community E-newsletter (not disclosed to protect anonymity).

According to the data from the 2006 census over a tenth of the population in the town (ABS, 2008) and half that number in the shire are Aboriginal (ABS, 2008a), compared to a national average of 2.3% (ABS, 2008a), and as explained by Creswell (2006) disclosures of this type of demographic information reinforce the notion of the 'bounded' nature of the qualitative approach. There is currently some contention over who the traditional landowners are in this area. The town is located in the 'Wattle Mob' Aboriginal and Torres Strait Islander (AaTSI) area and there are family groups from the 'Acacia Mob', 'Banksia Mob' and also the 'Hakea Mob' (all pseudonyms). Some of the Acacia Mob have recently begun looking into their family history and taking a more active and assertive role in the community. This has caused some changes to education practices, for example, teaching Language Two is no longer taught at the primary school because it is considered to be inappropriate to be taught by some AaTSI people and education staff. Importantly, the study is centred in a particular community and therefore, will limit the generalizability of the data.

There has also been some research into native title in the area (Mrs Yonga, personal communication, November 15, 2010). There is a hierarchy within the AaTSI people in this community, which affects the roles that family members play. The eldest man of the Acacia Mob (who is now aged 83) is very well respected within the Acacia Mob, but also within the broader AaTSI and Non-AaTSI community. In the past there has been feuding between two AaTSI families in the town (Mrs Yonga, personal communication, November 15, 2010), which has affected school practices. The tension caused has on occasions been brought to school with the children. Although, at the point of writing this is not currently a problem, it is an issue that should be considered in the

context of the Year-2/3 children in the study. There are also many AaTSI people from various families within the community willingly engaging in school experiences and who are happy to help provide AaTSI perspectives in the children's education.

Given the varying family backgrounds, there exists a divide in the attitudes of community members towards environmental sustainability, with some people disregarding sustainability measures: for example, clearing of vegetation, fishing restrictions, littering and vandalism. There are also active groups within the community aiming to restore and improve the natural and built environments. One example of this is the clean-up and revegetation work completed by the Oceanside Environmental Group at Clearwater Creek (Mrs Waitj, 2009). These differing attitudes are apparent and are brought from the home to the school environment.

There are also differing farmers' attitudes towards sustainability. Some innovative farmers have explored alternative practices such as using naturally occurring organisms to fertilize the soil. However, it is understood that other farmers are unwilling to try these and other methods because of an uncertainty of the monetary return despite current practices damaging aspects of the environment (Mrs Waru, personal communication, November 20, 2010). An example of such traditional practices is the use of insecticide and herbicide sprays. Freedman (2011) explains that spray use can negatively affect animals and their habitat: "By changing the vegetation of treated sites, herbicide use also changes the habitat of animals such as mammals and birds" (para. 3). It can also unintentionally affect nearby vegetation: "Often there is drift of herbicide beyond the intended spray site, and, unintended offsite damages may be caused to vegetation" (Freedman, 2011, para. 3).

Although the years one through to seven teachers at the teacher/researcher's school cover some aspects of environmental education in their science learning programs, there were crucial elements to learning for sustainability that are not addressed. The problematic issues were associated with critical reflection, and the level of participation - requiring children's involvement in decision making. It has also been recognized nationally that a significant issue in primary science teaching is that there is a, "general lack of confidence of practicing primary teachers with the content and processes of science" (Kenny, 2009, p. 19). The sustainability science-program in this study is an improvement on earlier programs used by the researcher because it is based on learning for sustainability. Although children have previously learnt about the 'environment' they were not necessarily actively involved in making decisions about it

(i.e., in and for their environment). Another noticeable difference in this program and other learning programs is that it requires the children to reflect critically about their current use of the environment.

AIRES and three principles of effective practice

There are three main principles of effective practice advised by ARIES (2009), which the sustainability science-program was based. One used in this program is critical thinking and reflection. This principle; “challenges us to examine and question the underlying assumptions that shape our world, knowledge and opinions by looking beneath the symptoms of unsustainable practice” (ARIES, 2009, p. 3).

A second principle addressed in this program is that of participation. The participation level required in this sustainability science-program; “goes beyond consultation, involving people in joint analysis, planning, and control of local decisions” (ARIES, 2009, p. 3).

A third principle of effective practice applied is envisioning a better future. The sustainability science-program used in this study, “establishes a link between long-term goals and immediate actions, and motivates people to action by harnessing their deep aspirations” (ARIES, 2009, p. 3).

Furthermore, these principles underpin learning for sustainability and Western Australian Department of Education, initiatives. For example, the DoE WA (2010) claims that science teaching should provide primary children with the opportunity to, “use scientific knowledge and skills to make informed decisions and to consider the consequences and implications of these decisions in their lives” (p. 17). This further highlights the need to improve science teaching and learning in a sustainability context. By educating young children who live in the town and empowering them to make responsible environmental decisions, the community can work towards sustainability.

The Teacher/Researcher Reflective Practice

This research project is an outcome of the teacher/researcher’s teaching, specifically linked to the following reflective questions:

- Do I cater for the varying needs and abilities of all children?
- Can I improve the quality of learning opportunities provided?
- Am I motivating and empowering the children to become active learners and community members?

- Have I considered AaTSI perspectives in the programs I offer? (Given the high numbers of Aboriginal children at the teacher/researcher's school.)

This research comes from a belief that young children learn best when they are working collaboratively to achieve shared goals. Early childhood teachers need to equip children with the social skills needed to work effectively with others, and in a variety of contexts. When teachers inspire and motivate children to become active learners and to take responsibility and ownership of their learning, they can develop the skills needed to become active participants in their communities. This is particularly relevant to issues of sustainability. Teachers need to inspire and equip children with the skills needed to work towards a sustainable future.

Furthermore, young children's science learning programs should acknowledge their prior knowledge and previous related experiences. Science should include AaTSI perspectives and should cater for the needs of all children. The researcher maintains that children should learn science understandings, as well as science knowledge because whilst science knowledge is dynamic and changing over time, science understandings involve the selection and application of science knowledge and skills to new situations. This process forms the basis for new science knowledge. Children should be encouraged to ask reflective science questions and should be equipped with relevant investigative skills.

Another crucial element for the development of effective science learning programs is sharing the decision making process. Children should be given opportunities to be involved in decisions that are made regarding their learning. Younger children gain a lot of enjoyment from such opportunities, becoming more responsible and engaged in their learning. For these reasons the researcher has incorporated opportunities for the Year-2/3 children to be involved in the decision making process throughout the sustainability science-program.

This sustainability science-program is also based on the researcher's personal interest in sustainability, as well as a review of education research literature. As a researcher/teacher there exists an obligation to help children work towards living in sustainable ways, for the benefit of future generations. Living sustainably revolves around using the environment responsibly. It is therefore crucial that children, as the as our future leaders, are exposed to, and actively involved in environmental sustainability from a young age. This should be covered in schools, not only because it is a part of the

Australian Curriculum, but also because it can easily be incorporated into rich and exciting learning programs.

The program in the study was designed to provide opportunities for purposeful and meaningful learning experiences linked to the children's local community. It aimed not only to assess attitudinal and behaviour changes, but also to teach the Year-2/3 children to take responsibility and become active community members.

The Research and the Australian Curriculum

The Australian Curriculum, Assessment and Reporting Authority (ACARA) have been commissioned to introduce the Australian Curriculum. The foundation of the Australian Curriculum was established with the Melbourne Declaration (MCEETYA, 2008) and its 'Goals of Education' (MCEETYA, 2008, p. 7). Each Australian State and Territory has existing curricula and is working with a combination of their existing frameworks, as well as making progressive adjustment to include the national agenda. It is within this context that this research was designed and implemented.

Rationale

An important role of early childhood and primary education is to build a foundation capacity in society so citizens can work towards achieving sustainability. UNESCO (1995- 2010) highlights the current international need for young primary through to older secondary students to work towards sustainability:

The United Nations Decade of Education for Sustainable Development (2005-2014), for which UNESCO is the lead agency, seeks to integrate the principles, values and practices of sustainable development into all aspects of education and learning, in order to address the social, economic, cultural and environmental problems we face in the 21st century. (para. 4)

In addition, Elliott and Davis (2009) discuss the relevance of environmental sustainability in early childhood:

There is possibly no greater global concern impacting on the lives of young children – with ramifications for both present and future generations – than the state of the environment and the equitable and sustainable use of its resources. (p. 66)

Given the importance and recognition of the need for early childhood contexts to work towards sustainability, this study aimed to explore and document attitudes to sustainability and use a sustainability science-program as a tool for developing positive attitudes and behaviours. Through participation in the program in this study, the Year-

2/3 children were provided with opportunities to gain the skills needed to reflect on, and make responsible decisions about, how they use their environment. The following research questions provided a focus for the investigation.

Research questions

1. What are Year-2/3 children's attitudes to issues of environmental sustainability in a small rural town, as a consequence of a sustainability science-program?
2. How can a sustainability science-program facilitate young children's engagement with and development of positive attitudes to issues of environmental sustainability?
3. How can junior primary teachers promote environmental sustainability in schools?

Significance of the proposed research

UNESCO (1995-2010a) identifies education as a primary means of working towards sustainability: "Teaching society how to behave responsibly towards the environment lies at the core of education for sustainable development" (para. 2). Given the significance of the use of education, it follows that research into how this can effectively be done would be beneficial.

This study is supportive of the Australian Sustainable Schools Initiative (AuSSI). This initiative is expanding throughout the states and territories within Australia and is aimed at supporting schools to become sustainable. At the point of writing it was, "being implemented in each state and territory using a variety of different models and is currently operating in almost 3000 schools (30 per cent of schools nationally), in all states and territories" (Department of Sustainability, Environment, Water, Population and Communities, 2010, para. 1). Along with supporting AuSSI, it is anticipated that the study will enhance the understanding of how junior primary teachers can promote a sustainability science-program to benefit the needs of a small rural junior primary context.

Cross-curriculum Priorities

Currently ACARA (2011) are working to design and deliver a comprehensive Australian curriculum. The science area (AC: Science) was developed in 2010, and all schools are currently expected to be implementing this. An overarching feature of the Australian Curriculum documents is the inclusion of three cross-curriculum priorities: AaTSI histories, Asia and Australia's engagement with Asia, and Sustainability. "Cross-curriculum priorities are embedded in all learning areas. They will have a strong but

varying presence depending on their relevance to the learning areas” (ACARA, 2011, p. 20).

ACARA (2011) explain the significance of sustainability as a cross-curriculum priority:

Education for sustainability develops the knowledge, skills, values and [worldviews] necessary for people to act in ways that contribute to more sustainable patterns of living. It enables individuals and communities to reflect on ways of interpreting and engaging with the world. Sustainability education is futures-oriented, focusing on protecting environments and creating a more ecologically and socially just world through informed action. Actions that support more sustainable patterns of living require consideration of environmental, social, cultural and economic systems and their interdependence. (para. 3)

Sustainability relates to many learning areas, but it has strong links with the science curriculum and is central to the design of the program used in the study.

Sustainability

The sustainability science-program used in this study also incorporates the Australian Curriculum. The sustainability priority aims for “all young Australians to develop an appreciation of the need for more sustainable patterns of living, and to build the capacities for thinking and acting that are necessary to create a more sustainable future” (ACARA, 2011a, para. 5)

ACARA (2009a) have sought to integrate sustainability across the Australian Curriculum:

ACARA has engaged education experts in sustainability from across the states and territories, academia and professional associations to provide advice regarding incorporation of sustainability in the content of the Australian curriculum. (para. 2)

This has led to a science curriculum for the ‘K-3 Years’ that integrates sustainability education. It involves a list of understandings to explore, skills to demonstrate and ways that science can be viewed as human endeavour. These include:

Table 1: ACARA science curriculum K-3, science understandings, skills and human endeavour

The science understandings
comparing, sorting and classifying objects and materials pushes, pulls, position and motion of objects living and non-living things needs, structures and growth of organisms objects in the sky changes on earth and the effects on living things
The science skills
explore, be curious and wonder ask questions and begin to investigate describe what has happened make and share observations use evidence to support ideas
See science as human endeavour in everyday life
recognise aspects of science in everyday life identify work associated with science in the community care for the environment

Some of these aspects of the curriculum are clearly linked to sustainability; for example: ‘changes on earth and the effects on living things’; ‘living and non-living things’; ‘ask questions and begin to investigate’, and ‘care for the environment’. The other aspects, particularly the list of skills, are not explicitly linked to sustainability, but require integration into a program based on learning for sustainability.

ACARA (2009) also suggests five inquiry strategies that should be used in Year-K-3 classrooms. They include:

1. Exploration: Investigation of objects and things around them as a precursor to more directed inquiry in later years.
2. Observation: Using the senses to observe and gather information about the environment, looking for what is the same and what is different.
3. Order: Observing similarities and differences and comparing, sorting and classifying to create an order that is more meaningful.

4. Change: There are many changes that occur in the world. Changes occur in materials, the position of objects, and the growth cycles of plants and animals. Some of these changes are reversible, but many are not. These changes vary in their rate and their scale.
5. Questioning and speculating: Questions and ideas about the world become increasingly purposeful; explanatory ideas are developed and tested through further exploration. (p. 7)

These science inquiry strategies can be applied across the curriculum and could be adapted to align with the Learning for Sustainability Approach (ARIES, 2004-2009).

Research Design

This research used an ethnographic mixed methods approach, employing data collection tools centred in qualitative methods, whilst being supported by quantitative methods, to answer the research questions.

The first research question:

What are Year-2/3 children's attitudes to issues of environmental sustainability in a small rural town, before and after participation in a sustainability science-program?

Data were collected to answer this research question through qualitative and quantitative methods. While children participated in the sustainability science-program, teacher observations, teacher reflections, children's work samples and children's reflective journal entries were collected and analysed to identify shifts in attitudes to sustainability. After participation in the program children were interviewed to identify if any changes in attitude had lead to behavioural changes associated with sustainability. The qualitative data were supported with quantitative data where children participated in a pre- and post- program survey to further ascertain their attitudes towards sustainability.

The second research question:

How can a classroom based sustainability science-program facilitate young children's engagement with and development of positive attitudes to issues of environmental sustainability?

This question draws from the same qualitative data collected as the first. Analysing children's work samples and journal entries, teacher observations, teacher reflections and children's interview transcripts has assisted in identifying several key

teaching strategies and approaches that facilitate young children's engagement with and development of positive attitudes to issues of environmental sustainability.

The third research question:

How can junior primary teachers promote environmental sustainability in schools?

An understanding of the third question was determined through collecting and analysing data that indicated children's engagement with the sustainability science-program, as well as interpreting the impact the program had on their attitudes to sustainability. The research identified several methods by which junior primary teachers can promote environmental sustainability in primary schools.

Ethnographic mixed methods

The use of an ethnographic mixed methods approach helped to improve the reliability of this study and to gain deeper understandings of the attitudes children hold to sustainability. A mixed methods approach "focuses on collecting, analysing and mixing both quantitative and qualitative data" (Creswell, 2006, p. 5). Firstly, a survey, entitled Children's Attitudes to Sustainability Survey (CASS) (see Appendix B ii) was developed aimed at identifying young children's attitudes to issues of sustainability. This quantitative method of data collection was conducted with children before they participated in the sustainability science-program. Next, qualitative data were collected during the implementation of the sustainability science-program. This data consisted of work samples, journal entries, anecdotal observation notes, informal interviews and teacher reflections. After completion of the program, children participated in formal interviews and the survey was again conducted with children. This data was analysed and combined to assist in the comprehension of the results.

There are several advantages to using a mixed methods approach. Creswell (2006) explained that one of these is that, "the use of quantitative and qualitative approaches in combination provides a better understanding of research problems than either approach alone" (p. 5). The quantitative data in this study supported the qualitative data by providing greater detail and insight into the Year-2/3 children's attitudes to sustainability. This resulted in a richer understanding of children's attitudes and a better ability to answer research question one.

Macdonald (2001) explains that ethnographic studies can involve, "fieldwork in which participant observation is central but which may also include other approaches such as interviews and quantitative surveys" (p. 60). This ethnographic study includes

each of these elements, plus other forms of qualitative data. The teacher/researcher was fully immersed in the study, which allowed for the collection of the varied and detailed data sources. It also allowed for an in depth understanding of the children and their attitudes to sustainability.

Narrative vignettes have been used in the qualitative data analysis. Renold (2002) states that, “Vignettes are short scenarios or stories in written or pictorial form” (p. 3). The vignettes used in this study were written in the children’s voices and were constructed by piecing together different qualitative data sources, including science journal entries, children’s reflections, work samples, teacher reflections, interviews and anecdotal notes. Renold (2002) further explains, “The central feature of this method is to explore participants’ subjective belief systems” (p. 3). This study incorporated the use of vignettes to illustrate the children’s attitudes to issues of sustainability.

Data collection tools

For the purpose of this research, a survey, a formal interview, informal interviews, children’s journal entries, work samples, anecdotal notes, teacher reflections and a pre- and post- program survey were used to answer the research questions. Analyses of the interviews, children’s journal entries, work samples, anecdotal notes and teacher reflections indicated the development of attitudes and behaviours relating to environmental sustainability. The survey was designed to support qualitative data by identifying children’s attitudes to issues relating to environmental sustainability. The sustainability science-program aimed to develop positive attitudes to environmental sustainability by encouraging children to become reflective, motivated and active participants in their learning.

Finding participants

The 15 children involved in this study were from the WA rural Year-2/3class, which the researcher was teaching in 2011. Participation in this study was voluntary and permission was sought from parents/caregivers and from the children (see Appendix C). Children who chose to be involved in the study participated in the sustainability science-program (see Appendix D) and data relating to those children’s attitudes to sustainability were collected.

Coding

The researcher manually coded all survey responses, interviews, work samples and journal entries to identify common themes and issues raised by the participants. All

research participants maintained anonymity. They each received a pseudonym and no identifiable information was included in the data or in the description of the context.

Piloting of data collection tools

In order to enhance validity and reliability, the attitude survey was piloted prior to it being administered. It was piloted with children of a similar age who lived in the same local community, but who attended different schools. Several changes were made to the survey including the deletion of some items and the re-wording of others. Explicit instructions were also given to the Aboriginal Islander Education Officer (AIEO) who conducted the surveys and interviews to encourage consistency.

The sustainability science-program

Development of the sustainability science-program was informed by the rationale and guiding principles of ARIES, AuSSI, the Australian Curriculum for science and sustainability as a cross curriculum priority, the Department of Education Western Australia's Curriculum Framework (1998) and the Australian Academy of Science (2012) resource, *PrimaryConnections*. It is based largely on the Schoolyard safari program from The Australian Academy of Science (2012) resource, *PrimaryConnections*, but is adapted to suit the individual needs of the young children in this study.

Outline of the Thesis

Chapter Two: Literature Review.

Chapter Two reviews the current literature. First it outlines definitions of sustainability and the international and national context surrounding the study. Thirdly it reviews literature related to education for sustainability and the curriculum. Next it describes the constructivist and socio-cultural theoretical backgrounds that underpin the study, followed by a description of Maslow's hierarchy of needs. Next the incorporation of AaTSI perspectives is explained. A detailed explanation of attitudes is given, and attitude measurement and development are described, leading to the identification of attitudes to sustainability. Finally this chapter summarises the reviewed literature by illustrating it as a conceptual framework flow diagram.

Chapter Three: Methodology.

Chapter Three outlines the ethnographic approach in this study. It describes the research design, the children participating in the study, the development and delivery of

the sustainability science-program, phases of the research, methods of data collection, data analysis, quality criteria and relevant ethical considerations.

Chapter Four: Findings

Chapter Four describes and analyses the findings. It is organised into two parts; Part A interprets the qualitative data and is supported by Part B, which interprets the quantitative data.

Chapter Five: Discussion

Chapter Five responds to the aim of the research outlined in Chapter I. It reviews the findings and comments on the significance of these findings in relation to the literature and within each of the environmental themes: mutual responsibility, biodiversity, habitat conservation, resource use, water pollution, litter and rubbish, interconnections and air pollution.

Chapter Six: Conclusion

Chapter Six provides a summary of the study in relation to the research questions. This chapter contextualises the significance of the research undertaken, provides suggestions for future research to be investigated, discusses the limitations of the study and makes recommendations for sustainability teaching based on the evidence gathered.

Chapter Two

Literature Review

Introduction

Chapter Two reviews the current literature relating to sustainability and is structured in nine sections as follows:

1. provides various definitions of sustainability and of environmental sustainability.
2. details the context of education for environmental sustainability explaining how the Australian Sustainable Schools Initiative (AuSSI), and the Caring for our Future policy are informing current research and with current teaching and learning initiatives.
3. discusses the ‘learning for sustainability approach’, as well as several examples of its successful implementation.
4. reviews *constructivism* and *socio-cultural learning* as the theoretical backgrounds underpinning this study. It also explores the 5E Instructional Model developed by Rodger W. Bybee during the 1980s (Bybee, Taylor, Gardner, Scooter, Powell, Westbrook & Landes, 2006), as used in *PrimaryConnections schoolyard safari* (Australian Academy of Science, 2012).
5. discusses the importance of Maslow’s hierarchy of needs to the specific context of this ethnographic study (Oceanside Clearwater Creek WA).
6. describes the ways in which AaTSI perspectives have been incorporated into the sustainability science-program.
7. defines attitudes, highlighting the difference between attitudes, values, behaviours and beliefs. In particular, literature is then reviewed relating to measuring attitudes and the development of attitudes in children.
8. explores several key themes relating to attitudes towards environmental sustainability.
9. synthesizes the literature into the study’s conceptual framework.

What is Sustainability?

The first section of this literature review outlines several definitions pertaining to sustainability and of environmental sustainability. ARIES (2004-2009) explains that sustainability seeks to redress: (1) the social; (2) environmental; (3) economic imbalances of modern society; as well as ensure the (4) wellbeing of current and future generations. UNESCO, like ARIES, highlights the significance of considering future generations in their definition. UNESCO (1995-2010) underscored that sustainable development is all about seeking to meet the needs of the present generation without compromising those of future generations yet to be born. Though these definitions differ slightly they both highlight the need for society to critically reflect upon our current use of the environment and our patterns of development, so as to not inhibit the development of future generations. Both definitions emphasise an integrated and interdisciplinary approach that moves from the local to the global dimensions of sustainability.

There are also similarities between these and other definitions of sustainability. Sutton (2000) describes eight principles underlying most definitions of sustainability:

1. Conservation of biodiversity and ecological integrity (including halting the non-evolutionary loss of biodiversity).
2. Constant natural capital and sustainable income.
3. Ensuring intragenerational (within generations) and intergenerational (across generations) equity.
4. Recognising the global dimension.
5. Dealing cautiously with risk, uncertainty and irreversibility.
6. Ensuring appropriate valuation of environmental assets.
7. Integration of environmental and economic goals in policies and activities.
8. Social equity and community participation. (Adapted from Sutton, 2000, para. 10)

Like ARES (2004-2009) and UNESCO (1995-2010), Sutton also identifies the need to consider future generations by referring to ‘intergenerational equity’. Further, Sutton’s (2000) definition of sustainability is similar to ARIES (2004-2009) definition as he suggests, through the above principles, that sustainable development includes environmental, social and economical aspects. UNESCO (1995-2010) provides a similar definition to Sutton and further highlights the various aspects of sustainability, claiming:

Sustainable development is a vision of development that encompasses populations, animal and plant species, ecosystems, natural resources and that integrates concerns such as the fight against poverty, gender equality, human rights, education for all, health, human security, intercultural dialogue, ... (para. 2)

One difference in Sutton's definition and UNESCO's; however, is that UNESCO (1995-2012a) further explains the underlying need for environmental sustainability:

There can be no long-term social or economic development on a depleted planet. Teaching society how to behave responsibly towards the environment lies at the core of education for sustainable development. (para. 2)

Here UNESCO (1995- 2012a) identifies the significance of environmental sustainability because neither social nor economical development can occur without environmental sustainability.

Environmental sustainability can be defined as “the ability to maintain the qualities that are valued in the physical environment” (ACS Education, 2007, para. 1). UNESCO (1995-2010a) identifies four themes relating to environmental sustainability, including:

1. Water;
2. climate change;
3. biodiversity, and
4. natural disaster prevention.

UNESCO (1995-2010a) says that, “education for sustainable development must continue to highlight the importance of addressing the issues of natural resources (water, energy, agriculture, biodiversity)” (para. 3). Clearly, environmental sustainability is concerned with using the environment for development in a responsible way. This should include the use of natural resources, as well as ensuring that the effects of development are not detrimental to future generations' use of the environment.

These definitions, though each worded differently, identify three dimensions of sustainability: social, economical and environmental. Each definition also identifies the need for development to occur, whilst consideration is given to future generations. Environmental sustainability is therefore paramount to any notion of development, as it facilitates both economical and social development.

Current Status of Sustainability Education

There is an internationally recognized need of education for sustainable development that is highlighted through the United Nations Decade of Education for Sustainable Development (DESD). The following discussion identifies Australia's response to this priority through the 'Caring for our Future' strategy and the National Symposium on the DESD and highlights the place of the AuSSI and the Australian Research Institute in Education for Sustainability (ARIES).

Decade of Education for Sustainable Development

The United Nations has placed education at the forefront of sustainable development. "Education has been recognised internationally as fundamentally important to addressing the critical global challenges we all face" (ARIES, 2009, p. 2). The significance of the role that education plays in sustainable development was recognised as an international priority in 2002 when the United Nations General Assembly put in place a United Nations Decade of Education for Sustainable Development (DESD) from 2005 to 2014 (UNESCO, 1995-2010).

Caring for our future

In response to the DESD the Australian Government, through the Department of Heritage (DEH) created the 'Caring for our Future' strategy, which aims to foster sustainable development through education. A vital aspect of this strategy includes communicating its concepts. This involves developing understandings of the principles and goals of education for sustainable development, including developing understandings of AaTSI heritage in land care; promoting education for sustainable development at national and local levels in government and non-government bodies; developing training and professional learning in education for sustainable development, and the sharing and promotion of successful case studies. The 'Caring for our Future' strategy also includes basing the approach on sound research, ensuring momentum of the strategy, promoting a whole-of-government approach, building partnerships and monitoring and evaluation of the strategy (DEH, 2007). This strategy emphasised the need for education to address sustainability issues.

National Symposium on the DESD in Australia

In further response to the United Nations DESD, a National Symposium was held in 2005. Its aim was to raise awareness of the DESD in Australia across a range of sectors and explore potential partnerships and collaborative activities (Department for Sustainability, Environment, Water, Population and Communities, 2011). Importantly,

both Government and non-government organizations across Australia were participants in this symposium.

One result of the National Symposium was the production of a National Action Plan by the Australian Government. This included key initiatives that were already occurring which supported the role of education in developing sustainability. The Department for Sustainability, Environment, Water, Population and Communities (DSEWPaC, 2005) explained that one key initiative of the plan was the establishment of the National Environmental Education Network, which aimed to coordinate activities and which underlies the Australian Sustainable Schools Initiative.

Australian Sustainable Schools Initiative

The Australian Sustainable Schools Initiative (AuSSI) is a joint federal and state government initiative that works towards supporting schools in their pursuit to become sustainable. AuSSI provided WA schools with support in planning processes and this enhanced practice outcomes (DoE WA, 2010). The DSEWPaC (2010a) explained that participants in AuSSI projects are involved in authentic, meaningful learning experiences related to real resource management by the school, including energy, waste, water, biodiversity, landscape and materials.

There are several key principles underlying AuSSI, as described by the DSEWPaC (2010b):

- Seeking to develop a *school culture* committed to the principles of sustainable development.
- Seeking to go beyond awareness raising towards *action learning* and *integration* with school curricula.
- Encouraging the *involvement of the whole school*.
- Encouraging the *involvement of a school's local community* and a shift in the broader community towards more sustainable practices and processes.
- Seeking to *develop relationships* with other areas that impact on the organisation and management of a school.
- Being founded on a sound basis of *theory and practice* in schools and school systems, *quality teaching and learning*, and environmental education for sustainability.
- Encouraging schools to achieve *measurable* social, environmental, educational and financial *outcomes*.

There are also nine goals of AuSSI stated by the DSEWPaC (2010b). The following goals build upon the previously identified principles:

1. Learning and teaching for sustainability as an integral component of school curricula.
2. Schools actively engaging in a continuous cycle of planning, implementing and reviewing their approach to sustainability as part of their everyday operations.
3. Schools using natural resources, including energy, water, waste and biodiversity, in more sustainable ways.
4. Schools and school authorities reporting on changes towards sustainability.
5. Schools working towards sustainability in partnership with their local communities.
6. Schools and school authorities implementing policies and practices that support effective education for sustainability.
7. Schools and communities developing values that support a sustainability ethos.
8. Young people sharing ownership of sustainability initiatives and decision-making.
9. Individuals supported to make effective sustainability decisions and choices.

These key principles underlying the AuSSI, and the goals listed above, have been used to form the basis of the sustainability science-program used in this study.

Schools that participate in AuSSI are able to choose an area of sustainability that particularly meets the needs and interests of the area. This research project focused largely on biodiversity due to the relevance of this concept to the participating Year-2/3 children and their communities. The DSEWPac (2010c) explained the benefits gained from focusing on biodiversity include children learning about their local environment, how ecosystems work, and developing understandings of their role in the environment.

This section of Chapter Two has identified the international and national recognition of the role that education plays in sustainable development, through the DESD, 'Caring for our future strategy', the National symposium on the DESD in Australia and the AuSSI.

Education for Sustainability

Section two explains the role of education in the learning for sustainability approach, within a science-teaching context and outlines examples of successful implementation of the approach in selective schools. Importantly, it describes the learning for sustainability approach.

The critical role of education in developing sustainability has been recognised within Australia and internationally. The Australian Department of Environment (2009) state: “Governments from around the world have been invited to strengthen their contribution to sustainability through a focus on education” (para. 1). Dunlap (1994) also highlights the significance of education by explaining that there is international agreement that education is the key to environmental sustainability: “across all nations there is a strong recognition of the importance of the wealthier nations providing educational and technological assistance in order to help the poorer nations protect their environments” (p. 124). This suggests that Australia, as a developed nation, has an obligation to assist poorer nations with education and environmental sustainability. It must also ensure education for sustainability occurs within Australian schools.

Given the role that education plays in developing sustainability, learning for sustainability needs to be addressed within Australian schools. Lummis (2004) suggests that as we are dependent upon the ecological systems of our planet, we should adopt an “ecologically-centred pedagogy” (p. 1535). Lummis (2004) further explains that providing people with experiences, “rich in naturalistic life and living engagement” (p. 1542) could lead to changes in policies and legislation, and encourage holistic worldviews. Science teaching through learning for sustainability provides children with these necessary experiences. Specifically, science offers attitudes, values and inquiry skills, which provide a strong foundation for understanding the interconnected world and achieving a transition to a sustainable environment (Murcia, 2008).

Tilbury, Coleman and Garlick (2005) described the slow response of Australian schools to change their practices to educating for sustainability and highlighted the need for this to happen, “there are few Environmental Education programs with a sustainability focus and even fewer courses that promote learning *for* sustainability” (p. 1). Since 2005, more schools throughout Australia have become actively involved in education for sustainability.

Cutter-MacKenzie (2010) reviewed the Australian Waste Wise Schools program: a program aimed at minimising waste in schools and in their broader communities. She conducted an online questionnaire in 2007 with 374 teachers whose schools had been identified as being a Waste Wise School. The questionnaire was designed to measure “teachers’ perceptions about and experiences of the Waste Wise Schools program” (Research methods section, para. 2). Her analysis revealed teachers were participating in more environmental education professional learning, were implementing a greater

number of other environmental education and sustainability science-programs, thereby contributing to, “a growing sustainability culture in Australian schools and communities” (para. 1). This change in culture has enabled more schools to successfully implement education for sustainability. Cutter-MacKenzie (2010) also found strong partnerships with community groups to be, “an essential component of a successful environmental education program” (Concluding Comment and Future Directions section, para. 4). This supports the AuSSI principles of education by encouraging involvement of the school and the school’s local community.

One example of a school highly successful in implementing an education for sustainability approach is Bentleigh West Primary School, in South Melbourne, Victoria. This school of circa 500 children applies AuSSI principles by, “involving students in participatory and enquiry based learning approaches” (ADEWHA, n.d., para. 1). ADEWHA (n.d.) explain that one important program at Bentleigh is Students as Teachers. This requires maximum child participation, as children are responsible for planning and delivering short lessons to visiting children from other schools. For example, the Students as Teachers educate children on the different local environments, such as the school’s wetland. This program builds self-esteem within children and fosters education for sustainability. It also encourages a sense of ownership amongst children, a key principle of the AuSSI. Another program at Bentleigh WPS involves incorporating learning about AaTSI cultures with environmental sustainability by using the local environments as the setting for AaTSI education, and by learning about bush foods and local flora. This integration of sustainability is an important aspect of the AuSSI. Bentleigh WPS practices a whole of community approach by working with groups outside of the school, such as the Glen Eira City Council. Children attending Bentleigh WPS are also encouraged to share in decision-making processes through personal education inquiries (ADEWHA, n.d.). These too, are key principles of the AuSSI.

Bulimba State School in Queensland applies AuSSI principles whilst prioritising sustainability, conservation of biodiversity and improving the school grounds (ADEWHA, n.d.a). This primary school of circa 480 children involves the parent body, staff and children actively working together as a whole of school community on projects such as the remodelling and landscaping outdoor areas within the school. Children worked collaboratively, and in a hands-on way to transform steep school grounds into a “useable outdoor learning space for students” (ADEWHA, n.d. a, para. 2). Children also

gained understandings of environmental conservation and sustainable landscape design. Bulimba SS have applied the AuSSI principles by involving the whole school and by integrating the landscaping project with the school curricula. Children at Bulimba SS have also been involved in cleaning up, revegetating and improving areas of bush land within the school. These areas have been used for children's play and as an outdoor setting for inquiry-based learning. For example, the Year 3 class studied the frilled neck lizards living in this area (ADEWHA, n.d.a). The reclamation and responsibility for these areas of bush encouraged a sense of ownership amongst children, and supported children to make effective sustainable decisions, both of which are key principles of AuSSI.

Both Bentleigh West Primary School and Bulimba State School provide examples of the successful implementation of programs aimed at education for sustainability. Whilst Cutter-MacKenzie (2010) describes the growing sustainability culture within Australian schools, it is important that schools continue to adopt this approach and become actively involved in educating for sustainability.

Learning and Teaching for Sustainability

The Learning for Sustainability Approach gives children the necessary skills to become active, informed citizens who make responsible decisions regarding the use of the environment. According to Tilbury et al., (2005) the approach, "motivates, equips and involves both individuals and institutions in reflecting on how they currently live and work. This assists them in making informed decisions and creating ways to work towards a more sustainable world" (p. 1). The approach educates and empowers children through the incorporation of several key processes. According to ARIES (2004-2009) the learning for sustainability approach includes five processes:

1. *Envisioning a better future.*

This involves motivating and inspiring people to work towards improving the current situation.

2. *Critical thinking and reflection.*

This process encourages people to think critically and creatively about unsustainable practices.

3. *Participation.*

Participation gives those involved the opportunity to be responsible for some decision making.

4. *Partnerships for change.*

This requires creating a shared vision and sense of ownership amongst participants.

5. *Systems thinking.*

This addresses the need to change our way of thinking so that we see the relationships and view the whole process. (para. 1-5)

These principles underlie the learning for sustainability approach and have been used as a basis for developing the Oceanside Clearwater Creek sustainability science-program used with the 15 Year-2/3 children in the teacher/researcher's study (2011).

One of the above key principles to the Learning for Sustainability Approach is the level of participation that children have. Tilbury et al. (2005) explained that a participatory approach involves, "equity, sharing, listening, reflection, co-learning, negotiation, 'critical' thinking, co-operation, collaboration, trust, futures-orientation and democracy" (p. 1). This principle is particularly significant, as the involvement of children in programs at higher levels requires more input from them, and therefore gives a greater sense of ownership. These, along with the engagement of critical reflection, were the reasons why *participation* was focused on throughout the sustainability science-program used in this study.

The next section of the literature review discusses the theoretical backgrounds underpinning this study, namely Constructivism and Socio-Cultural Learning established by Lev Vygotsky (1978), with synthesis with the constructivist developmental theories of Jean Piaget (1970). The theme of social constructivism is explained as being developed for science education teaching and learning by Rodger Bybee during the 1980s with reference to his 5E Instructional Model, which is now modelled by the Australian Academy of Science's resource *PrimaryConnections* (2012).

Constructivist Learning Theory

At its most simple level, Constructivist learning refers to an individual ability to construct personal knowledge. Piaget (1970) explains that: "Learning as a function of experience is therefore not due to pressures passively undergone by the individual but rather to the accommodation of his[/her] schemas of assimilation" (p. 75). This suggests that children create schemas of knowledge based on their actions with the world, and that these schemas are adapted and assimilated as learning occurs. In this sense, children

are actively constructing their own knowledge as they build on what they already know by linking new experiences to previous ones.

Piaget's (1970) Constructivist Learning theory explains that children progress through a series of developmental stages as learning occurs. During the first stage of development (birth to two years), "the young baby's sensory-motor activity... allows him[/her] to organize schemas, essential for future knowledge, of object permanence and the possible displacements in space of an object" (Piaget, 1970, pp. 74- 75). This suggests that through hands-on activities and through the use of their senses, very young children learn by developing schemas for interpreting the world that is surrounding them. From two through to seven years, children are in a transitional stage from action to operation. Here children's actions are internalized, but are not yet understood with logic as complete operations (Piaget, 1970). Piaget (1970) claims that at around seven years of age, "actions become capable of being organised into reversible systems" (p. 76), or operations. This is indicative of the concrete-operational stage (7-12 years). The final stage of development is formal operational (12-years to adulthood). During this stage people reach a level of, "propositional operations" (Piaget, 1970, p. 44), where individuals are able to think logically and work scientifically.

Piaget (1970) acknowledged that adults can assist in children's learning noting, "the adult, being more advanced than the child, can help him[/her] and speed up his[/her] development in the course of educational processes either within the family or at school" (p. 41). Although highlighting the adult as a facilitator, Piaget's constructivist theory is centred upon the individual constructing their own knowledge through the development and adjustment of schemas (Piaget, 1970). This differs to a social-cultural theory of development (Vygotsky, 1978) whereby the latter highly values the role of the socio-cultural context in the learner's development.

Socio-Cultural Learning Theory

Socio-cultural theory suggests that development occurs as a result of the social and cultural interactions children have with others in their environment. Vygotsky (1978) identifies the importance of speech in his socio- cultural view of children's development where: "children solve practical tasks with the help of their speech, as well as their eyes and hands" (p. 26). This suggests the use of language as a problem-solving tool. Vygotsky explains that as well as for social purposes, language can be used to name and describe the world, to plan a problem-solving approach and to internalise social speech. Internalising social speech involves children guiding themselves through

a problem by applying previously seen examples of their social speech (Vygotsky, 1978). In each of these examples language is used as a tool to develop higher levels of cognition. In addition to language being used as a tool, Vygotsky (1978) explains how human speech is also linked with perception. Young children primarily use language for labelling and through doing so they begin to perceive the world through speech. As development occurs, children then use speech to synthesise their experiences in a more complex way (Vygotsky, 1978).

Robbins (2005) explains that in *socio-cultural theory*, learning is a collaborative process that relies on the interactions with others in socio-culturally appropriate tasks where, “thinking is very much contextually specific, guided by others and mediated by particular cultural tools and artefacts” (p. 143). Here, Robbins (2005) highlights the importance of social interactions in teaching culturally specific behaviours. This was originally identified by Vygotsky (1978) when he explained that cultural behaviours are internalised in order to be learnt: “Every function in the child’s cultural development appears twice: first on the social level, and later, on the individual level” (p. 57). This means that children’s learning of cultural behaviours, occurs firstly through their interactions with others, and then secondly as these interactions are internalised and developed within the child. This indicates that the roles played by the *culture*, and the people surrounding the child, are paramount in the child’s development. The significance of the interactions between the child and the people surrounding them is also identified by Flear (2006), when she explains: “Development is not something that exists within the child, but rather takes place as the child interacts with his or her cultural community” (p. 8). Howitt and Blake (2010), emphasise the importance of identifying the role of the cultural community and reinforce the significance of the social learning context:

Children do not learn in isolation. Rather, they learn through the many interactions they have with others. Their friends, parents, teachers, and the wider social and cultural context contribute to the overall teaching learning experienced by children. (p. 7)

Socio-cultural theory is premised on the understanding that learning is mediated through the many and varied interactions (i.e., between children and the social and cultural contexts of which they are a part). Vygotsky’s (1935) Zone of Proximal Development (ZPD) describes how learning through interactions with others occurs. The ZPD can be defined as:

[T]he distance between the level of his actual development, determined with the help of independently solved tasks, and the level of possible development, defined with the help of tasks solved by the child under the guidance of adults or in cooperation with more intelligent peers. (Vygotsky, 1935, para. 31)

This difference between the actual development and the potential development is also referred to as: a difference in intrapersonal functioning (completing the task independently once understanding of it has been internalised), and interpersonal functioning (completing the task through imitation and with the assistance of others) (Fleer & Robbins, 2006 and Vygotsky, 1978). As Fleer and Robbins (2006) explain, “The ZPD is a hypothetical ‘space’ bound by interpersonal functioning at one end and intrapersonal functioning at the other” (p. 30). Learners therefore rely on their socio-cultural interactions with peers, family members, teachers and other more capable people to scaffold their learning to new levels and to gain intrapersonal functioning.

Fleer and Robbins (2006) describe scaffolding as a strategy, which adults and capable peers apply by assisting children to complete particular tasks that are above their developmental level. McInerney and McInerney (2002) similarly define scaffolding as, “providing guidance that allows the learner to progress through the zone of proximal development” (p. 46). Each of these definitions acknowledges the purpose of scaffolding as assisting children to work in their ZPD and achieve at more difficult levels. Fleer and Robbins (2006) explain that because children learn while they are operating within their ZPD, the assistance given by an adult or a more capable peer, is essential in the child’s success. This supports the use of Kagan (2009) cooperative learning strategies in the present study to provide opportunities for active cooperation amongst children and therefore opportunities for learning.

According to Vygotsky (1935), these new and higher levels of development are the most important and should be focussed on, “for the dynamics of mental development and for school achievement, those functions that are in a process of maturation are more essential than those that are already well developed, the latter being just a prerequisite” (para. 38). These functions referred to as in a process of maturation, are those that lie within the ZPD. McInerney and McInerney (2002) say that:

Children should be challenged to be engaged in activities that appear to be beyond their current level of development. Children can often complete activities with the collaboration of teachers and peers that they could not complete on their own. (p. 47)

This assertion identifies the need to challenge children. Then, with scaffolding and supportive interactions with others, that children learn to complete tasks on their own and internalise them as new skills.

Robbins (2005) explains that a key difference between socio-cultural and socio-constructivist theory in research is that shared understandings are of significance in socio-cultural perspectives; where as individual constructions are focussed on when a social-constructivist perspectives are applied. Whilst the sustainability science-program used in this research allows time for independent reflection of children at the end of most sessions, children have worked collaboratively with each other and with the teacher/researcher to develop shared understandings during most other activities in the program. Through interactions and dialogue with others, children were encouraged to develop shared understandings by making sense of scientific concepts, building upon previous knowledge and understandings, practising and applying scientific skills in new situations, working collaboratively on a child-directed scientific investigation, and discussing and developing attitudes to issues of environmental sustainability.

Another feature of socio-cultural research, discussed by Robbins (2005), notes:

Consideration would also be given to the rich and collaborative exchanges that occur in conversations with children, rather than focusing on the first thing that they say, or on whether the responses to questions match the expected 'right' answer. (p. 146)

Rich and varied qualitative data were collected during the sustainability science-program, including the collection of children's work samples and journal entries, analysing teacher/researcher observations and anecdotal notes made on children's conversations and behaviours, and children's participation in a post-program interview. Collating and analysing this data, whilst also supporting it with the pre and post-program survey provided a much richer understanding of children's attitudes to issues of environmental sustainability.

According to Robbins (2005), another difference between socio-cultural and socio-constructivist research is acknowledgement of the role of the teacher/researcher. Robbins (2005) explains:

[A]ttention would be paid to the reciprocity and negotiation of meanings between various participants (including the researcher) within the research activity, especially if that involves interviews or conversations with children. (p. 145)

The role of the teacher/researcher in this study is acknowledged as being a contributing factor in the development of shared understandings. The teacher/researcher was actively involved in the sustainability science-program in several ways; for example: by prompting and directing children's discussion of stimulus images. The teacher/researcher also made anecdotal notes of relevant conversations that occurred throughout the program of which she was a part. Recording this involvement acknowledges that the teacher/researcher did not play a neutral role, but instead was involved in the negotiation of meaning.

5 E Instructional Model

In the 1980's the Biological Science Curriculum Study (BSCS), led by Rodger Bybee, developed an instructional model for teaching science. The model, named the 5E Instructional Model, aimed to better develop children's science knowledge, attitudes and skills through the implementation of sequential, organised units of lessons (Bybee, Taylor, Gardner, Scotter, Powell, Westbrook & Landes, 2006). Based on social constructivist theory, the 5E Instructional Model reflects the understanding that Science concepts are developed by building upon previous knowledge through interactions with others and with the environment. "The contributions of social interaction to learning" (Bybee et al. 2006, p. 4) are recognised by ensuring opportunities are provided for this to occur at all phases of the model. In his more recent work, Bybee (2010) identified the significance of the interactions between the teacher and the children claiming this is key to the children's learning and must be added to the original 5E model.

The 5E Instructional Model, as described by Bybee et al. (2006), consisted of five key phases, being: engagement, exploration, explanation, elaboration and evaluation. The engagement phase involves activating the learner's prior knowledge, and linking previous experiences to short, captivating activities that engage children in a new scientific idea. These activities should require physical and mental involvement by the children. Exploration and development of the learner's prior knowledge occurs through involvement in shared activities during the exploration phase. Children also explore questions through beginning investigations facilitated by the teacher. During the explanation phase children deepen their understandings by demonstrating or explaining concepts and skills from earlier phases. Explanations can also be given from teachers relating to new scientific concepts and skills and introducing science vocabulary. The elaboration phase requires the application of skills and understandings to new activities, thereby extending children's science capabilities. A key aspect of this phase is the social

interaction amongst children. The final evaluative phase involves the assessment of children's science understandings and skills by the teacher and by the children.

The 5E Instructional Model has informed the structure and development of the sustainability science-program used in this study linked to the Australian Academy of Science research *PrimaryConnections*-schoolyard safari. The researcher modified the schoolyard safari resource to ensure that it reflects the socio-cultural context of the participating 15 Year-2/3 children (2011); for example: including locally based excursions, inviting family and community members to assist with sessions, and incorporating AaTSI perspectives and education.

Maslow's Hierarchy of Needs

This section of the literature review outlines the relevance of Maslow's hierarchy of needs to the present study.

This study drew from Maslow's (1954) model of hierarchy of needs. The model described the hierarchical structure of the attainment of human needs. Figure 1 illustrates that lower level needs, such as physiological and safety needs, must be met before higher level needs, such as self-actualisation, can be met.



Figure 1: Maslow's Hierarchy of Needs model (McLeod, 2007)

Maslow's theory relates to this study because it positions essential prerequisite needs with the development of children. It suggested that it would not be possible for children to develop understandings about sustainability or to show interest in the sustainability science-program if their most basic level needs have not been met. The physiological level is the most basic of human needs, such as the need for food (Maslow, 1954). This is relevant, because some Oceanside Clearwater Creek Year-2/3 children in this study (2011) often came to school without having eaten breakfast.

Levels two and three underscore the need for safety, belongingness and love. The safety needs include, but are not limited to, "security; stability; dependency; protection; freedom from fear, from anxiety and chaos; need for structure, order, law limits" (Maslow, 1954, p. 39). The belonging and love needs refer to the close relationships a child may have with family and friends (Maslow, 1954). Some of the Year-2/3 children participating in this study had very unstable home environments, and on several occasions become overwhelmed with emotion, feeling anxious at school because of their complex family situations. Maslow's hierarchy of needs model applies here because these issues must be resolved before children have the opportunity to develop

their formal academic abilities, such as science understandings and attitudes to environmental sustainability.

Level four refers to the self-esteem needs. Maslow (1954) explained that people have a need for esteem, which can include self-confidence, self-respect and respect from other people. The intent of the program was to develop self-esteem with the Year-2/3 children (i.e., to develop self-confidence and self-esteem during the sustainability science-program by being given opportunities to make decisions for themselves regarding their learning). For example: by creating opportunities for the children to act responsibly in their environment, by contributing to the revegetation of the Clearwater Creek in 2011. The researcher designed her program with the intended opportunity for her Year-2/3 children to develop feelings of usefulness and self-importance.

The highest level of the hierarchy of needs is self-actualisation. Maslow (1954, p. 46) stated this is, “to become everything that one is capable of becoming”. It also includes working towards your potential (Maslow, 1954, p. 46). Development at this level was encouraged in the sustainability science-program through the discussion and reflection of issues of environmental sustainability. Children were given the opportunity to reach their own conclusions about sustainability issues after listening to other children’s ideas and reflecting critically on these at an age appropriate level. The program design also offered opportunities for the Year-2/3 children to engage in reflecting critically on their own behaviour and the behaviours of others. These activities encouraged children to develop self-actualisation as they were given opportunities to develop their own, individual attitudes and behaviours.

Maslow’s (1954) description of the attainment of human needs differs largely to Piaget’s (1964) theory of cognitive development. Whilst Maslow (1954) suggests that human needs are met in a sequential way, based on environment and surroundings, which is not necessarily related to children’s age; Piaget suggests that children’s development is based on their biological and physiological development, ending in adulthood. Piaget (1964) claims that development is a “spontaneous process” (p. 176) and that, “learning occurs as a function of total development, rather than being an element which explains development” (p. 176). Whilst both theories are based on the progression from one stage, or level, to the next, Piaget’s (1964) cognitive developmental theory emphasises age appropriate developmental levels and Maslow’s (1954) hierarchy of needs emphasises the impact that environmental situations have on humans’ attainment of needs.

Piaget (1964) explained four progressive stages of children's development: sensory-motor, pre-operational, concrete operational and formal operational. This theory of cognitive development suggests that children would not reach the highest and most developed stage of formal operational, until they are at least 11 years old. Piaget's (1964) theory was considered in the sustainability science-program as far as the learning activities being age appropriate; however, it also contrasts with this study as Year-2/3 children in the teacher/researcher's study (2011) showed aspects of development at Maslow's (1954) highest level of self-actualisation as they were supported throughout the sustainability science-program.

Maslow's (1954) description of the attainment of human needs, and socio-cultural theory (Vygotsky, 1978 and Robbins, 2005) both accept that the adult mentors, and the environment surrounding children of different ages, are fundamental to the development of younger children. Each of the levels of Maslow's hierarchical structure requires social and cultural interactions for their attainment. For example: for the 'physiological' level to be met, children rely on family members and/or care givers to ensure that food and shelter were provided. The third level, 'belongingness and love', is based on the relationships that children have with family, friends and others. In the 'self-actualisation' level children have reached, or are working to their potential, which could involve pursuing their talents. For this to occur, children must have had such opportunities offered to them by parents and/or caregivers. They must have also accepted guidance by experienced others to learn the particular skills needed to pursue that talent; for example: learning to play a musical instrument, or expressing himself or herself artistically. Clearly the social and cultural interactions between children and the people surrounding them are crucial for their attainment of human needs and for their optimum development.

AaTSI Perspectives in Learning

The sixth section of the literature review discusses acknowledgement of the inclusion of AaTSI perspectives in education.

The sustainability science-program used in this study incorporates AaTSI perspectives, which accommodates the above national average of Aboriginal inclusion in the Oceanside Clearwater Creek community (2011). Including AaTSI perspectives in learning is an integral aspect of educating for Australian citizenship at general level, but essential for the particular Year-2/3 participants involved in the teacher/researcher's study.

The Department of Education Western Australia (2010a) developed AaTSI Perspectives Across the Curriculum (APAC). It aims to develop both students' and teachers' understanding of AaTSI cultures. APAC encourages teachers to value AaTSI cultures in their classrooms, through explicitly teaching AaTSI education or through incorporating AaTSI perspectives into student learning.

AaTSI perspectives have also been acknowledged by ACARA (2011) as a cross-curriculum priority within the Australian Curriculum. It is based around three key concepts: Country/Place, Peoples and Cultures (ACARA, 2011). Through the incorporation of AaTSI histories and cultures into learning areas children will, “gain a deeper understanding and appreciation of Aboriginal and Torres Strait Islander histories and cultures, deep knowledge traditions and holistic world views” (ACARA, 2011, para. 3). For this reason AaTSI perspectives have been incorporated into the sustainability science- program used in the teacher/researcher's Oceanside Clearwater Creek Year-2/3 study (2011). More importantly, there were significant numbers of AaTSI people in the school and community, with 34% of the children in the Year-2/3 class coming from an AaTSI background.

The Australian Academy of Science (2010) highlights the crucial need to be inclusive of AaTSI perspectives, as with other cultures, when teaching primary science. They state:

Teachers' development of a critical consciousness that reflects awareness of cultural diversity is crucial to providing culturally sensitive and meaningful learning environments for all learners. (para. 5)

This reinforces that teachers should be professionally aware of the large diversity that is evident within AaTSI cultures, in order to be able to design appropriate programs and learning experiences.

Attitudes

This section of the chapter defines the term ‘attitudes’, and describes the differences between: attitudes, values, beliefs and behaviours. It then reviews the literature to discuss ways in which attitudes can be measured generally and specifically in children, as well as attitude development.

Attitudes

This study focused on investigating the attitudes held by young children to issues of environmental sustainability. Given the significance and frequent use of the term

‘attitudes’, it is important that a shared understanding of what attitudes are, is held, and that the term be defined. Bohner and Dickel (2011) claim:

An attitude is an evaluation of an object of thought. Attitude objects comprise anything a person may hold in mind, ranging from the mundane to the abstract, including things, people, groups and ideas. (p. 392)

They continue, that most researchers generally agree upon this basic definition; however, more complex definitions do vary significantly (Bohner & Dickel, 2011). Bohner and Dickel’s (2011) definition has similarities to that of Eaton and Visser (2008) when they state:

An attitude is a general, relatively enduring evaluation of an object. Attitudes are evaluative in the sense that they reflect the degree of positivity or negativity that a person feels toward an object. (p. 40)

Both definitions highlight the fact that attitudes are held toward, what Bohner and Dickel (2011) refer to as, the attitudinal object. Each definition also identifies the evaluative nature of attitudes. Dowds (2003) noted: “An attitude is a tendency to respond in a constantly favourable or unfavourable manner towards a specific topic, concept or object” (p. 12), as did Petty, Wegener and Fabrigar (1997). Dowds’ (2003) reference to a ‘favourable’ or ‘unfavourable’ response is similar to Eaton and Visser’s (2008) reference to the ‘positivity’ or ‘negativity’ felt by people toward an attitudinal object, thereby highlighting the essence of evaluation in attitudes. Eaton and Visser’s (2008) definition, however, differs from Bohner and Dickel’s (2011) by claiming that attitudes are, “relatively enduring” (2008, p. 40). This elaboration signifies the differences between more complex definitions. Eaton and Visser (2008) explain this difference by writing: “Attitudes are enduring in that they are stored in memory and they remain at least somewhat stable over time” (p. 40). Dowds (2003) reinforced the same notion, by highlighting the constant nature of attitudes in her definition; however, it was not included in Bohner and Dickel’s (2011) basic definition.

The difference of whether or not attitudes are memorised and remain stable over time, or whether they are constructed and change as judgments are made, is a distinction made clear by Bohner and Dickel (2011). Whilst there are varying views of how attitudes are formed; however, “attitudes may be defined along a continuum, ranging from purely memory-based summary evaluations that are easily retrieved to evaluative judgments that are constructed from currently accessible information” (Bohner & Dickel, 2011, pp. 396-397). They suggest that stronger attitudes are more likely to

remain constant over time and in varying contexts, and that they can be easily accessed from memory. They also suggest that weaker attitudes are less easily accessed from memory and are more likely to change depending on the situation (Bohner & Dickel, 2011).

Given the differences in theories relating to how attitudes are formed and can change, attitude strength becomes an important factor in determining behaviour. Whilst it has been claimed that attitudes affect behaviour (Bohner & Dickel, 2011; Eaton & Visser, 2008), the degree to which behaviour can be predicted by attitudes, seems to be a contentious issue (Dowds, 2003; Eaton & Visser, 2008). Eaton and Visser (2008) state the significance of determining attitude strength:

[Is] knowing an individual's attitude toward a particular object can be tremendously useful in predicting his or her behaviour toward the object, but it is just as important to know the *strength* of the attitude.
(p. 42)

They continue to explain that attitude strength can be influenced by several factors, including the amount of prior knowledge related to the attitude, thought given to the attitudinal object and the personal significance of the attitude. Consideration of these factors allows for greater understanding of the strength of an attitude and therefore it's potential impact on behaviour, given that stronger attitudes are more likely to encourage what Eaton and Visser (2008) refer to as, "attitude-congruent" behaviours (p. 42).

Values

When considering the construction and affects of attitudes, the distinction between attitudes and values must be made clear. Bardi and Schwartz (2003) state simply, that "values convey what is important to us in our lives" (p. 1208). They continue that people consider different values to be important and that these values also vary in their significance (Bardi & Schwartz, 2003). This definition suggests that values reflect and communicate what we hold personally significant in guiding our lives, and that these core ideas vary between people.

Following from this definition of values, Dowds (2003) explains how values differ to attitudes:

Values are more abstract, higher order constructs than attitudes and represent an enduring belief that one way of behaving (or being) is personally or socially preferable to the reverse mode of conduct. Values are more permanent and resistant to change and may have a direct or indirect influence on attitudes and behaviours. Thus values

are determinants of attitudes, but a single attitude can be ‘caused’ by many values. (p. 14)

This definition highlights the permanent nature of values and recognises them as ‘higher order constructs’ compared to attitudes. Rokeach (1971) identified these value-linked ideas with his reference to values as, “more fundamental components within a person’s make-up” (p. 453) than attitudes. These each relate back to, and elaborate upon, Bardi and Schwartz’s (2003) simple definition of values through the recognition of the main ideas that people hold as important.

Given the nature of values being higher-level components of cognition than attitudes, Dowd’s (2003) explanation further identifies that values play a larger role in guiding people’s behaviours and attitudes toward a particular way of living. Rokeach (1971) explained that people, “have many thousands of attitudes but only [circa a dozen values]” (p. 453), and that these core values could be determinants of the many different attitudes and behaviours.

Behaviours

Given that behaviours may be influenced by both attitudes and values (Bohner & Dickel, 2011; Dowds, 2003; Eaton & Visser, 2008; Rokeach, 1971) their nature as lower level components of cognition, seems apparent. Crow and Liggett (2014) explain that behaviours are things that can be observed, and define them simply as, “actions that people do or do not do” (p. 1531). Bardi and Schwartz (2003) suggest that behaviours can include both conscious and non-deliberate behaviours such as habits, and that each of these may be influenced by values. They explained the link between values and behaviours noting: “The natural way to pursue important values is to behave in ways that express them or promote their attainment” (p. 1208). This suggests that behaviours can be used as a tool or a medium for communicating and expressing values and attitudes.

Beliefs

Whilst values have been described as the higher level ideas that guide and influence attitudes and behaviours, and attitudes have been claimed to influence behaviour, it is important that the term ‘beliefs’ is not confused with any or each of these. Crow and Liggett (2014) define beliefs as a, “conviction of the truth of something” (p. 1532) and explain that they are constructed through the consideration of our knowledge and experiences, and are impacted by the social culture and the environment surrounding us. This suggests that beliefs may be constructed through

some similar processes that Eaton and Visser (2008) outlined for establishing attitude strength, such as the consideration of prior knowledge and relevant experiences. However, beliefs fundamentally differ to attitudes because of the evaluative nature of attitudes. Attitudes require an evaluation to be made of an attitudinal object and indicate how positive or negative a person feels toward that object, where as beliefs are the ‘truths’ that people consider as factual. It is also important to consider the relationship between values, attitudes and beliefs. This has been explained by Dowds (2003):

A positive attitude towards an object may result from beliefs that the person or thing is positively associated with the fulfilment of important values. A negative attitude may result from beliefs that the attitudinal object is inconsistent with highly revered values or linked with negatively valued objects and concepts. (p. 14)

This explanation suggests that, in a hierarchical sense, values are the most highly ordered, which guide the development of attitudes. It further suggests that beliefs serve to fulfil values and that attitudes are dictated by the beliefs held. In this sense, attitudes and beliefs are outcomes of and working together for, the pursuit of values.

Measuring attitudes

This section of the chapter outlines several methods for attitude measurement and then describes instruments used to measure the attitudes of children in general and in environmental contexts.

In order to describe attitudes and to predict or understand their potential impacts on behaviours, there is a need for effective measures of attitudes and attitude strength. According to Dowds (2003) an: “Attitude measurement involves locating someone’s position on an affective continuum ranging from very positive to very negative towards an attitudinal object” (p. 12). There are several scaling systems available to measure people’s attitudes. Dowds (2003) described three scaling systems that can be used for attitude measurement, including Guttman scales, Thurstone scaling and Likert scaling. She explained that the Guttman scales consist of a list of items that are ordered in terms of favourability. Another key feature of it is that it focuses on one issue or attitude, therefore making it inappropriate for use in this study. It is for this reason also, that Thurstone scaling was not appropriate for this study, as it too, focuses on one main issue. Thurstone scaling involves participants responding by agreeing or disagreeing to a set of statements with numerical attitudinal scores, thereby contributing to an overall attitude score for each participant (Dowds, 2003).

In contrast to Thurstone scaling, Likert scaling involves, “the summing of respondents’ answers to a series of positive or negative statements about the attitudinal object” (Dowds, 2003, p. 14). The participants’ responses to these statements also indicate the attitude strength in each statement. Dowds (2003) further explains that Likert scales allow the calculation of an Alpha Coefficient, which measures the reliability of the scale. Though each of the scales has different features Likert scaling is considered to be the most popular scale of attitudinal measurement (Dowds, 2003; Eaton & Visser, 2008). A Likert scale was used in the teacher/researcher’s Year-2/3 primary school study (2011), because of its widespread use, as well as the ability to measure attitude and attitude strength.

Attitudinal studies in children

Holliman and Ray (2013) developed an instrument to be used to assess young children’s attitudes through their emotional and social development after participation in Child-Centred Played Therapy (CCPT). Landreth (2012), as cited in Holliman and Ray (2013), reported that CCPT aims to help children:

- (1) develop a more positive self-concept;
- (2) assume greater self-responsibility;
- (3) become more self-directing;
- (4) become more self-accepting;
- (5) become more self-reliant;
- (6) engage in self-determined decision-making;
- (7) experience a feeling of self-control;
- (8) become sensitive to the process of coping;
- (9) develop an internal source of evaluation; and
- (10) become more trusting of himself. (p. 60)

Using these objectives as a guide, Holliman and Ray (2013) designed the Child Interpersonal Relationship and Attitudes Assessment (CIRAA). This instrument addressed four core factors, including: self-control, interpersonal relationships, coping skills and internal locus of evaluation. The study was completed with 136 children aged three to 10 years, with a mean age (6.5 years).

A key feature of this instrument is that it was designed for parents to self-administer. As such, the authors have ensured that completing the CIRAA is a simple process. One way that this was achieved is that the instrument is relatively short, containing only 30 items. Additionally, completion of the CIRAA requires simple tick-a-box responses to a, “5-point Likert scale ranging from 1 = Strongly Agree to 5 = Strongly Disagree” (Holliman & Ray, 2013, p. 61). These each relate to the Children’s Attitudes to Sustainability Survey (CASS) used in the present study, as it too, aimed for an easy completion process given that children were responding themselves. The CASS used a 4-point Likert scale and also ranged from Strongly agree to Strongly disagree. These labels are clear and easy to understand and were supported in the CASS pictorially for ease of comprehension. The tick-a-box responses also seemed appropriate for children of a young age.

Another important aspect of the CIRAA’s design is that it is based on parental observations. Holliman and Ray (2013) explained these observations as observed variables, which are:

the behaviours one person can observe about another person and are believed to be linked to underlying variables, which cannot be directly observed. Such unobservable variables are called latent variables. While using observed variables to estimate the presence of latent variables seems less than ideal, for this study of the CIRAA, the use of observed variables to measure latent variables provided the best available method of assessing attitudes, beliefs, emotional states, and inner processes of children. (p. 72)

This proposes that children’s behaviours can indicate their attitudes, and that parent observations is one way in which the attitudes of children can be assessed in a parent report instrument. Some of the children’s attitudes were assessed through their responses to items on the CASS relating to behaviours or behavioural intentions. One example of this is Item-1, which stated: *“I always put my rubbish in the bin”*. Children’s responses to this behavioural item indicate an attitude toward litter and rubbish. Holliman and Ray (2013) described the potential applications of the CIRAA, yet they also claimed the significance of a holistic assessment of the child. They wrote: “A full assessment of a child needs to include information from multiple sources” (p. 72). This further relates to the present study because although the CASS was developed to assess the attitudes of young children to issues of sustainability, it was used to support detailed qualitative data from varied sources, thereby assisting in gaining a more holistic assessment.

Eagles and Demare (1999) conducted a study into the effects of participation in the weeklong Sunship Earth program (an Environmental Education program) on Canadian children's environmental attitudes. This study involved 72 children aged between 10 and 11 years. Children completed a pre-test survey before participating in the residential camping program, after which, they completed a post-test survey. The survey consisted of 38 questions, some of which were reverse worded. Eight questions sought personal information that could act as influencing variables, such as: "*Do you read books or magazines on nature and the environment?*" (Eagles & Demare, 1999, p. 34) Thirty questions investigated the children's environmental attitudes, for example: "*I am in favour of protecting some natural areas even if it means that some people will lose their jobs*" (Eagles & Demare, 1999, p. 35). The questions were based on ecologicistic and moralistic attitudes that were focused on in the Sunship Earth program. Eagles and Demare's (1999) explained that the questions were guided by Kellert's (1979) identification of several environmental attitude categories. Although Kellert (1979) designed the categories for attitudes toward animals, Eagles and Demare (1999) adapted the questions for environmental attitudes.

The Eagles and Demare (1999) survey included 11 items that addressed ecologicistic attitudes, eight items that addressed moralistic attitudes and 11 items regarding other attitudes. Children were required to choose from a 5-point Likert scale ranging from Strongly Agree to Strongly Disagree with *Don't Know* being the middle option. Eagles and Demare (1999) found that there were no significant changes in ecologicistic or moralistic attitudes as a result of participation in the Sunship Earth program. They did find that there were significant correlations between both children's ecologicistic attitudinal scores and their moralistic attitudinal scores, "for three activities: talking about the environment at home, reading environmental books or magazines, and watching environmental television or movies" (p. 35). These findings suggest that the largest influencers of children's ecologicistic and moralistic attitudes were the long-term, regularly practiced factors that occur largely in the home, and somewhat in the school or community environment. Eagles and Demare (1999) claim the significance of this:

Environmental attitudes are formed by many influences over a long period of time. For an EE [Environmental Education] program to be effective in influencing attitudes it must be part of holistic EE [Environmental Education] curricula over many years. (p. 37)

This relates to the present study in two major ways. The first is that the two studies differ in their duration and in their composition. Children in the Sunship Earth

program were actively involved for one week, in contrast to the Year-2/3 children in the teacher/researcher's study, who participated in the sustainability science-program for 10 weeks. Although the latter was a science-based program, it was integrated with most other learning areas and involved the participation of parents and community members. It was also designed specifically to suit the needs of the 15 participating Year-2/3 children, and was situated in a unique WA rural community in 2011. As well as being a much longer program, there existed multiple factors that contributed to a more holistic (but bounded) educational environment, which Eagles and Demare (1999) identified as being critical for effective environmental education.

A second point of difference between the Sunship Earth program, and the Year-2/3 Oceanside Clearwater Creek sustainability science-program (2011); is the age of children involved in each program. Eagles and Demare (1999) investigated children aged 10-11 years, where as the teacher/researcher's Oceanside Clearwater Creek study investigated children aged (7-8) years. This is important given that the Eagles and Demare (1999) found that:

Attitude structures are well formed by the end of high school; major change occurs most readily in the younger years. Attitude flux occurs throughout youth, up to the early teen years. At this time the attitudes solidify and become much less amenable to change. (p. 37)

Eagles and Demare (1999) claim that younger children are more easily influenced in the development of positive attitudes toward the environment and that the children's attitudes in their study had begun to fluctuate. This suggests that the children in the teacher/researcher's Oceanside Clearwater Creek (2011) Year-2/3 study; could have been more capable of attitudinal change. This is an important consideration for other WA junior primary teachers who are interested in the possibility of changing children's attitudes towards science and sustainability.

Musser and Malkus (1994) developed a Likert scale used to measure the environmental attitudes of 171 primary children aged between eight to 12 years. The Children's Attitudes Toward the Environment Scale (CATES) consisted of a list of 25 items: eight regarding behaviours; eight regarding beliefs; and nine affective statements. Musser and Malkus (1994) explained that each item was constructed in two parts. Firstly, the item described two different people that expressed different attitudes toward a topic, and the child had to select which person they more closely resembled. For example, Item-1 stated: *"Some kids like to leave the tap running when they brush their teeth, but other kids always turn the tap off while brushing their teeth"* (1994, Table 1,

Item 1). Once children had chosen which person they were most similar to, they then chose if the item was, “*really true*” or “*sort of true*”. This scale required simple tick-a-box responses from children. Musser and Malkus (1994) explained that they had to carefully consider the language used in the wording of items in CATES.

The CASS used in the present study was also designed specifically for young children. It too, used language that was familiar and easy to understand. Though some of the language used was similar to the CATES project (Musser & Malkus, 1994), such as ‘plants’, ‘animals’, ‘rivers’, ‘bikes’ and ‘cars’, language differed between the surveys for several reasons. One reason is that the language used in each survey reflected the environmental themes. For example, the CATES project used the words ‘car-pool’ and ‘solar energy’ to address the theme pollution, and the CASS used the words ‘bush’ and ‘clear’ to address the theme habitat conservation. Another reason for differences in language use was that the CATES project was aimed at slightly older children. As such, words including: ‘prevent’, ‘recycle’, ‘concerned’, ‘fertilizers’ and ‘extinct’ would be too difficult to include in the CASS. A final reason for differences is that the language used in both surveys reflects the socio-cultural environments of the children being surveyed. For example: the CATES project used the words ‘trash’ and ‘rainforest’, where as the CASS used the words ‘rubbish’ and ‘bush’. A second way that the CATES project catered for young children was by reading aloud items to some children during implementation of the scale. Musser and Malkus (1994) noted that this usually occurred with the younger children. The CASS also used this strategy, whereby in the teacher/researcher’s Oceanside Clearwater Creek (2011) Year-2/3 study it was the Aboriginal and Indigenous Education Officer (AIEO) who read aloud each item of the survey to the 15 children. Children could have further explanation of items if it was needed, though strict instructions on what further information could be given were followed to ensure consistency.

A final consideration of the CATES project (Musser & Malkus, 1994) was that the completion time of the survey was around 20 minutes per child. This was similar to the CASS, as it took around 10 minutes to complete and consisted of 14 items. This helped ensure children were attentive during completion of the survey.

Attitudinal development

Dohman, Falk, Huffman and Sunde (2012) completed a study into the transmission of attitudes from parents to children. Using data from the German Socio-Economic Panel (SOEP) conducted in 2003 and 2004 they investigated attitudes

relating to trust and risk. Participants included 3751 parents and their children (adult children), with an average age of 25.3 years old. Data from 10 questions were investigated; seven addressing risk attitudes, and three addressing trust attitudes. Six of the risk related questions were answered using an 11-point Likert scale that ranged from completely willing to completely unwilling. These questions addressed risk taking behaviour in general and specifically including, “car driving, financial matters, sports and leisure, career and health” (Dohman et al., 2012, p. 650). There was also a final risk related question that was open ended and addressed people’s willingness to risk money. People’s willingness to trust others was focused on in three questions that were answered using a 4-point Likert scale ranging from Strongly Agree to Strongly Disagree. Dohman et al. (2012) included:

- (1) In general, one can trust people.
- (2) These days you cannot rely on anybody else.
- (3) When dealing with strangers, it is better to be careful before you trust them. (p. 650)

Although the children surveyed in this study were in fact ‘adult children’, the results were particularly relevant. Dohman et al. (2012) found that there is a transmission of risk and trust attitudes from parents to their children. A causal relationship was not identified, but a strong positive correlation indicated that, “parents who are more willing to take risks, or who are more trusting, raise children with similar traits, consistent with a process of intergenerational transmission” (Dohman et al., 2012, p. 647). Through strong positive correlations, they also identified the role of the community as a significant factor, “attitudes in the region play a part in shaping child attitudes, in addition to the parents” (Dohman et al., 2012, p. 647). Further, the researchers suggest that the process of socialisation is largely responsible for the transmission of attitudes. These findings relate to the Oceanside Clearwater Creek Year-2/3 study because: Dohman et al. (2012) reported that people’s attitudes are shaped by their parents, and by the attitudes present in the community in which they live. It follows, that the development of the attitudes of the 15 Year-2/3 children in the teacher/researcher’s 2011 study, would also be influenced by their parents’ attitudes, as well as by the attitudes of people surrounding them in Oceanside Clearwater Creek.

Similarly to Dohmen et al. (2012), Grønhøj and Thøgersen (2009) investigated the similarities between parents and their children’s values, attitudes and behaviours, focusing on a home environmental context. In 2006, they conducted a study of 1202

people from 601 Danish families. One parent and one child, aged between 16 and 18 years, completed the on-line questionnaire from each family. The family combinations included 132 father-son dyads, 111 father-daughter dyads, 161 mother-son dyads and 197 mother-daughter dyads. Values were assessed using an adapted version of Schwartz's Portrait Value Questionnaire. This consisted of 22 items relating to all 10 of Schwartz's (2006) value domains, but focusing on the environmental values. Participants were asked to consider how similar they were to a described person. This was measured with a 6-point scale ranging from 'Very much like me' to 'not like me at all'.

Three environmentally related household behaviours were measured. These included, "buying organic and environmentally friendly products, source-separating household waste, and making an effort to save electricity" (Grønhøj & Thøgersen, 2009, Procedures, para. 2). Participants were asked to state how often they completed these types of behaviours on 5-point frequency scale ranging from 'Always' to 'Never'.

Participants' attitudes were assessed in relation to these household behaviours. Three items were included on a 7-point semantic differential scale with the response choices including good/bad, beneficial/detrimental and wise/unwise. One item, for example, read: "To buy organic and environmentally friendly products is ..." (Grønhøj & Thøgersen, 2009, Procedures, para. 4).

Although Grønhøj and Thøgersen's (2009) study was conducted with adolescent children, the results are relevant to the teacher/researcher's Oceanside Clearwater Creek study (2011). After completion of the Grønhøj and Thøgersen (2009) research, a key finding saw the general values of children being correlated with the values of their parents. There is an even stronger positive correlation with respect to environmental values. This is significant because it suggests an intergenerational transmission of values. Given that research indicates the influence of values upon the development of attitudes (Dowds, 2003; Rokeach, 1971), this could suggest that their parents influence the environmental attitudes of children. This finding is in support of the work of Dohmen et al. (2012).

When investigating the similarity of behaviours between children and their parents, Grønhøj and Thøgersen's (2009) found consistency amongst families. They reported, "within-family correlations regarding the performance of the three specific pro-environmental behaviours are significant and positive" (Behaviour results, para. 2). This suggests the parents do influence children's environmentally related household

behaviours. This finding was replicated in regards to attitudes toward these behaviours. Grønhøj and Thøgersen's (2009) reported, "significant positive correlations between parents' and adolescents' attitudes towards each of the three everyday pro-environmental behaviours" (Attitudes results, para. 2). This data further suggest the transmission of environmentally related attitudes from parents' to their children. Another important finding was the differences between the generations as a whole. Grønhøj and Thøgersen (2009) reported that values, attitudes and behaviours were less positive in the children's generation than in the parent's generation. Grønhøj and Thøgersen (2009) explained that the reason for this intergenerational gap is the 'life-stage' barriers that adolescent children experience at this developmental stage, where: peers; media; resources; and opportunities were cited as examples of potential barriers (Socialisation and the IG transfer of values, attitudes and behaviours, para. 1). This also relates to Eagles and Demare (1999) with their identification of the 'solidifying' of attitudes in adolescent children, compared to younger children whose attitudes are more susceptible to change. This highlights the significance of attempts to positively change children's attitudes occurring at a much younger age.

Attitudes to Sustainability

This section of the chapter reviews the literature to identify several key themes relating to attitudes to environmental sustainability.

The development of surveys can involve the identification of theme sets. Michalos, Creech, McDonald and Hatch Kahlke (2009) explained the significance of firstly identifying a set of themes to be used in the development of a survey of attitudes to sustainable development. They suggested that once a list of themes was identified then they could develop a survey of people's knowledge, attitudes and behaviours regarding sustainable development. The CATES project was designed by Musser and Malkus (1994) to measure children's attitudes toward environmental issues through several key themes. These themes guided the development of the 25 items in the scale, and included: recycling (3 items), conservation (8 items), animal protection (6 items), nature appreciation (4 items) and pollution (4 items). The identification of these themes suggests that children do hold measurable attitudes to these environmental issues, many of which are similar to the themes that were used to inform development of the CASS used in the present study, as shown in Table 2.

Table 2: Survey themes

(Musser & Malkus, 1994): Children's Attitudes Toward the Environment Scale	(Eagles & Demare, (1999) Sunship Earth Program evaluation	Present study (2011): Children's Attitudes to Sustainability Survey
Recycling	Ecologicistic	Litter and rubbish
Conservation		Habitat conservation
Animal protection		Biodiversity (plants and animals)
Nature appreciation		
Pollution		Air pollution
		Water pollution
	Moralistic	Mutual responsibility
	Ecologicistic/ Moralistic	Resource use
		<i>Interconnections</i>

This suggests that five of the themes used in the CASS, including: litter and rubbish, habitat conservation, biodiversity, air pollution, and water pollution, matched themes used in the CATES, as well as the ecologicistic themes used by Eagles and Demare (1999). The theme Mutual Responsibility matches Eagles and Demare's (1999) moralistic attitudes, and the theme Resource Use aligns with both ecologicistic, as well as moralistic attitudes. The theme interconnections emerged after completion of the CASS and as such did not inform the development of items.

The need to develop in an environmentally sustainable way is recognised broadly in the international community. Dunlap (1994) described the results from the George H. Gallup International Institute's 'Health of the Planet' survey conducted in 1992. People from 24 countries were surveyed, varying geographically and economically. The sample sizes in most countries ranged between 1000-1500 people, with the exception of India having 4984 surveyed. People were interviewed in a face-to-face method at home. The Health of the Planet survey consisted of 10 questions, with a mix of open-ended questions, closed questions and Likert scaled questions. Seven questions asked participants to respond to environmental issues, including: the quality of local, national and world environments; the seriousness of environmental problems at local and world levels; contributors to environmental problems in developing nations; actions industrialised nations could take to help developing nations; giving monetary support to an international environmental agency; and an international environmental agency influencing government policies. Each of these questions used Likert scales, with six of

the questions using 4-point scales and one using a 5-point scale. The survey also included two closed questions. One of these related to responsibility for the world's environmental problems and asked participants to choose from three options. The second closed questions addressed options for assisting developing nations and asked participants to choose from five options. One open-ended question relating to environmental problems faced by nations was included in the survey and this addressed environmental problems facing nations. When discussing the results of this survey, Dunlap (1994) claimed, "environmental deterioration is seen as very serious by citizens of all types of nations" (p. 125). The viewing of environmental deterioration in such a serious way is a crucial aspect to achieving environmental sustainability. The questions used in the present study aimed to develop an understanding of young children's attitudes toward sustainability. The questions addressed various aspects of environmental deterioration, including litter, water pollution, air pollution, habitat loss and loss of biodiversity. The responses indicated if the participating children also viewed environmental deterioration seriously.

Leiserowitz, Kates, and Parris (2005) described the results from the Environics International Environmental Monitors (EIEM) survey conducted in 2000. Environics International Ltd (2014) explained that participants from 11 developed countries and 23 developing countries were surveyed via face-to-face or telephone interviews. Each country had a sample size of around 1000 people, with a total of 35162 people surveyed. This survey focused on the attitudes of people from around the world to issues of natural resources and environmental issues. It consisted of 108 questions, including 86 questions using either 4-point or 5-point Likert scales, and 22 closed questions where participants were required to select 1 out of several options. Participants were asked nine more questions relating to their demographics. This study confirmed international agreement over the serious nature of environmentally sustainable development. Leiserowitz et al. (2005) stated that the results:

[D]emonstrate very high levels of public concern about a wide range of environmental issues, from local problems like water and air pollution to global problems like ozone depletion and climate change.
(p. 26)

Eagles and Demare (1999) underscored the significance of viewing environmental sustainability as a serious way forward; for example: they emphasised research that related the theme of moralistic attitudes toward the environment in 10-11 year old

children. As such, the idea of viewing environmental sustainability in a serious way was used to inform items in the CASS.

Dunlap's (1994) discussion of the 'Health of the Planet' survey further informed the questions included in this study's survey. Participants in the survey were asked to rate the quality of the environment in their nation. When asking this question, the natural environment was defined as, "the air, water, land and plants and animals" (Dunlap, 1994, p. 117). These four dimensions relate to each of Musser and Malkus' (1994) identification of themes in the CATES, including: recycling; conservation; animal protection; nature appreciation, and pollution. Dunlap's (1994) four dimensions, along with Musser and Malkus' (1994) themes, and Eagles and Demare's (1999) ecologicistic and moralistic attitudinal study, were used to shape questions relating to the environment in the survey used in the Oceanside Clearwater Creek (2011) study.

Dunlap (1994) further reported that residents from both developing and industrialised countries around the world share similar views regarding shared responsibility of environmental problems in developing countries: "There is little evidence of a strong tendency for the poor to blame the rich, and vice versa; rather, there tends to be widespread acceptance of mutual responsibility for environmental problems" (Dunlap, p. 122). The theme of mutual responsibility is another key element to environmental sustainability. Evidence that this can be explored in children was given through Eagles and Demare's (1999) investigation of children's moralistic attitudes toward the environment. The present study further explored the children's attitudes to sustainability by asking questions that address the idea of mutual responsibility.

As evidence, Leiserowitz et al. (2005) described the results from the World Values Survey Wave 4; conducted from 1999-2004. The World Values Survey Association (2014) explained that this survey was conducted in 96 countries each with a minimum of 1000 people being surveyed in each country, through face-to-face or telephone interviews. The survey aimed to investigate the diverse range of values that people hold from around the world. It consisted of 235 questions, plus 10 questions seeking information on participants' demographics. The questions included a mix of closed questions that asked participants to respond by selecting one or several options; and Likert scaled questions with 3-point, 4-point, 5-point and 10-point scales. Leiserowitz et al. (2005) explained that from the people who were surveyed through the World Values Survey in 2000, (76%) of participants agreed that people should, "coexist

with nature”, as opposed to, “master nature” (p. 25). Leiserowitz et al. (2005) further explained that the results from the World Values Survey in the United States in 2002, suggested that they, “strongly agreed that nature has intrinsic value and that humans have moral duties and obligations to animals, plants, and non-living nature (such as rocks, water, and air)” (p. 25). These results reinforced the significance of responsibility in environmental sustainability. It also suggested that it is our moral responsibility as human beings to care for the environment and its various aspects. This too relates to the study of moralistic attitudes in children completed by Eagles and Demare (1999). As such, this study also addressed attitudes of the children in this study, towards responsibility for the environment.

Furthermore, Leiserowitz et al. (2005) reported that in the EIEM 2000 survey of 34 countries worldwide, “52 percent of the global public said that if no action was taken, ‘species loss will seriously affect the planet’s ability to sustain life’ just 20 years from now” (p. 26). The value of biodiversity is another theme essential to environmental sustainability. This was also supported by Musser and Malkus’ (1994) identification of animal protection and conservation as key themes for the CATES, and by Eagles and Demare (1999) when they studied children’s ecologicistic attitudes toward the environment. As such, biodiversity was also explored through questions asked of the participants in this study.

However, within this international community there are groups of people who hold negative or apathetic attitudes towards sustainability. Despite increasing environmental awareness of farmers, Lowe and Pinhey (cited in Filson, 1993) claimed: “rural people are usually less environmentally inclined than urbanites” (p. 166). The present study was conducted in a rural area and examined the attitudes of rural children of Oceanside Clearwater Creek, to environmental sustainability.

Vogel (1996) describes the results of a questionnaire completed in 1991 with 2095 Austrian farmers. He explained that the questionnaire predominantly used scaled items with a 7-point scale, plus the inclusion of some multiple-choice questions. The questionnaire consisted of 39 items in total and was based around six themes, including:

1. Personal value system (six scaled items);
2. Problem-based environmental knowledge (five scaled items and one closed question);
3. General attitudes towards the environment (seven scaled items);
4. Environmental attitudes as a farmer (nine scaled items);

5. Feeling of stress (one scaled item and one closed question); and
6. Preparedness to act (six scaled items, two closed questions and an open question).

(A list summary from Vogel, 1996)

Vogel (1996) found that general attitudes to the environment and environmental attitudes as a farmer were significantly influenced by the location and size of the farm. This reinforced that rural people hold a variety of attitudes towards issues of sustainability. Given the recognition that children's attitudes are influenced by their parents attitudes and by the attitudes of people surrounding them (Dohman et al., 2012; Grønhøj & Thøgersen, 2009), it follows that rural children's attitudes toward the 'environment' could also vary.

Habitat conservation is another theme of environmental sustainability, which is relevant to the community in which this study is conducted. Leiserowitz et al. (2005) defined sustainable development as, "meeting human needs and reducing hunger and poverty while maintaining the life-support systems of the planet" (p. 23). This definition highlights the significance of sustaining the natural, life-support systems of the environment. The 'life-support systems' refer to: the air, water and land in the environment, but another key aspect that must be considered is 'habitat'. Habitat is affected by farming and other land use practices in many different ways in this community and has a direct impact on biodiversity. One example of this; is when farmers use sprays and fertilisers in paddocks. These can leach into waterways and affect the balance of ecosystems. Another example: is the clearing of native vegetation for road widening, gravel pits or farming. The theme of habitat conservation relates directly to the identification of conservation by Musser and Malkus' (1994) as a theme relevant for CATES, and to the ecologicistic attitudes of children investigated by Eagles and Demare (1999). The theme was also addressed in the CASS used in the present study as it directly impacts environmental sustainability.

Questions in the CASS were also informed by a survey conducted by Filson (1993) that investigated differences in farmers' attitudes to sustainable agriculture. Completed in 1991, this study surveyed 1105 farmers from Ontario. Filson (1993) explains that the survey consisted of 30 items: (15 were related to, "... opposition to the use of agricultural chemicals ..."; six addressed, "... support for the use of high control interventions ..."; four related to, "... environmentalist orientation ...", and five addressed, "... conservation attitude" ... p. 170). Participants responded to the items in this survey through a 5-point Likert scale. Filson (1993) compared the results of this

survey with the results of a survey (though slightly modified) completed in conjunction with his, by Australian farmers Alan Black and Ian Reeve. When comparing farmer's attitudes towards sustainability from Ontario and Australia, Filson (1993) found that: "Australian farmers were also more likely to feel that the things conservationists are trying to protect are not worth worrying about and were more suspicious about the attention the government pays to the Green Movement" (p. 180). Along with these feelings of scepticism, Filson (1993) claimed: "Australian farmers also felt they had a right to receive the financial benefits of primary producer status regardless of whether they follow sustainable agricultural practices" (p. 180). Attitudes including not valuing the conservation of habitat, scepticism towards global warming and an unwillingness to explore sustainable practices were likely to be evident in the community in which the study was conducted. It would be expected that these attitudes could be reflected in the children's attitudes, given that Dohman et al. (2012), as well as Grønhøj and Thøgersen (2009) identified the significant influencing role of parents and community in the development of children's attitudes.

Another issue of environmental sustainability that some people hold negative attitudes toward is the responsible use of fishing resources. Reser (2007) claimed a significant threat to Australia's natural environment is the, "imminent exhaustion of fisheries stocks" (Reser, p. 2). The researcher has learnt through involvement in the Oceanside Clearwater Creek that this problem is evident in this community, as there are some people who engage in unsustainable fishing practices and hold negative attitudes toward the fishing quotas (i.e., regarding sizes and limits). This example: suggests another critical theme to environmental sustainability is the responsible use of natural resources. This theme was addressed through the exploration of children's ecologicistic attitudes in the Eagles and Demare (1999) study, and as such it was also used to inform the development of items in the CASS.

Through reviewing the literature related to surveying attitudes to sustainability, six key themes were identified:

1. Mutual responsibility;
2. Environmental deterioration through litter and rubbish;
3. Environmental deterioration through water pollution;
4. Environmental deterioration through air pollution;
5. Valuing biodiversity; habitat conservation; and

6. The sustainable use of natural resources through responsible fishing practices.

These identified themes were used to inform a set of items in the CASS (see Appendix B ii) that develop an understanding of the children's attitudes toward sustainability. The responses indicated what the children's attitudes towards issues of environmental sustainability were.

Conceptual Framework

The final section of Chapter Two synthesises the reviewed literature in the form of a conceptual framework model, which is presented in Figure 2.

This (2011) study was influenced by the current international and national recognition of education for sustainability and was based on social constructivist learning theory. It drew heavily from the Australian Academy of Science (2012) resource, *PrimaryConnections* and incorporated Maslow's hierarchy of needs and AaTSI perspectives. The study aimed to develop positive attitudes to environmental sustainability in young children through participation in the sustainability science-program.

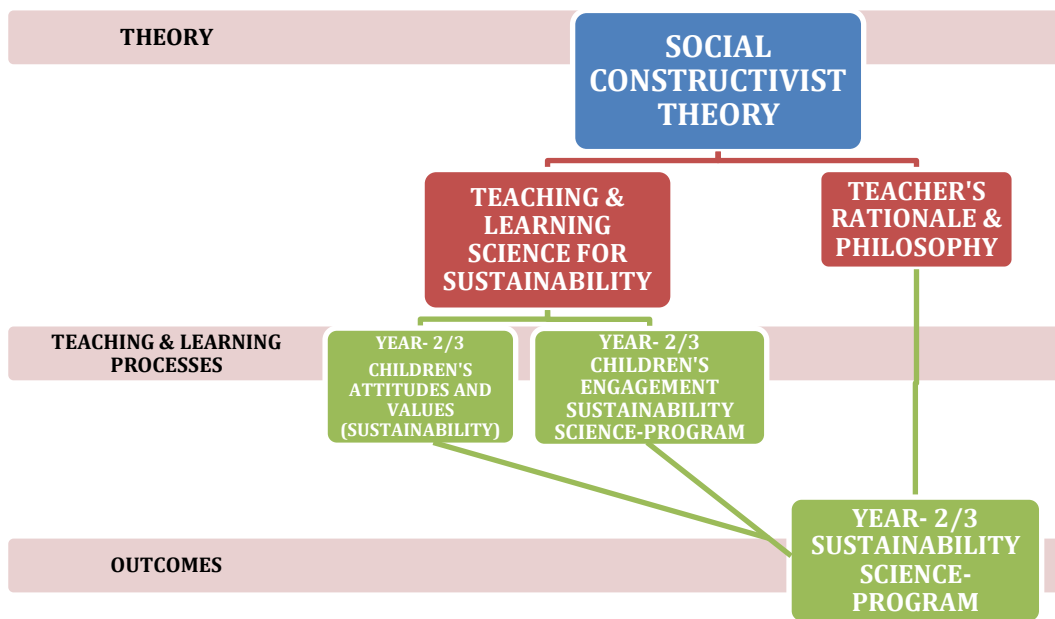


Figure 2: Conceptual Framework

Chapter Three

Methodology

Introduction

This ethnographic study used mixed methods to investigate attitudes in young rural children to environmental sustainability. This approach allowed the triangulation of qualitative and quantitative data to gain a deeper understanding of the development of children's attitudes. This chapter describes in detail: the research design, the children participating in the study, the sustainability science-program, phases of the research, methods of data collection, data analysis, quality criteria and ethical considerations.

Research Approach

This research was premised on the need to improve children's learning for sustainability. This ethnographic study aimed to inform sustainability education by investigating and documenting young children's attitudes to environmental sustainability and by building understanding about how sustainability science teaching and learning impacted on the children's attitudes and behaviours to their local environment. It also aimed to understand young children's attitudes to issues of environmental sustainability through its ethnographic nature. This section of Chapter Three defines and describes the features of ethnography as they relate to this study.

It has been recognised that ethnography refers to research activities of a particular social or cultural setting, involving field work whilst being immersed in that setting; as well as to the written account presenting that research (Caines, 2010; Murray, 2008; Ybema, Yanow, Wels & Kamsteeg, 2010). Brewer (1994, 2000) clarifies these research activities by explaining that ethnography refers to both a methodology, that is, a form of: "qualitative research as a whole" (2000, p. 10); and on a smaller scale, to a method of data collection, that is fieldwork. When referring to ethnography as fieldwork, Brewer (2000) defines it as:

The study of people in naturally occurring settings or 'fields' by means of methods which capture their social meanings and ordinary activities, involving the researcher participating directly in the setting, if not also the activities, in order to collect data in a systematic manner but without meaning being imposed on them externally. (p. 10)

This definition identifies several key aspects of ethnography including; immersion through active participation by the researcher, field work, the process of data collection, and the need to balance involvement of the researcher with the imposition of meaning on the study.

Immersion in the environment and setting of the study is an essential aspect of ethnography. Brewer's (2000) definition of ethnography identified immersion through the role of the researcher being highly active by, "participating directly in the setting, if not also the activities" (p. 10). Ybema et al. (2010) elaborated on this when they wrote: "By participating in people's lives, researchers develop an understanding 'from within', describing situational members' lived experiences in detail and in depth" (p. 348). This suggests that the teacher/researcher role in ethnography is to become an active and direct participant in people's lives. Caines (2010) explained the benefit of such participation by claiming: "Cultural/social immersion is irreplaceable for providing a way of seeing" (p. 433). This "way of seeing" (p. 343) links strongly to Ybema et al.'s (2010) recognition that immersion allows for an "understanding from within" (p. 348). Each of these authors recognise that immersion provides the researcher with a unique ability to gain a deeper, empathetic understanding of people through active involvement in the setting and in their lives. The researcher was completely immersed in the setting in which this study was based. This was due to having lived in the town and taught in this particular school for seven years before conducting the research. The researcher also participated actively in local sporting and community groups, and had taught some children in this class the year previously so had well-established relationships with the children and their families. This active participation in the children's lives assisted the researcher to gain an understanding of the children 'from within', as described by Ybema et al. (2010).

Bell (2005) explained one potential problem with ethnography as the time that it can take for the researcher to develop relationships with the people, and understandings of the social context in which they are researching. She wrote:

The researcher has to be accepted by the individuals or groups being studied, and this can mean doing the same job, or living in the same environment and circumstances as the subjects for lengthy periods. (Bell, 2005, p. 17)

Through living in the town for several years, the researcher had established active participation in the community. The researcher had taught many family members of

many children in the study; therefore the children and their families had already accepted the researcher, so 'acceptance' was not a problem.

Brewer's (2000) identification of participation in the field is central to ethnographic studies. Fieldwork, as outlined in his definition of ethnography, involves the study of people in environments, or settings, in which they behave naturally and participate in ordinary activities (Brewer, 2000). However, in this definition Brewer (2000) has not identified the need for fieldwork to be sustained over a period of time as highlighted by Murray (2008). She claims the, "hallmark of ethnographic research is long-term fieldwork within a particular environment, setting, or group of people." (Murray, 2008, p. 367) Fieldwork was an essential element undertaken throughout this study. The teacher/researcher used surveys to collect data for two weeks before implementation of the sustainability science-program; then collected data whilst implementing the sustainability science-program for 10 weeks (not inclusive of two weeks school holidays during this time); and finally used surveys and interviews to collect data for two weeks after completion of the sustainability science-program. Whilst the 14-week duration of this study may not be considered long-term it was an appropriate time frame for completion of a science-program with young children.

Another important aspect of fieldwork in ethnography concerns who collects the data. Caines (2010) also confirms that fieldwork should be completed over an extended period of time, noting there is an expectation that, "the ethnographer goes into the field to collect [her] own data" (p. 433). The teacher/researcher completed the majority of the field work in this study, with the exception of the formal children's interviews conducted after participation in the sustainability science-program and the surveys conducted before and after the sustainability science-program. The AIEO was chosen to complete these with the children to reduce the desire in children to give answers they thought would be 'correct' instead of what they actually believe, and to help children feel more comfortable as they were familiar with her. Brewer (2000) explains that this is referred to as the interviewer effect. He claims that the socio-demographic factors between the interviewer and the respondent can influence the answers that are given and that the researcher should try to reduce this effect by matching the demographics of the people involved in the interview. The AIEO was chosen to conduct the formal interviews so that both AaTSI and non-AaTSI children would feel more comfortable giving their responses. The AIEO completed interviews with both AaTSI and non-AaTSI children, was given very explicit instructions regarding conducting the

interviews and what feedback she could give, and was given the predetermined questions beforehand. These measures were taken to ensure a constant interviewer effect, as suggested by Brewer (2000).

A unique feature of ethnography is the research process that is used. Given the unpredictable nature of working with people in 'real' world contexts, Brewer (2000) described the research process in ethnography as flexible in its nature and consisting of several planned events that are blended together, as opposed to a set of sequential stages. He continued that careful research design in ethnography could include the triangulation of data. Caines (2010) explained that the triangulation of data is common in ethnography as multiple methods are used to, "flesh out the complexities of a setting" (p. 432). It has been recognised that three common methods of data collection used in ethnography include observation, interviews and analysing documents (Brewer, 2000; Caines, 2010; Murray, 2008; Ybema et al. 2010), each of which have been used in this study.

A final aspect of ethnography as identified by Brewer's (2000) definition is balancing the active role of the researcher with not imposing meaning on the study. Ybema et al. (2010) explain that whilst immersion in the setting is important, a balance must be obtained between participation in the fieldwork and keeping enough distance to observe things critically as a researcher. Both Brewer (2000) and Ybema et al. (2010) recognise the need for the researcher to be an active participant in the setting but also not to impose any meaning on the study. Ybema et al. (2010) explain this process of balancing the roles of active participant and critical observer by suggesting that when the researcher is immersed in the setting they need to, "regenerate a basic wonder about the unexpected ... in order to make what seems familiar and understandable strange again" (p. 349). The researcher in this study maintained a balance of the two roles by participating actively whilst critically reflecting on occasions, but also by spending time being less actively involved in the setting. On occasions throughout sessions in the sustainability science-program, the researcher would reframed from active participation in the immediate context, in order to purely observe and record notes on behaviours and conversations had amongst the children and between the teacher and the children. This created an opportunity to, "regenerate a basic wonder" (Ybema et al. 2010, p. 349) when the researcher thought this was needed.

Another way that the researcher attempted to not impose meaning on the study was through critical reflection of potential influencing factors. Brewer (1994) suggests

that a problem with some ethnographers is that they do not reflect critically on their work by considering, “the influence of such factors as the location of the setting, the sensitivity of the topic, or the nature of the social interaction between the researcher and the researched” (p. 233), each of which were considered in this study. The setting of this study was familiar with the children as it included their regular classroom, the school grounds and the local Clearwater Creek. The familiarity of the settings should have enabled children to feel comfortable and behave naturally, thereby reducing any potential imposition of meanings on data and the study.

Somewhat controversial topics were used in the sustainability science-program in this study through the use of stimulus images that related to issues of sustainability, such as fishing restrictions and size limits. Children had some familiarity with these topics and they were discussed in a sensitive manner. This was achieved through whole class discussion where all children had the opportunity to listen to others and the option of contributing verbally or not. After much discussion, children were given time to reflect privately on the issues by individually writing or drawing their reflections in their science journals. The researcher directed the discussion of the stimulus images through the use of open questions with the children and was careful to avoid giving personal opinions and attitudes, or giving positive or negative responses to children’s contributions. With critical thought and consideration given to the planning and implementation of sessions, and to the teacher/researcher’s presentation of ideas, topics were handled with sensitivity, thereby not imposing meaning on the study.

Consideration was also given to the relationships and the interactions between the teacher and the children. Although there is a difference in the ‘power’ involved in the relationship between the teacher and the children, the establishment of strong, positive relationships assisted in reducing the potential for uncomfortable feelings and potential unnatural behaviours by the children in regard to the teacher-child relationship. The teacher behaved in natural ways during the implementation of the sustainability science-program, which encouraged positive social interactions between the teacher and the children. These behaviours included; prompting children’s thought with questions; giving positive and constructive feedback regarding children’s work and behaviours; valuing children’s contributions to class discussions regardless of whether or not they were scientifically correct or reflective of a common attitude; and encouraging children’s participation through maintaining a safe environment. Consideration was also given to the socio-demographic differences between the teacher and children. This was

assisted with the use of the AIEO to conduct the formal interviews at the end of the sustainability science-program as well as the attitude surveys at the beginning and end of the sustainability science-program, and also the inclusion of the AIEO in everyday class activities during the program. The incorporation of AaTSI perspectives and education into the sustainability science-program also addressed the socio-demographic differences between the teacher and children and assisted in helping AaTSI children feel more comfortable. These measures assisted the positive relationships and interactions between the children and the teacher, as well as the children and the AIEO, which further reduced any imposition of meaning on the study.

Summary of the research

Table 3 shows the link between the research questions formulated at the beginning of the study and the particular data sources. It also shows how those data sources were analysed.

Table 3: Summary of research

Research question	Data source	Data analysis
What are Year-2/3 children's attitudes to issues of environmental sustainability in a small rural town, as a consequence of a sustainability science-program?	Pre and post-program survey, children's science journals, teacher observations, children's work samples, teacher reflections, formal and informal interviews.	Code all qualitative and quantitative data into themes. Analyse development of attitudes within themes. Compare frequencies of scores in pre- and post-program surveys.
How can a sustainability science-program facilitate young children's engagement with and development of positive attitudes to issues of environmental sustainability?	Children's science journals, teacher observations, children's work samples, teacher reflections, formal and informal interviews.	
How can junior primary teachers promote environmental sustainability in schools?	Children's science journals, teacher observations, children's work samples, teacher reflections, formal and informal interviews.	

Selection of participants and context

The children who participated in the sustainability science-program in 2011 were aged between seven and eight years, with a mean age of 7.5 years and were from the same class and the same government school. They came from varied socioeconomic and family backgrounds, and lived in a rural setting. There were seven year 2 children and eight year 3 children as shown in Table 4.

Three children lived on farms while the other 12 lived in town. Two children had a parent working in the police, eight children had a parent who works in the mining sector and two children had a parent involved in small business. Five of the 15 children were AaTSI. Several children had unstable home environments with various serious issues associated, which largely impacted on the children's attendance and progress at school. Five of the children were achieving below the expected level in literacy and/or numeracy based on teacher judgments and NAPLAN results.

Given the differing family backgrounds of the children it was important to consider their particular needs. Using the notion of a 'hierarchy of prerequisite needs', in context with age appropriate developmental considerations (Piaget, 1964), as well as accommodating Maslow (1954), "people are motivated to fulfil basic needs before moving on to other needs" (cited in Cherry, 2010, para. 1). Under this study, the needs of the children were accommodated. According to Maslow (1954), it is important that a child's physiological and safety needs are met, along with their need to belong and for self-esteem. An example of the need to consider Maslow's ideas in the implementation of this study is that some children from Oceanside Clearwater Creek attended school without having had breakfast, or very little sleep. These factors were taken into account throughout the study, as an ethical consideration, and as possible influences. If the lower level needs of these children were not being met, then they wouldn't have been in a position to gain the most from their time at school and to develop their attitudes towards sustainability.

Table 4: Participant details

Name	Year at school	Age during study	Boy/ Girl	AaTSI yes or no	Parental/ Care giver Occupations	Live on farm or in town
Anne	2	7	girl	no	- childcare - mine	town
Alan	2	7	boy	no	- shire - mine	town
Betty	3	8	girl	yes	Mine	town
Brian	2	7	boy	yes	Mine	town
Cathy	2	7	girl	no	- shop assistant/educational assistant - police	town
Denise	2	7	girl	no	- nurse - farmer	farm
Ella	2	7	girl	no	Home handyman	town
Colin	3	8	boy	no	- shop assistant - police	town
David	3	8	boy	no	- teacher - farmer	farm
Fay	3	8	girl	yes	Mine	town
Edward	3	8	boy	yes	- Educational assistant - Mine	town
Grace	3	8	girl	no	unemployed	town
Helen	3	8	girl	no	mine: managing	town
Gary	2	7	boy	no	Painter and gardener	farm
Henry	3	8	boy	yes	Mine	town

Sustainability science-program

A key part of this study was the implementation of a sustainability science-program. This program was based on the Learning for Sustainability Approach and the 5E Instructional Model (Bybee et al., 2006). The Australian Curriculum: Science (AC: Science) guided the development of the program and Kagan (2009) Cooperative learning strategies were incorporated. The sustainability science-program aimed to promote children's science understandings of the interdependence of living and non-

living things through: the investigation of the needs, structures, growth and life cycles of locally found small animals; and through planning, conducting and evaluating an investigation of local plant habitats. It also aimed to develop children's care for the environment and the promotion of environmentally sustainable attitudes. This sustainability science-program was tailored to suit the needs of the participating children as it incorporated classroom work and excursions to the local Clearwater Creek, and included AaSTI perspectives and education. A detailed copy of this program can be found in Appendix D and the relevant teacher made resources in Appendix E.

PrimaryConnections 5E model

The Australian Academy of Science (2012) resource, PrimaryConnections, was used as a basis for the development of this sustainability science-program. PrimaryConnections' program 'Schoolyard safari' has formed the outline of the program, though this has been added to and some parts have been changed to make it relevant to the children in the study. The Schoolyard safari program is structured in accordance with the 5E model originally developed by Rodger Bybee (Bybee et al., 2006). The Bybee-5E model is based on social constructivist learning theory, meaning that children work collaboratively to construct new knowledge. It also involves the children working out ideas and explanations for themselves (Australian Academy of Science, 2010a). The Bybee-5E model requires that the five sequential phases: engage, explore, explain, elaborate and evaluate be used in units of work (Australian Academy of Science, 2010a) and is summarized in table 5.

Table 5: Bybee-5E instructional model summary

Phase	Description	Sessions in sustainability science-program
Engage	Excite children, activate prior knowledge and introduce topic	1
Explore	Children use own language to explore a scientific concept through a shared learning experience	2-3
Explain	Offer scientific language and concepts to explain experiences	4-9
Elaborate	Children apply understandings and skills to new situations	10-11
Evaluate	Children reflect on their learning and demonstrate knowledge	12-14

Engage

The Engage phase involves activating prior knowledge in children and exciting them about the topic (Australian Academy of Science, 2010a). Schoolyard safari suggests a school walk focusing on small animals found in the schoolyard environment. This sustainability science-program broadened the focus to also include living things (plants and animals), as these would play a large role in the group investigations later. The sustainability science-program also included the discussion and reflection of acting responsibly in the children's science journals in Session-1.

Explore

The Explore phase involves the children participating in a shared learning experience and using their own language to discuss and explores a scientific concept (Australian Academy of Science, 2010a). In Session-2, this sustainability science-program provided opportunities for children to: compare, classify and sort their collected specimens (and photographs) taken from Session-1. During this task children used their own language to justify why they grouped different specimens together as they explored and developed their understandings of sorting.

The sustainability science-program also provided the opportunity for children to explore their ideas of environmental interconnections. Session-3 involved the children participating in a shared interdependence activity at Clearwater Creek. This activity was included because it introduced the children to Clearwater and because it gave them the opportunity to use their own language to describe the concept of environmental interconnections.

The Schoolyard safari program suggested that children be involved in the exploration of the features, habitats and behaviours of earthworms, snails and ants. This sustainability science-program provided opportunities for children to explore the features, habitats and behaviours of earthworms through the exploration of a worm farm. It also allowed for the exploration of the features, habitats and behaviours of witchetty grubs and honey ants. Witchetty grubs and honey ants were included in the sustainability science-program to incorporate AaTSI perspectives and to increase the relevance of the program to the children. Children first read a poem called 'Honey Ants' (McDougall, 2000, p. 28). They were then shown pictures of honey ants and of witchetty grubs. Children shared stories about these creatures and then discussed their habitat, behaviour and features.

Tadpoles were also included in the sustainability science-program and explored by the children. This was done so that children had the opportunity to see small

creatures in their natural habitat and to develop understandings of creatures in the local environment at Clearwater Creek. These inclusions in the explore phase made the sustainability science-program more relevant to the participating children in this context.

Explain

The Explain phase involves the introduction of scientific vocabulary and concepts as explanations for the children's experiences (Australian Academy of Science, 2010a). This sustainability science-program allowed for children's ideas about earthworms to be explained through the reading of a class big book, the discussion of features of earthworms and the illustration of scientific diagrams of earthworms. This occurred in Session-4 after the children had first explored earthworms and used their own language to describe the experience. The sustainability science-program planned to explain the earthworms immediately after exploring them because of the point of need. The children had just completed a hands-on, shared experience with ideas and experiences fresh in their minds. The most effective time to expand on these ideas by offering scientific vocabulary and views was immediately.

The Schoolyard safari program suggests the introduction of current scientific views about features, habitats and behaviours of small creatures, and that children make comparisons of the similarities and differences between small creatures. This sustainability science-program allowed for the explanation of witchetty grubs in Sessions five and six. The Year-2/3 children learnt about how AaTSI cultures use witchetty grubs and how they are collected. Part of this involved the AIEO and the children from the class adding relevant AaTSI words to the word wall. They were also involved in making clay models of witchetty grubs to demonstrate their understanding of the features of them.

This sustainability science-program involved the explanation of tadpoles during the same session that they were being explored, Session-7. This was done to suit the context. Whilst on excursion at Clearwater Creek and in the natural environment it made sense to further develop children's own ideas by offering current scientific views about the creatures, at the point of need. A model of the life cycle was taken to the creek and the children were able to look at this model and compare it to the tadpoles they could see that they had just caught in the creek. This could not have been done as effectively had the children's experiences been explained at a later date and when the context had been removed.

This sustainability science-program included Sessions 8 and 9, which focused on the term 'biodiversity'. During these sessions the children were involved in reflecting in their science journals about the meaning of biodiversity and about stimulus images that relate to biodiversity and animal life. The inclusion of the biodiversity sessions relates directly to earlier sessions where different creatures have been explored and explained. It also provided an opportunity for the introduction and exploration of the scientific concept of biodiversity.

Elaborate

The Elaborate phase involves children discussing their ideas and applying their understandings or skills to new situations (Australian Academy of Science, 2010a). Schoolyard safari suggests that children be guided in planning and conducting an investigation that compares different types of animal's habitats, including looking at the type and number of animals found. This sustainability science-program provided the opportunity for children to discuss habitats and suggest habitats found at Clearwater Creek. It focused on plants as habitats (such as reeds or a eucalypt tree) to allow for deeper understandings of the connections amongst animals and plants. Children worked in groups to choose a habitat and plan and conduct an investigation into the types and numbers of animals found within that habitat. The children also used computers to design and print their own recording sheet for their investigation.

Evaluate

Evaluating involves the children reflecting on their learning and skills and demonstrating any changes to these (Australian Academy of Science, 2010a). The Schoolyard safari program suggests children have the opportunity to show what they know about features, behaviours and habitats of small creatures and to reflect on their learning. The sustainability science-program firstly required children to organise and represent their data collected from the investigations. The children constructed tables for their data and used the interactive whiteboard to construct simple bar graphs. They then showed their data to the rest of the class and discussed what they found. Also during this session they reflected on stimulus images 17-20 as they related to habitat conservation.

In Session-13 the class as a whole offered simple explanations for the results and the children worked in their groups to complete a teacher made evaluation sheet. This focused on what species the children found, why they thought they lived there, how species used their habitats, difficulties in the investigation, things learnt, what the

children enjoyed, what they could investigate from here and how they could care for biodiversity at Clearwater Creek. Ideally the class would have next discussed things they could do to care for Clearwater Creek and this could then occur. With guidance the children decided to plant trees at Clearwater; however, given the rainfall and the timing in the year, this had to occur after Session-4. If this could happen at the end of the sustainability science-program it would allow children to reflect on ways in which they could help environmental sustainability and further develop a sense of responsibility. At the conclusion of the sustainability science-program, the children completed written reflections in their science journals about what they had learnt throughout the program.

Learning for Sustainability Approach

The Learning for Sustainability Approach motivated children to reflect critically on the way they live and make informed decisions regarding the environment (Tilbury et al., 2005). The key elements involved active child participation, and giving individuals control of the learning process, as explained in the literature review. ARIES (2004-2009) explained that the processes: envisioning a better future; critical thinking and reflection; participation; partnerships for change; and systems thinking, guide the key elements and underlie the development of the sustainability science-program. Table 6 summarises the application of the Learning for Sustainability approach to the sustainability science-program used in this study by highlighting the links from each session to the relevant processes and sustainability themes that were addressed.

Table 6: Sustainability science-program: Processes and themes

Session	Activities	Sustainability theme	Learning for sustainability process addressed	How process was applied to activity
1	Children act responsibly during a school walk whilst collecting and recording living things. Reflect on what acting responsibly is and how they did this.	Mutual responsibility	Envision a better future	Inspire, motivate and empower children to realise they can make positive changes to environment by acting responsibly
2	Classify photos and specimens of living things by looking for similarities and differences. Reflect on classification.	Biodiversity	Critical thinking and reflection	Children think critically and creatively about the classification of organisms
3	Excursion to Clearwater Creek: record living and non-living things. Interdependence activity: demonstrate and discuss relationships between living and non-living things at Clearwater Creek. Discuss care for local environment.	Interconnections	Partnerships for change Systems thinking	Excursion fosters sense of responsibility for and ownership of the environment and children create shared vision. Viewing the whole process and seeing the relationships between organisms and between the living and non-living parts of the environment.
4	Observe and record information about the diet, behaviour, habitat and features of earthworms	Biodiversity Interconnections	Systems thinking	Viewing the whole process and seeing the relationships amongst organisms, and between living and non-living parts of environment.

Session	Activities	Sustainability theme	Learning for sustainability process addressed	How process was applied to activity
5	Discuss the diet, habitat, structure and cultural significance of witchetty grubs and honey ants.	Biodiversity Interconnections	Systems thinking	Viewing the whole process and seeing the relationships amongst organisms, and between living and non-living parts of environment.
6	Construct clay witchetty grubs focusing on structure of grubs Discuss and reflect upon Stimulus images 1-4 related to litter and working together	Biodiversity Interconnections Litter and rubbish Mutual responsibility	Systems thinking Partnerships for change	Viewing the whole process and seeing the relationships amongst organisms, and between living and non-living parts of environment. Discussion of sustainable and unsustainable practices creates a shared vision of what is acceptable and not.
7	Excursion to Clearwater Creek Observe and record information about the diet, habitat, features and life cycle of tadpoles Discuss and reflect upon stimulus images 5-8 related to water and air pollution	Biodiversity Interconnections Water pollution Air pollution	Partnerships for change Systems thinking Partnerships for change	Excursion fosters sense of responsibility for and ownership of the environment and children create shared vision. Viewing the whole process through seeing the relationships amongst organisms and between living and non-living parts of environment. Discussion of sustainable and unsustainable practices creates a shared vision of what is acceptable and not.

Session	Activities	Sustainability theme	Learning for sustainability process addressed	How process was applied to activity
8	Define 'biodiversity' in pairs, share, discuss and write class definition Reflect individually on what biodiversity means and share	Biodiversity	Partnerships for change	Children create a shared understanding of what biodiversity is through reflecting and sharing their ideas
9	Create biodiversity display Discuss and reflect upon stimulus images 9-13 related to animal biodiversity	Biodiversity	Systems thinking	Discussing biodiversity and the relationships amongst animals as a part of the whole process.
10	Class input into planning habitat investigation, children chose which habitat to investigate and they design an appropriate recoding sheet. Discuss and reflect upon stimulus images 23-24 related to fishing responsibly	Habitat conservation Resource use	Participation Envision a better future	Children actively involved in their learning through being responsible for some decision making during the planning stages and for constructing the recording sheet. Inspire, motivate and empower children to realise they can make positive changes to environment by engaging in sustainable fishing practices.

Session	Activities	Sustainability theme	Learning for sustainability process addressed	How process was applied to activity
11	<p>Excursion to Clearwater Creek</p> <p>Conduct habitat investigation</p> <p>Discuss and reflect upon stimulus images 14-16 related to plant biodiversity</p>	<p>Habitat conservation</p> <p>Biodiversity</p>	<p>Partnerships for change</p> <p>Participation</p> <p>Critical thinking and reflection</p>	<p>Excursion fosters sense of responsibility for and ownership of the environment and children create shared vision.</p> <p>Children are actively involved in their learning by implementing their own investigation</p> <p>Children described and reflected critically upon images related to plant biodiversity.</p>
12	<p>Organise data into table and bar graph and communicate findings</p> <p>Discuss and reflect upon stimulus images 17-20 related to habitat conservation</p>	Habitat conservation	<p>Participation</p> <p>Critical thinking and reflection</p>	<p>Children are actively involved in processing and translating information collected from habitat investigations</p> <p>Children described then reflected upon images related to habitat conservation.</p>
13	<p>Evaluate investigation as a class, in small groups and individually</p> <p>Class chose tree planting as a way to help environmental sustainability at Clearwater Creek for Session-14</p>	<p>Habitat conservation</p> <p>Interconnections</p>	<p>Participation</p> <p>Participation</p>	<p>Children are actively involved in describing and evaluating their investigations.</p> <p>Children given greater control of their learning by giving their input.</p>

Session	Activities	Sustainability theme	Learning for sustainability process addressed	How process was applied to activity
14	Excursion to Clearwater Creek for tree planting	Biodiversity	Partnerships for change	Excursion fosters sense of responsibility for and ownership of the environment and children participate in fulfilling their shared vision of the local Clearwater Creek.

Australian Curriculum

The Australian Curriculum Assessment and Reporting Authority (2009a) have developed a science curriculum that integrates sustainability education, which has been used as a document around which the sustainability science-program had been planned. Sustainability has also been made a cross curricular priority within the Australian Curriculum. The K- 3 curriculum is, “organised around three interrelated strands: Science Understandings, Science Inquiry Skills and Science as a Human Endeavour” (ACARA, 2009, p. 6). These three strands have been considered in the development of the sustainability science-program and are each addressed by different sessions. Table 7 summarises the links between these strands and each of the sessions.

Table 7: Sustainability science-program: AC: Science

Session	Activity	Science Understandings	Science Inquiry Skills	Science as Human Endeavour
1	Children act responsibly during a school walk whilst collecting and recording living things. Reflect on what acting responsibly is and how they did this.	Living and non-living things.	Explore, be curious and wonder	Recognise aspects of science in everyday life Care for the environment

Session	Activity	Science Understandings	Science Inquiry Skills	Science as Human Endeavour
2	Classify photos and specimens of living things by looking for similarities and differences. Reflect on classification.	Comparing, sorting and classifying objects and materials.	Make and share observations Use evidence to support ideas	Recognise aspects of science in everyday life
3	Excursion to Clearwater Creek: record living and non-living things. Interdependence activity: demonstrate and discuss relationships between living and non-living things at Clearwater Creek. Discuss care for local environment.	Living and non-living things. Changes on earth and the effects on living things	Make and share observations	Care for the environment
4	Observe and record information about the diet, behaviour, habitat and features of earthworms	Needs, structures and growth of organisms	Make and share observations	Recognise aspects of science in everyday life
5	Discuss the diet, habitat, structure and cultural significance of witchetty grubs and honey ants.	Needs, structures and growth of organisms	Make and share observations	Recognise aspects of science in everyday life
6	Construct clay witchetty grubs focusing on structure of grubs Share grubs with children in other class Discuss and reflect upon stimulus images 1-4 related to litter and working together	Needs, structures and growth of organisms	Make and share observations	Recognise aspects of science in everyday life Care for the environment

Session	Activity	Science Understandings	Science Inquiry Skills	Science as Human Endeavour
7	<p>Excursion to Clearwater Creek</p> <p>Observe and record information about the diet, habitat, features and life cycle of tadpoles</p> <p>Discuss and reflect upon stimulus images 5-8 related to water and air pollution</p>	<p>Needs, structures and growth of organisms</p> <p>Life cycles of organisms</p>	Make and share observations	<p>Recognise aspects of science in everyday life</p> <p>Care for the environment</p>
8	<p>Define 'biodiversity' in pairs, share, discuss and write class definition</p> <p>Reflect individually on what biodiversity means and share</p>	Living and non-living things.	Ask questions and begin to investigate	Care for the environment
9	<p>Create biodiversity display</p> <p>Discuss and reflect upon stimulus images 9-13 related to animal biodiversity</p>	Living and non-living things.	Make and share observations	Care for the environment
10	<p>Class input into planning habitat investigation, children chose which habitat to investigate and they design an appropriate recoding sheet.</p> <p>Discuss and reflect upon stimulus images 23-24 related to fishing responsibly</p>	Needs, structures and growth of organisms	<p>Explore, be curious and wonder</p> <p>Ask questions and begin to investigate</p> <p>Plan and conduct simple investigations</p>	Care for the environment

Session	Activity	Science Understandings	Science Inquiry Skills	Science as Human Endeavour
11	Excursion to Clearwater Creek Conduct habitat investigation Discuss and reflect upon stimulus images 14-16 related to plant biodiversity	Needs, structures and growth of organisms	Ask questions and begin to investigate Plan and conduct simple investigations	Care for the environment
12	Organise data into table and bar graph and communicate findings Discuss and reflect upon stimulus images 17-20 related to habitat conservation	Needs, structures and growth of organisms	Describe what has happened Use evidence to support ideas	Care for the environment
13	Evaluate investigation as a class, in small groups and individually Class chose tree planting as a way to help environmental sustainability at Clearwater Creek for Session 14	Needs, structures and growth of organisms	Describe what has happened Use evidence to support ideas	Care for the environment
14	Excursion to Clearwater Creek for tree planting	Changes on earth and the effects on living things		Identify work associated with science in the community

Instructional strategies

Various instructional strategies were used throughout the sustainability science-program, many of which focused on cooperative learning. Kagan (2009) explains the significance of children participating cooperatively:

Students need to know how to cooperate if they are to thrive in the job world. Beyond that, there is a very rich, embedded curriculum students acquire when cooperative learning structures are used- a curriculum that cannot be acquired by exclusive direct instruction. (p. 120)

Kagan's (2009) ideas fit in with the Australian Academy of Science (2012) PrimaryConnections Schoolyard safari program. They also tie into ARIES (2004-2009) partnerships for change principal as they allow children to work cooperatively to create a shared vision. Cooperative learning strategies including RallyRobin, RallyTable, Pairs Compare and RoundRobin were used in the program along with paired and small group work. Other instructional strategies were also used throughout the program, including word wall, class discussion, journal writing, explicit teaching, field trip, field observations, shared reading, role play, multiple intelligence, problem-based instruction and group swap. Table 8 defines each of these strategies, and Table 9 summarises the use of instructional strategies within the sustainability science-program.

Table 8: Instructional strategies summary

Instructional Strategy	Definition
Cooperative learning	Children work in small groups on a shared task requiring cooperation for its completion (Guthrie, 2002)
RallyRobin	Children work in pairs and take turns to respond verbally to each other by offering answers to a question (Kagan, 2009).
RallyTable	Children take turns to write responses to a question (Kagan, 2009).
Pairs Compare	A pair of children make a list of ideas, and then mix with another pair to compare lists (Kagan, 2009)
RoundRobin	Children work in a group of 4 and take turns at sharing ideas.
Word wall	A display containing a collection of words (Saskatoon Public Schools, 2004-2009)
Discussion	Talking amongst the teacher and children about learning to encourage engagement and communication (Guthrie, 2002)
Journal writing	Children reflect and write about learning, feelings or other topics (Saskatoon Public Schools, 2004-2009)
Explicit teaching	Highly structured teaching focusing on particular outcomes directed by the teacher (Saskatoon Public Schools, 2004-2009)
Field trip	An activity conducted outside the classroom and in the ‘real’ world (Saskatoon Public Schools, 2004-2009)
Field observations	Observing that occurs outside the classroom (Saskatoon Public Schools, 2004-2009)
Shared reading	A method of direct instruction that provides information through reading (Saskatoon Public Schools, 2004-2009)
Role play	Children act a given situation out (Saskatoon Public Schools, 2004-2009)
Model building	A method of experiential learning focused on the activity (Saskatoon Public Schools, 2004-2009)
Problem-based instruction	Children conduct investigation based on meaningful and authentic problems (Guthrie, 2002)
Group swap	Children mixed with a person from another group and shared information collected

Table 9: Sustainability science-program: Instructional strategies

Session	Instructional strategy	Application of strategy to activity
1	Word wall RallyRobin Discussion Journal writing	Word wall for sustainability science-program started RallyRobin what makes things living Class discuss acting responsibly when collecting specimens Reflect in journals about acting responsibly
2	Concept teaching RallyTable Pairs compare Journal writing	Explain the concept/skill of classification RallyTable strategy adapted to classify specimens of living things by moving pictures instead of writing Compare classification with another pair Reflect on classification in journals
3	Field trip Cooperative learning Class discussion Journal writing	Excursion to Clearwater Creek Interdependence activity as a class Discuss care for local environment Reflect in journals about activity and interconnections
4	Field observations Shared reading	Observe earthworms in a worm farm Read and discuss big book <i>Earthworms</i> as a class
5	Shared reading Role play Class discussion Word wall	Class read poem <i>Honey Ants</i> Act poem as reading aloud Discuss collection and uses of honey ants and witchetty grubs Word wall added to with AaTSI words
6	Multiple intelligence Children as teachers Class discussion Journal writing	Demonstrate knowledge of witchetty grub structure through clay construction Children teach younger children about witchetty grub model Discuss stimulus images regarding litter and working together Reflect on stimulus images in journal
7	Field trip Field observations Class discussion Journal writing	Excursion to Clearwater Creek Catch and observe tadpoles in creek Discuss stimulus images regarding air and water pollution Reflect on stimulus images in journal
8	Cooperative learning Class discussion Journal writing	Children work in pairs to define biodiversity Discuss biodiversity and decide on class definition Reflect on biodiversity in journals

Session	Instructional strategy	Application of strategy to activity
9	Multiple intelligence Class discussion Journal writing	Cut and glue images depicting biodiversity onto letters to form word 'biodiversity' for class display Discuss stimulus images regarding animal biodiversity Reflect on stimulus images in journal
10	RoundRobin Problem-based instruction Class discussion Journal writing	Brainstorm list of plants that could be investigated as habitats Children plan habitat investigation in small groups Discuss stimulus images regarding fishing responsibly Reflect on stimulus images in journal
11	Field trip Problem-based instruction Cooperative work Group swap Class discussion Journal writing	Excursion to Clearwater Creek Children work in groups to conduct habitat investigation by collecting data Children swap groups and share findings Discuss stimulus images regarding plant biodiversity Reflect on stimulus images in journal
12	Problem-based instruction Cooperative work Class discussion Journal writing	Children organise, process and translate data from investigation in groups Discuss stimulus images regarding habitat conservation Reflect on stimulus images in journal
13	Problem-based instruction Cooperative work Class discussion	Children work in groups to evaluate habitat investigation Discuss as a class and choose a way to help Clearwater Creek
14	Field trip Journal writing	Excursion to Clearwater Creek for tree planting Reflect on learning throughout the term in journal

AaTSI perspectives

This section of the chapter describes in detail the ways in which AaTSI perspectives were incorporated into the sustainability science-program used in this study.

One strategy used to incorporate AaTSI perspectives was to set up a 'science word wall' at the beginning of the sustainability science-program. This was used as a reference point during sessions and children could add words they thought were relevant as the program progressed. At the end of Session-5 the AIEO and children suggested AaTSI words relating to bush tucker to add to the wall, after learning about witchetty

grubs and honey ants. This activity acknowledged AaTSI languages in a relevant and meaningful context and supported children in understanding the, “diversity of Aboriginal and Torres Strait Islander Peoples’ culture through language” (ACARA, 2011, para. 6). By including children’s home languages, as well as relevant Western ‘scientific’ language, children’s identity and cultural heritage were valued. Accommodating the diverse cultures and languages of children in the classroom (Howitt & Blake, 2010), and thereby valuing children’s backgrounds is identified as crucial aspects of teaching science to AaTSI children (Edwards, 1993).

Another way in which science programs can include AaTSI perspectives is through the contextualized study of holistic ecology. Christie (1990) explains that science in AaTSI cultures involves a high degree of environmental sensitivity, which encourages study of the whole ecology and consideration of the whole context. The idea of children learning about holistic ecology was applied in the sustainability science-program used in this study. An example of this was during Session-3 when children completed the interdependence activity at Clearwater Creek. After listing the living and non-living elements that they observed at the creek, children were required to think about these and other influencing aspects within the environment, such as water, soil and air, and how these aspects related to each other. This activity encouraged consideration of the environmental interconnections and the broader ecology of the creek.

Many sessions throughout the sustainability science-program were based around hands-on scientific experiences for children to engage with. Edwards (1993) claims that AaTSI children may prefer such activities. During Session-6 the children made clay models of witchetty grubs, paying attention to the structures of it, and drew a labelled diagram of the grub in their science journals. After the clay had set the children shared their models and their knowledge of witchetty grubs with children from the Year-1 class. This session reinforced what children had learnt previously about AaTSI peoples and their ways of life and experiences. It also provided children with a hands-on activity. Another example of a hands-on activity is during Session-7, when children learnt about the structure, diet, habitat, behaviour and life cycle of tadpoles. Children collected tadpoles at Clearwater Creek, and were able to observe them in their natural environment and up close after they had been caught. AaTSI children particularly enjoyed this hands-on activity and were engaged and focused on the tasks.

The sustainability science-program used in this study also included AaTSI perspectives through locally based excursions and investigations. Edwards (1993) explains that programs that involve investigating familiar environments are relevant to AaTSI children, and that AaTSI children prefer such locally based programs. Christie (1990) also claims the need to make science programs relevant to AaTSI children's lives when he writes, "science must become re-embedded in the context of our physical environment ... This means focusing the curriculum right down to the things which are of immediate ecological significance to the lives of the science students" (p. 64). During this sustainability science-program, children spent four sessions working at Clearwater Creek, a small creek that runs through the town of Oceanside. Many children were familiar with this creek as they visit it during outside of school time for 'tadpoling', picnics and general playing. Through investigating aspects of the creek area, children were involved in ecological activities that were directly related to an area with which they were familiar, and were investigating the, "immediate, real-life ecological context of their lives" (Edwards, 1993, p. 35). It is these flexible learning environments that support 'maximum engagement' in children (Howitt & Blake, 2010).

This sustainability science-program catered for AaTSI children through the child-centred nature of activities throughout the program. Edwards (1993) claims that science programs that involve, "student-centred, interactive processes" (p. 35) are relevant to AaTSI children. During Sessions 10-13 of the sustainability science-program, children were required to work in groups, to plan an investigation of plants as habitats. This was child-centred as children were actively involved in the entire investigation, including; choosing which plant to investigate, formulating the questions to research, designing a recording sheet for data collection, conducting the investigation, processing the data, presenting the data in ways they thought appropriate, and evaluating the investigation. Sessions 13 and 14 also exemplified child centred processes as they involved children firstly brainstorming several possible ways of assisting the biodiversity at Clearwater Creek, and then collectively deciding to plant trees with the local Oceanside Environmental Group. Child-centred processes encouraged both AaTSI and non-AaTSI children's active participation in the sustainability science-program as they gained ownership of, and responsibility for, personal learning. It also encouraged curiosity as children could direct their learning in ways that were relevant to them.

Similarly to Edwards' (1993) recognition of child-centred processes, other authors claim the role of the child as a negotiator of knowledge as an important aspect of

science curriculum relevant to AaTSI children. When explaining the key principles of an Aboriginal science curriculum used in Alice Springs, Christie (1990) claims, “The students themselves are scientists negotiating with their teachers and classmates to produce knowledge” (p. 66). McCormack and Cowey (2008) also identify the role of children as active contributors to knowledge by stating, “students’ contributions are valued and incorporated into this wealth of common knowledge” (p. 70). This process of valuing the children’s contributions relates to child-centred processes as children are held partially responsible for the knowledge produced and the role of the teacher is not the ‘giver’ of information. The sustainability science-program in this study encouraged child contributions and negotiation of knowledge amongst children and teachers through several activities, such as the science word wall in Session-1, the habitat investigation in Sessions 10- 13 and the classification activity during Session-2. In this session, the children classified specimens, and photos of living things found during their school walk. They looked for similarities and differences and negotiated the classification with their partner. This required contributions by all children and involved the negotiation of knowledge amongst children and with the teacher.

Each session in the sustainability science-program required social interactions amongst children, and between children and staff. McCormack and Cowey (2008) recognise that a key principle in AaTSI students’ learning is that children’s learning is based on deep relationships. Harrison (2008) also explains the importance of the social context in AaTSI children’s learning when he writes: “For Indigenous students, the focus of their work is on the relationships between them and their teachers and fellow students, not just the content being taught” (Harrison, 2008, p. 20). This sustainability science-program was based on the trusting relationships already established amongst children, between the children and the teacher/researcher, and between the children and the AIEO. The activities incorporated a high degree of collaboration and cooperative work skills from children. It is through these interactions with others that children’s learning occurs (Howitt & Blake, 2010). An example of this is during Session-2 when children completed a classification activity by turn taking in pairs. This required participation by all children, but also fostered social relationships through cooperation.

The strong, positive social context between children and staff in this study provided the basis for supporting children’s learning through scaffolding. Harrison (2008) identifies scaffolding as one effective method of helping AaTSI children learn. McCormack and Cowey (2008) explain that trusting relationships between the children

and the teacher allow AaTSI children to, “learn first on the social plane in the company of experts, and then individually as they internalise new understandings” (p. 69). Scaffolding children’s learning through a supportive social context relates directly to Vygotsky’s (1978) ZPD, which is applied throughout the sustainability science-program. For example, the excursion to Clearwater Creek in Session-7 involved children firstly interacting informally with each other whilst exploring the habitat of the tadpoles and observing them. The teacher/researcher then showed children a model of the tadpole’s life cycle and children discussed each of the stages. A familiar, ‘expert’ volunteer from the local Oceanside Environmental Group also attended this excursion and discussed the changes involved in the life cycle of tadpoles. Next children recorded information about what they had seen and learnt. Throughout the progression of tasks children were given the opportunity to learn firstly in a social context and from ‘expert’ others, that is, from other children who had previous knowledge, the teacher/researcher, the AIEO and from the volunteer from Oceanside Environmental Group. Children were scaffolded in their learning, through social interactions, to the point that they were able to internalise new understandings and perform individually.

AaTSI cultural education was also incorporated into sustainability science-program. During Session-5, children were introduced to the idea of bush tucker by reading and acting out the poem Honey Ants (McDougall, 2000, p. 28). Children then viewed pictures of honey ants and witchetty grubs, watched short videos showing how they are collected, as well as how AaTSI people use these animals as a sustainable food source. The teacher, the AIEO and the class discussed the diet, habitat and structure of witchetty grubs and the significance of this for AaTSI people. The AIEO was actively involved in this whole class discussion and lead parts of it. This session deepened the children’s understanding of particular aspects in AaTSI cultures relating to food and activities conducted by AaTSI people. As such, it supported the children’s understanding of the diversity of AaTSI cultures through ways of life and experiences, which is a part of the second key concept described by ACARA (20011) within this cross-curriculum priority. Edwards (1993) claims: “Students’ Aboriginality must not be denied by learning programs which define science purely in terms of the dominant Western culture” (p. 33). Through learning about the environmental connections between honey ants and witchetty grubs, and their diets and habitats, AaTSI and non-AaTSI children also gained an understanding of some of the scientific aspects involved in AaTSI cultures.

The sustainability science-program in this study also took measures to eliminate feelings of shame amongst AaTSI children. Harrison (2008) explains that shame can be experienced when AaTSI children feel embarrassed at taking risks, get answers wrong, or are singled out for some reason. He states: “Shame can dominate how many Indigenous children think, talk and behave in the classroom” (Harrison, 2008, p. 28). For this reason it is essential that all learning programs address the issue of shame, and measures be taken to eliminate AaTSI children experiencing it. One measure that Harrison (2008) advised involved children being given the opportunity to practice skills in small groups or individually, rather than with the whole group. An example of this was in Session-4 when children were given time to individually draw and label an image of an earth worm at the end of the session, after spending much time observing, handling, discussing and reading about them. Another measure taken to eliminate feelings of shame in AaTSI children was to scaffold children’s learning, which was incorporated throughout the sustainability science-program.

Finally, involving the AaTSI community beyond the school is an important consideration in this sustainability science-program. To encourage optimal participation and success for children, schools should develop strong, positive links between the school and the broader community. The Australian Academy of Science (2010) explains: “Genuine relationships and partnerships based on intercultural understanding and mutual respect between teachers, students, parents, schools and communities provide greater opportunities to improve the educational outcomes of Indigenous students” (para. 9). Harrison (2008) also advises finding out children’s interests outside of school and building relationships with AaTSI community members as important contributions to AaTSI children’s education. The teacher/researcher in this study had already established strong relationships with some AaTSI community members as a result of attending school in a town nearby with some AaTSI community members, living and participating actively in the community and through teaching AaTSI children at the school for several years. These relationships were further encouraged throughout this sustainability science-program by inviting family members of AaTSI and non-AaTSI children to attend all excursions and by inviting local AaTSI family members to assist with particular learning experiences at school, such as tree planting, and learning about AaTSI science and cultures in Session-5.

Summary of sustainability science-program

The design of the sustainability science-program has been based on social constructivist learning theory through the adaptation of the Australian Academy of Science's (2012) PrimaryConnections Schoolyard safari program. This program has been elaborated on and contextualised to suit the children in the study through the use of the local environment and through the inclusion of AaTSI perspectives and education. It has also included other activities that promote learning for sustainability and the development of positive attitudes to environmental sustainability, and was planned in accordance with ACARA's Shape of the Australian Curriculum: Science (2009). It should be noted that the sustainability science-program would ideally have occurred during one school term to minimise interruptions. This was not able to happen in this study because of the time taken for permission forms to be returned and the pre-program interviews taking longer than anticipated. This meant that school holidays cut the sustainability science-program into two blocks.

Phases of the research

This research involved eight distinct phases, as outlined in Table 10. Initially it involved the seeking of approvals and permission from relevant people and authorities. It also involved piloting of the survey. Between the pre-program and post-program surveys all children participated in a sustainability science-program. After completion of the program and of the final survey children were interviewed to further assess their attitudes.

Table 10: Research phases

Research Phase	Approximate Dates	Research activity
1	April- May, 2011	Seek approvals
2	May, 2011	Pilot survey
3	Late May, 2011	Seek permission from parents of children, staff involved and local AaTSI people
4	Early June, 2011	Conduct pre-program survey with all participating children
5	June-September, 2011	Implement sustainability science-program; make observations; collect work samples; collect teacher anecdotal notes; collect teacher reflections; conduct informal interviews
6	September, 2011	Conduct post-program survey with all participating children
7	September, 2011	Conduct interviews with all participating children.
8	October, 2011- July, 2012	Data analysis

This study consisted of eight phases and in this section these phases are explained in more detail.

Phase One: Approval

The first phase of this research involved the seeking of approvals. Ethics approval was sought from Edith Cowan University Ethics Committee, as well as approval of the research proposal. Given that the study was to be conducted with children from the school at which I teach, approval was then sought from The Department of Education and Training. Finally, approval was sought from my Principal. Appendix C contains the relevant correspondence.

Phase Two: Piloting

Another important step in the procedure of this study was piloting the survey. Participants used in the pilot consisted of children who were of a similar age and who lived in the same rural community, but who were not going to be participating in the formal study. Ten children were used in total during the pilot. Three of the children were boys and seven of the children were girls. Five children were seven years old and five were eight years old. No children were AaTSI. Bell (2005) stated, “the pilot and trial collation and presentation of data should give you clues as to which information is

likely to be of interest and at that stage there is still time to make adjustments to your data-collecting instruments” (Bell, p. 213). This means that necessary changes can be made to the instruments before data collection begins. Piloting also provides an opportunity to check that the instruments are reliable. As Bell (2005) explained, ‘the check for reliability will come at the stage of question wording and piloting of the instrument’ (Bell, p. 117). This means ensuring that the test, “produces similar results under constant conditions on all occasions” (Bell, p. 117).

Piloting the research further helps to check the validity of the instruments used. An instrument can be defined as valid if it, “measures or describes what it is supposed to measure or describe” (Bell, 2005, p. 117). Bell (2005) described how this could be done:

Ask yourself whether another researcher using your research instrument and asking factual questions would be likely to get the same or similar responses. Tell other people (colleagues, pilot respondents, fellow students) what you are trying to find out or to measure and ask them whether the questions or items you have devised are likely to do the job. (p. 118)

It is essential that the instruments reliability and validity be considered. This occurred during the piloting stage of the research and then necessary changes were made.

The pilot was conducted by the teacher/researcher. This occurred with children individually at the local sporting complex one Friday afternoon from approximately 4.00-5.00pm. This location and time was chosen because many of the local families attend sports training at this venue during this time, so it made children’s participation in the pilot survey easy for parents. Participating children were surveyed in the squash court seating area as this was not being used at the time, so it provided a quiet setting. It was also chosen to eliminate children’s potential feelings of isolation because this area adjoined the basketball stadium where many families were. Further, this room was familiar to the children that assisted them in feeling comfortable.

The pilot survey consisted of 18 statements, and can be found in Appendix F. To measure the pilot survey’s reliability, Cronbach’s alpha coefficient was calculated by inputting the data into the SPSS program: ‘PASW Statistics Student version 18.0’. The original Cronbach’s alpha coefficient was 0.40. This is considered to be a low reliability score. Cronbach’s alpha rose to 0.72 if the following items were deleted:

- Pouring things down the sink or a drain is a good way to get rid of them
- Some animals in the environment can be pests.
- All plants are good for the environment.
- It's my job to help look after the environment.
- We shouldn't limit the number of fish we catch.

It should be noted that the very small sample size of the pilot could have influenced Cronbach's alpha. It is for this reason that other factors were used along with the reliability score to determine the change and deletion of items from the pilot survey.

Item-4 in the pilot survey stated: Pouring things down the sink or a drain is a good way to get rid of them. Reliability analysis indicated that; Cronbach's alpha would increase if, the item was deleted. The item was also not specific enough as it did not state which 'things' were being poured down the drain or sink. Children further seemed to hesitate when responding to the item. Whilst hesitation could have been due to children thinking carefully about their response, considerations of each of these factors lead to the deletion of the item.

The sixth item in the pilot survey stated: Some animals in the environment can be pests. The researcher found that many children in the pilot did not understand the term 'pests' and some commented to this affect. Given that this item also did not contribute positively to a strong Cronbach's alpha, the researcher chose to change the wording. The term 'pests' was changed to 'bad', and the item was re-worded to state: Some animals can be bad for the environment.

Item-7 in the pilot survey stated: All plants are good for the environment. Deletion of this item was indicated to result in a higher Cronbach's alpha. The researcher also considered that the survey consisted of four other biodiversity related items, two of which specifically addressed plants. For these reasons, the researcher chose to delete this item.

Item-12 in the pilot survey read: It's my job to help look after the environment. After consideration of this item, the researcher concluded that the use of the word 'environment' was too broad. Though relating to individual responsibility, the item needed to be contextualised for the children through the use of a specific example. One appropriate and familiar example is behaviours related to litter and rubbish. Given that this survey already consisted of three items related to these activities, and that deletion of this item would increase the reliability of the survey, the researcher chose to delete it.

The final item that was deleted from the pilot survey was Item-17, which stated: We shouldn't limit the number of fish we catch. The wording of this item confused many children. The use of the word 'shouldn't' meant that the item was worded negatively. Whilst some children did not understand meaning of 'limit', when the two words were used together it further complicated the item. For these reasons this item was deleted.

Three other survey items were reworded after piloting. In the pilot Item three stated: "It's important for us to work together to reduce litter around our school". Many children did not understand the phrase 'reduce litter'. This item was simplified to state: "It's important for us to work together to get rid of rubbish around our school".

Survey Item-11 was also changed to assist children's comprehension. During the pilot it stated: "It's okay to clear bush on farms or around town". Some children in the pilot needed the word 'clear' explained, so it was substituted with the words 'get rid of'. After piloting it read: "It's okay to get rid of bush on farms or around town".

Item-14 was adjusted after piloting the instrument. During the pilot it read: "It's okay to catch fish if they are too small or young". After piloting this item was simplified to read: "It's great to catch lots and lots of fish". This decision was made to encompass both Item-14 and the other item that addressed responsible fishing that was deleted. It also simplified the item to assist children's comprehension.

During the piloting phase the researcher noticed that some children struggled to read the words 'important' and 'environment', and this lead to the conclusion that the survey administrator reading the items aloud, could enhance the children's comprehension. Although some children could read these words, reading the surveys aloud to all children ensured consistency.

Given that some survey items needed words explained, the researcher realised the need for explicit instructions to be written for the person who would be conducting the survey. These instructions included how the words 'environment', 'native' and 'cleared' could be defined for children. They also reminded the administrator to ensure that children answered only one response in each item line and that lines were not missed, as the researcher found this to be a problem with one child during the pilot. Further, the instructions stated the administrator should give children a practice question as this was found to be necessary to focus children on the task, to demonstrate how to respond appropriately to items and to check children's understanding. These instructions needed

to be made clear and needed to be consistently applied to all children to ensure validity. These instructions can be found in Appendix B (i).

Phrase Three: Permission

Parents of all of the children in this class were contacted and informed about the research study through an information letter that was sent home with children. This was deemed an appropriate method given that all parents could read and that other class information was handed out in this way. It was necessary to thoroughly explain to parents the purpose of the study, the voluntary nature of participation in the study, what participation in the study would involve, the right to withdraw at any time and the collection and storage of data. Parents completed and signed the ethics forms indicating their child/ren's willingness for them to participate.

Children were informed about the study in several ways. Firstly, the teacher explained: the purpose of the study; what would be involved, as well as emphasising that a child did not have to participate in the study. This was discussed as a whole class so children could ask clarifying questions. Participation in the study was further discussed at home between parents and children, and children were given a simplified information letter. Children indicated their intent to participate or not by circling 'yes' or 'no' on a consent form and by writing their name.

Consent for participation was also sought from key staff including the Principal as well as the school's AIEO. The latter was directly involved in data collection for the surveys and interviews, as well as participating in all of the sustainability science-program excursions and many of the sessions.

Verbal permission was also sought from an AaTSI representative from the people in this area. The female elder who was approached is highly regarded amongst AaTSI and non-AaTSI people and is an active leader within the community. She provided information on the AaTSI family groups in the town and the hierarchy within some of these groups. The AIEO ensured all activities were culturally appropriate and provided advice on how to include AaTSI perspectives in the sustainability science-program, for example active involvement in planning and implementing Session-5.

Phase Four: Pre-program survey

The next phase in the research design involved the pre-program survey of each of the children to assess their attitudes to environmental sustainability. The AIEO worked with one child at a time whilst conducting this survey. They were conducted in a room next door to the rest of the class. The children regularly use this room, so they would

have felt comfortable in it. The AIEO explained the structure of the survey to the children, including the response choices and what the emoticons at the top indicated. Emoticons were used to help the children identify with the emotions that they showed. This way they provided a visual support for the words. The AIEO then explained that she wanted the children to answer truthfully about each statement and read the survey items to the children while they circled their responses. If the children looked puzzled or sought clarification she was able to explain the meaning of words as detailed on the instructions given to her earlier. She also had a note taking sheet on which she recorded any necessary observations or dialogue; for example, if the children did not understand or seemed to guess responses. The survey, instructions and note-taking sheet can be found in Appendix B (i).

Phase 5: Sustainability science-program and collection of data

This phase of the study involved two parts. The first part was the implementation of the sustainability science-program. This was developed based on *PrimaryConnections'* Schoolyard safari program (Australian Academy of Science, 2012), but was adapted to suit the needs of the children in this study. A detailed explanation of the program can be found in Appendix D.

The second part of Phase 5 was the collection of data. Throughout the implementation of the program, the researcher collected qualitative data including; children's science journals, teacher observations, children's work samples, teacher reflections and informal interviews.

Phase Six: Post-program survey

After participation in the sustainability science-program all children were again involved in the survey to measure their attitudes to environmental sustainability. This followed the exact same format as the pre-program survey and was conducted by the AIEO. It was also presented in the same way whereby children were asked to respond truthfully to how they felt about each of the items.

Phase Seven: Post-program interview

After conducting the post survey with each child, the AIEO also conducted formal interviews with the children. These were completed one on one and the children were asked several questions regarding their attitudes and behaviours to environmental sustainability. The AIEO asked the same set of questions for each child and did not ask any elaborating questions to ensure consistency. The interviews took a couple of

minutes each and were conducted in the same room as the surveys. The children's responses were audio recorded and then later transcribed and analysed.

Phase Eight: Data analysis

This study involved the analyses of qualitative and quantitative data. All qualitative data including: teacher observations; children's work samples; teacher reflections; children's science journals; informal interviews; and formal interviews; were coded and categorised into themes relating to environmental sustainability. Quantitative data obtained from the surveys were analysed by comparing the mean scores before and after implementation of the sustainability science-program, and by comparing changes within survey items.

Methods of data collection

Diverse qualitative, and selective quantitative data were collected in this research. The qualitative research approach attempted, "to understand individuals' perceptions of the world" (Bell, 2005, p. 7). For example: qualitative research is conducted, "through the analysis of unstructured information – things like interview transcripts, emails, notes, feedback forms, photos and videos. It doesn't just rely on statistics or numbers" (ATLAS.ti, 2010, para. 4). Methods of this nature were deemed appropriate to the study as it explored children's attitudes towards environmental sustainability. It also relates to the use and analysis of interviews after the implementation of the sustainability science-program. This section of the chapter defines the methods of data collection, outlines the advantages and limitations of each method and describes the implementation of them in the sustainability science-program.

Interviews

Conducting interviews is an important method of systematic data collection involved in the process of ethnography. Interviews can be defined as using, "a verbal stimulus [the question] to elicit a verbal response [the answer] from a respondent" (Brewer, 2000, p. 63). They can consist of open or closed questions (Brewer, 2000) and can vary in their degree of formality, from being informal conversation through to highly structured interviews (Brewer, 2000; Caines, 2010; Ybema et al. 2010). Caines (2010) asserts that ideally ethnographic fieldwork should incorporate both formal and informal styles to add to the depth of understanding, both of which were used in this study.

There are several advantages to conducting interviews. Bell (2005) suggests that one advantage of interviews is that responses can be clarified and explained. This occurred through the interviewer asking probing questions to further develop the participant's ideas and by seeking explanations during informal interviews.

A second advantage is that the interviews, when paired with participant observation, can allow for greater understanding of the observations (Caines, 2010). This occurred through the teacher asking supplementary questions during informal interviews and in conjunction with observations throughout the sustainability science-program.

A third advantage of interviews relates to the face-to-face interactions that occur. This allows the interviewer to interpret the participant's body language and tone to choose questions that explore emotions and reasoning behind the participants responses (Bell, 2005). Children's attitudes to issues of sustainability and their reasoning for these attitudes were explored during class discussions of the stimulus images. The researcher asked questions that prompted thought yet also maintained a neutral position, for example, "What could be happening in this picture?" and "What might this person be doing?"

Another important advantage to using interviews in this study is that it helped to cater for the needs of all children. By allowing children to demonstrate their attitudes to issues of sustainability verbally in the formal and informal interviews, children were offered another means of expressing themselves. This is important given the young age of the children involved and was used in conjunction with other non-verbal data collection methods, such as reflective science journals, work samples and the attitudes survey. The use of interviews further adds to the depth of the study by contributing another valuable source of data for analysis. This allows for a more thorough understanding of the participants attitudes and behaviours regarding environmental sustainability.

There are also some important limitations to interviews as a method of data collection, which must be acknowledged. One limitation of interviews, as suggested by Bell (2005), is that they are time consuming. This was not found to be a significant issue in this study because the small sample size (15 children) allowed for all children to be interviewed. This was further assisted by the length of the interviews being kept short to encourage children's engagement with the questions. Interpreting the interviews

by coding and analysing responses could also potentially be time consuming, however this issue was again not found to be significant given the relatively small number of participating children.

A second limitation to interviews is their subjective nature, which can lead to bias (Bell, 2005). This could potentially occur through the questions asked and through the interpretation of responses. It is for these reasons that the researcher: did not impart personal opinions on children during class discussions; accepted all contributions made by children, and thereby encouraged children to feel that their own attitudes and ideas were valued. Having predetermined questions for the formal interviews ensured consistency amongst all children and prevented potential bias from the AIEO determining questions. The researcher attempted to overcome this issue in the informal interviews by using the science skills and understanding outcomes as a guide for questioning where appropriate. During discussions related to the stimulus images the researcher again, refrained from imparting personal opinions and attitudes, instead using probing questions to elicit children's attitudes.

A third limitation to interviews is that participants may sometimes be hesitant in their responses if they are being audio recorded (Bell, 2005). Children in this study did not appear to be intimidated during the formal interview process or hesitant because of the tape recorder. This may have been assisted by several measures taken to ensure the children felt comfortable during the interviews, such as explaining the interview process, conducting the interviews in a familiar and adjacent classroom, using the AIEO as the interviewer and using familiar wording of the questions. Given these measures, and the benefits of the researcher being able to transcribe, code and analyse the recorded interviews, this seemed an appropriate data collection technique.

The AIEO who worked with the children conducted all formal interviews (see Appendix G) at the end of the sustainability science-program. This person was chosen because the children already knew her, therefore allowing them to feel more comfortable with her than with an unknown person. She was also someone who the AaTSI children in the class felt comfortable with. As the classroom teacher/researcher, if I was to conduct the interviews myself, the results may have been influenced by the nature of my role. This avoided the situation where children may have made comments because they thought I wanted to hear them, or they thought they were the correct things to say. The formal interviews were conducted individually in the classroom adjoining the main Year-2/3 classroom. Children regularly used this area for general classroom

activities and felt comfortable in here. The door was kept open so children did not feel isolated, yet it was a much quieter space to encourage children to focus on the questions asked. Interviews took approximately 5 minutes and were conducted during a half hour block after lunch, approximately from 1.30-2.00pm. Whilst a morning session may have been optimal for children's engagement, it was not possible given timetabling issues. This time slot was kept constant for all children. The questions were audio recorded and later transcribed by the teacher/researcher.

The AIEO's role in the interviews was to ask the following three open-ended questions:

1. Can you tell me what biodiversity is?
2. Can you think of anything you have done to help look after the biodiversity at Clearwater Creek?
3. What could we do in other places to look after the biodiversity?

These questions focused on the theme biodiversity. They aimed to find out children's understandings of the concept of biodiversity and what children have done or could do to protect biodiversity. This gave an insight into whether the children could apply their understandings and if the sustainability science-program had influenced their behaviours. The AIEO was not instructed to ask any further questions in order to keep the interviewing process consistent. She was also not required to scribe or record in writing any comments as the interviews were recorded.

Caines (2010) also claims: "A critical skill the ethnographer must learn is to discern when interviewing adds depth and understanding to participant observation and when interviewing interrupts focused fieldwork" (p. 432). For this reason, the researcher also conducted very informal interviews used in combination with participant observation. Brewer (2000) describes unstructured interviews:

In this type of interview there may be some questions worked out beforehand, or a guide to topics that need to be addressed, but open questions are used and there is a relative absence of structure. Researchers give themselves the latitude to ask whatever they want, in the form and order they determine, and to prompt, probe and ask supplementary questions as the occasion or respondent warrants. It takes the form of a natural conversation that is skilfully guided or focused by the researcher. (p. 66)

Whilst conducting observations of children and the informal interviews, the researcher considered the potential impact of interrupting children's focused work, as suggested by Caines' (2010). As such, the informal interviews occurred at the time of need and when the researcher thought it was appropriate to engage in conversations with the children by asking questions or prompting and directing children's thought during science sessions. Given the informal nature of these interviews, these were generally very short consisting of 1-5 questions. The questions were also conducted in the context of the classroom setting. Using predominantly open questions, the researcher aimed to prompt and extend children's thoughts. The science skills and understandings (listed in the sustainability science-program, Appendix D) that were focused on in each session were used to guide the questions asked by the researcher. Conversations generally included from one to four children, as they were working in small groups during most sessions. The conversations occurred in normal, everyday classroom setting between the teacher and children. Data were collected by recording anecdotal notes of conversations held with children during sessions throughout the sustainability science-program.

An example of an informal interview conducted during the sustainability science-program was in Session-2. After collecting photos and specimens from the school walk in Session-1, the class was discussing some ways that living things could be classified. All children were sitting on the floor in front of the whiteboard with the photos and specimens blue-tacked onto it. This activity was completed as a whole group demonstration before children completed their own classification in pairs. Children had already suggested several different categories for items and when there was a significant pause in suggestions, the teacher prompted children's thoughts and sought explanations with open-ended questions (14/06/2011):

Teacher: "What should we move over here?" [Pointing to the 'animal' group]

Ella: "Put that grasshopper there because it's an animal".

Teacher: "What makes it an animal?"

Grace: "It moves".

Teacher: "Yes, but trees also move with the breeze. What else makes it in animal?"

Brian: "It's living".

Teacher: "Yes, what else?"

Gary: "It has legs".

Through this informal interview, the researcher encouraged the children to practice the following science skills: make and share observations; use evidence to support ideas; and compare, sort and classify objects. The researcher also encouraged

children's science understandings of comparing, sorting and classifying through seeking justification of the children's classifications. Both the formal interviews and the informal conversations added depth to the information gained from participant observation, as Caines (2010) suggested.

Science journals

A key method of data collection used in this study was children's science journals. While these can be defined simply as a, "purposefully focused genre" (Shepardson & Britsch, 2001, p. 46), it is through children's illustrations and written texts that journals entries reveal, "the child's socially constructed understandings" (Shepardson, 1997, p. 884). Children's science journals can take different forms, ranging from more traditional records of facts and results, to forms that allow children to choose a combination of writing and drawing to communicate their understandings (Shepardson & Britsch, 2001). Shepardson and Britsch (2000) explained that effective science journal use could assist, "children in making observations, remembering events and communicating understandings" (p. 29).

There are several advantages to the effective use of science journals with young children. One important advantage is that journals can assist to develop children's scientific thought. This can occur by children being encouraged to make sense of science activities rather than focusing solely on the completion of the activities (Shepardson & Britsch, 2001). In order to make their ideas explicit and reconstruct the experience into a science journal entry, children connect new scientific experiences with their prior knowledge to develop their understandings (Shepardson, 1997; Shepardson & Britsch, 2001). This process of connecting and reconstructing scientific experiences is enhanced through effective science journal use.

A second advantage of science journal use is the potential to inform teaching (Shepardson & Britsch, 2000). Shepardson and Britsch (2004) explain that careful analysis of, and reflection upon, children's journal entries can be pedagogically informative. This could include critical reflection of the effectiveness of pedagogical strategies, or allowing analyses of children's scientific understandings to direct the choice of appropriate courses of action to follow.

It is also advantageous to use children's science journals for assessment of science concepts and understandings. Their potential to be used diagnostically (Shepardson & Britsch, 2004), means that analyses of journal entries can, "provide insight into students' developing understandings" (Shepardson & Britsch, 2001, p. 65), allowing teachers to

identify misconceptions and work with children to further develop their understandings. Analysing journal entries directly related to classroom activities also ensures assessment is clearly linked with the curriculum (Shepardson & Britsch, 2001; Shepardson & Britsch, 2004).

Another advantage to using science journals with young children is their flexibility and adaptability. Shepardson and Britsch (2001) suggest that children should be given the opportunity to choose how they will write, draw, or write and draw their journal entry, thereby allowing children to use their journal in, “cognitive appropriate” (p. 65) ways. The open-ended nature of this task encourages catering for different learning styles and ensures children of all levels are supported.

A final advantage to the use of science journals is that they can encourage children to develop different perspectives. Shepardson (1997) explains that it is paramount that teachers provide children with time to engage in scientific dialogue through sharing and discussing journal entries. Listening to each other’s explanations “provides an opportunity for children to take the perspective of others” (Shepardson, 1997, p. 887), in turn influencing the re-development of children’s own science understandings.

There are three key limitations to using science journals with young children. The first limitation relates to how the journals are used. Shepardson and Britsch (2000) claimed that children’s use of science journals varies greatly depending on the ways in which activities are structured, what is focused on in the lesson and the instructions given by the teacher. This suggests that effective journal use also varies greatly between contexts. Shepardson and Britsch (2001) describe the impact that ineffective use of science journals has on science learning: “This process of logging experiments and results limits children to a mastery of the traditional discourse and rules of school science: using vocabulary, memorizing facts, following procedures” (p. 45). The authors continue that rather than limiting their science learning, children should use science journals to assist them to think creatively as scientists and develop scientific literacy.

Also relating to the effective use of journals, a second potential limitation of science journals is providing time for children to discuss and share their entries. Shepardson (1997) articulated this when he wrote: “Providing time for children to question and explain their journal entries to each other is essential in understanding the ways others see and know phenomena” (p. 887). This suggests that whilst using science journals may be time consuming, it is essential that enough time be given to ensure that

journals are implemented effectively in order to develop children's scientific understandings.

Interpreting children's science journal entries can be another limitation to their effective use. Not only is it potentially time consuming, but also it has been identified that the process of effectively interpreting journal entries takes practice (Shepardson & Britsch, 2004). Using journals to assess children's science learning can also be difficult because the teacher must "differentiate whether children are representing the science activity or the science understanding in their journals" (Shepardson & Britsch, 2000, p. 33). This suggests that teachers must carefully consider inferences drawn from children's journal entries.

Science journals were used in the sustainability science-program as a record of children's reflections, their science understandings and children's attitudes to issues of sustainability. For the purposes of this study, all journal entries were analysed to track changes in attitudes to sustainability. Verbal reflections occurred amongst the whole class in the form of class discussions in every session of the program for the purposes of: engaging children's critical reflection of activities and learning; interpreting findings; communicating children's understandings; communicating children's attitudes to issues of sustainability; connecting science understandings from different activities; and summarising the session. These reflective discussions generally took around 10 minutes and were conducted at the end of the session, or at the end of an activity within a session.

Children used science journals to record their reflections following these discussions in 12 of the 14 sessions. Journals were not used in Session-2 because of time constraints so the use of a word wall was instead chosen as a reflective tool and summative task. They were also not used in Session-13 because this session was focused on evaluating children's learning from their group habitat investigation. During this session the class worked together to give simple explanations for children's results. Children then worked individually and in their groups to reflect on difficulties experienced, personal learning and future investigations and ways to help biodiversity at Clearwater Creek. Given that this session involved a large amount of reflection it would not have been appropriate to then engage in further reflection through use of the science journals.

Six of 12 sessions that used science journals did not use stimulus images, but instead focused on reflection of the science activities completed in that session. This

began as a whole class discussion and children then recorded their reflections by writing or drawings. Children were given a focus for their journal entry that related to the science skills and understandings objectives relevant for that session. For example: in Session-1, children were asked to think about what they had done earlier in the session and what acting responsibly means. In Session-8, children were asked to think about what biodiversity meant to them. Children were then given the opportunity to again briefly share their reflections.

The other six of the 12 sessions used stimulus images as a reflective focus for children's science journal entries. Children were firstly shown a set of stimulus images and then engaged in whole class discussion of the presented images. Children were then given the opportunity to individually critically reflect upon that discussion and by writing or illustrating in their science journals. This process, like the other journal entries, occurred at the end of the session, but took around 20 minutes.

Critical reflection can be described as, "systematically evaluating a range of complex factors resulting in a judgment or decision about a course of action or future response" (Watts, 2009, p. 610). The children engaged in critical reflection through guided discussion of the themes that the stimulus images related to. This discussion largely identified reasons for attitudes and evaluation of behaviours. They then used this discussion, along with their own ideas, to formulate an attitude or judgment regarding the theme. This often related to how the children envisioned a better future.

The stimulus images that children were required to reflect on were presented as a visual narrative. Lemon (2006) explains that a visual narrative can involve viewing a set of photographs. Bach in Lemon (2006) explained how visual narratives encourage people to reflect on their lives as, "it enables us to look at a scene in our lives with different perspective" (2006, p. 3). The use of photographs and images that the children could relate to aimed to encourage reflection and consideration of their values towards sustainability. To increase the relevance of the stimulus images, photographs taken from the local environment were used as some of the images (including images 1, 10, 11, 13, 14, 15, 16, 18, 20 and 22). These photos and the other stimulus images are presented in Appendix H.

In addition, Lemon (2006) highlighted that a, "visual narrative, however, is not complete without narrative support through dialogue and language" (p. 2). Critical reflection was encouraged and directed as the children engaged in discussion about the stimulus images. This discussion assisted focusing the children's reflection on

environmentally sustainable attitudes and behaviours. Class discussion also provided opportunities for children to view the photographs from varying perspectives by listening to other children's comments.

Observations

Participant observation is one of the key data collection methods used in ethnography (Brewer, 2000; Murray, 2008) and in this study. Brewer (2000) defines participant observation as, "data gathering by means of participation in the daily life of informants in their natural setting: watching, observing and talking to them in order to discover their interpretations, social meanings and activities" (p. 59). This definition suggests an active role of the observer by including talking with the participants.

Caines (2010) recognised that the degree of activity of the researcher in participant observation varies greatly in ethnography, from pure observation to active participation. The teacher/researcher level of participation in observation during the sustainability science-program varied greatly. At times, such as when the teacher was guiding class discussions or giving instructions, a very high level of participation was required. Other occasions required participation by the teacher at a moderate level, such as when the researcher was prompting children's thought and engaging with them by asking and answering questions. The teacher also played a purely observational role when children were involved in group work or independent reflection.

The varying levels of participation by the researcher were reflective of the varying levels of participation that the teacher had with the Year-2/3 children in an everyday classroom setting. The children's behaviours were also representative of how they would behave in an everyday setting with the researcher as the teacher. This relates to Brewer's (2000) definition of participant observation by the significance of the natural setting and natural behaviours.

The opportunity to observe natural behaviours is an important advantage in participant observation. Caines (2010) notes: "The strength of extensive participant observation is that everyone, members and ethnographer, likely assumes natural behaviours over prolonged fieldwork" (p. 432). Whilst the observations in this study were not long-term, they were over an extended period, where the relationships between the teacher/researcher and the children being well established, and therefore encouraging naturally occurring behaviours.

A second advantage to the use of observations also relates to the duration of time over which the observations were made. Bell (2005) explained that in participant

observation “researchers are able to observe changes over time” (Bell, 2005, p. 187), contrasting the data gathered from one-off observations. This was particularly relevant to the present study as changes in children’s attitudes to issues of sustainability were observed and investigated.

Another advantage of observations is the depth of understandings that can be gained through interpreting the data. Bell (2005) explained, “Once mastered it can reveal characteristics of groups or individuals which would have been impossible to discover by other means” (p. 184). This is possible given the active role of the researcher through, “listening, observing, questioning and understanding (or trying to understand) the life of the individuals concerned” (Bell, 2005, p. 186).

Along with several advantages, the use of observations as a method of data collection also includes limitations; one being that it is a complex process. Bell (2005) claims that effective observation, “requires considerable skill” (p. 184). This is due to the large amount of planning that should occur prior to implementation of this technique regarding: what will be observed; why observation is used; if observation is necessary; how observations might be recorded, and if observations will be used in combination with other data sources (Bell, 2005). Another complex aspect of observations is the ability to identify and extract relevant data from amongst the teacher/researcher perceptions (i.e., personal subjectivities within the teacher/researcher background) that provide bias (Bell, 2005).

This relates to the next limitation of observations, being that they are based on the teacher/researcher perceptions. Given that observation, “depends on the way people perceive what is being said or done” (Bell, 2005, p. 184) there is also therefore, the potential for bias (Bell, 2005; Brewer, 2000; Ybema et al. 2010). Bell (2005) explained: “As observers, we ‘filter’ the material we obtain from observation and that can lead us to impose our own interpretations on what is observed” (p. 185). Bell (2005) also suggests that researchers may not observe situations critically because of their familiarity with the participants and the environment. For these reasons, researchers should try to not impose meaning on the study (Brewer, 2000; Ybema et al. 2010) and to, “eliminate preconceived ideas and prejudices” (Bell, 2005, p. 185).

Given the complex process involved for ‘effective observations’, it follows that this method of data collection can be time consuming. Although Bell (2005) identified this as another potential limitation of the technique, the present study did not find this to be an issue. One reason for this was that observation was structured in this study in that

it was focused primarily on Year-2/3 children's attitudes and behaviours to issues of sustainability, but also on the science skills and understandings relevant in each session. Another reason is because observations were recorded as brief anecdotal notes as they occurred throughout the sessions. A third reason that time was not an issue in this study, being that it was already a practiced method used by the teacher in the everyday classroom. Further, the observation process fitted in with implementation of the sustainability science-program, as the teacher/researcher was able to observe children whenever the children were working in groups or individually.

The teacher/researcher used observation in this study to collect data from children's behaviours, class discussions, informal dialogue between and amongst children, and communication between children and the teacher that related to environmental sustainability. The researcher recorded this information by taking anecdotal notes on 'post-it notes', as these significant moments and conversations occurred during sessions throughout the sustainability science-program. An example of an observation made: related to children's science skills and understandings during Session-2, when the children were classifying their specimens and photos. The teacher observed and recorded: "*Explaining classification, Gary said: We put all the insects in one group, all the birds in one group, all the plants in one group.*" (14/06/2011). An example of an observation based on children's behaviours related to issues of environmental sustainability was during Session-11. The teacher recorded: "*Helen - Was very careful in finding a safe home for the small frog that she found. Put it in amongst the rocks in the creek.*" (04/08/2011) As Bell (2005) describes, these observations were structured in that the researcher had already considered the objectives for the study, had chosen the focus of the observations and had recognized the importance of observing children's attitudes and behaviours relating to issues of sustainability.

Work samples

A third method of data collection common to ethnography (which adds to the triangulation of data sources), is the study of visual and written documents specifically through engaging children's work samples. This method was defined by Ybema et al. (2010) as the, "close reading of documents [where relevant to the research question and setting]" (p. 348). Howard (1983) defined a work sample as, "an example of one's work, job, or profession" (p. 782). Marrelli (2005) elaborated on this definition by explaining work samples as a method of data collection, which "involves the systematic collection

and review of products created during the normal course of work. Work samples are actual specimens of routine on-the-job work” (p. 43). Relating to children’s work samples in a school setting, these definitions suggest that work samples would include the collection and analysis of examples of children’s actual work completed during everyday classroom activities. Cooper (2009) suggested that reviewing children’s work samples should further include consideration of children’s thoughts behind the production of the work sample. Cooper (2009) explained that through effective analysis of children’s work “teachers could organize more individualized instruction and maximize learning for all students” (p. 355). The researcher collected and analysed visual and written documents in the form of her Year-2/3 children’s work samples all throughout her sustainability science-program.

There are several advantages to the analysis of work samples as a method of data collection. Caines (2010) explained that one of these advantages is that interpreting documents can enhance fieldwork by exploring aspects of the study not otherwise addressed. The use of work samples in this study enhanced the fieldwork by providing the researcher with access to another source of data. It also enhanced the fieldwork by the nature of the data that was collected, that is, children may have written or drawn in their work samples things that could they would not have communicated during class discussions that therefore could not have been observed.

Another advantage to the inclusion of work samples as a method of data collection is that they allow the researcher time to complete analysis of the documents at a later date, or in this case, after the sustainability science-program. When comparing work samples with other techniques, Marrelli (2005) stated: “While performance tests and observations both require the presence of the worker, work samples examine the tangible results of work performance, but the worker is not present during the review of the work” (p.43). It is for this reason that the researcher was afforded the time to analyse children’s work samples without such pressure.

A third advantage to the use of work samples in this study is that they provide access to data that could indicate changes in attitudes to issues of environmental sustainability over time. As work samples are collected, “over an extended period” (Marrelli, 2005, p. 43) they can be, “compared before and after the introduction of an intervention” (Marrelli, 2005, p. 44). Whilst the present study did not collect work samples before and after the sustainability science-program, it did collect samples

during the program. This allowed for comparisons to be made between work samples collected at different points from within the program.

Given that work samples in this study consisted of documents produced directly by the children, an advantage to their use was that they were not based on the teacher/researcher perceptions. Marrelli (2005) explains:

Work samples provide direct evidence of performance and therefore offer strong validity. Unlike data collection methods ... in which data are based on the reports of people, the data in work samples are not filtered through others' perceptions. (p. 45)

The inclusion of work samples as documents for analysis added to the triangulation of data sources, thereby offering greater depth to the qualitative data in the study. The use of work samples requires a great deal of input time by the researcher, and this could be deemed as a limitation. Marrelli (2005) claimed: "The collection of an adequate number of work samples can require substantial administrative coordination and time" (p. 45). This study did not find it to be a significant issue, because the work samples consisted entirely of work that children completed through participation in the sustainability science-program. Time was spent in developing the sustainability science-program; however, there was no extra administrative time needed to prepare different pieces of work to be used specially for the purpose of sampling.

The second limitation to this method, relates to the time demands of the researcher (i.e., the time taken to interpret the results). Howard (1983), as well as Marrelli (2005) explored this limitation noting: "The review of work samples can be expensive and time consuming, especially when highly trained reviewers are required" (p. 45). The teacher/researcher was solely responsible for analysing work samples in this study. While this was not an expensive task, it did take a considerable amount of time.

A final limitation to this method of data collection is that individual work samples include data on a single task. This means that the data collected is somewhat limited (Marrelli, 2005), which suggests that the work sample may not show the entirety of what children know and think about a topic. For this reason: "It is important that other data collection methods be used along with work samples (Marrelli, 2005, p. 45). Importantly, Year-2/3 children's work samples were collected throughout the duration of the sustainability science-program. Samples were authentic, they came directly from the activities conducted in the program, and were not produced for the purpose of collecting a work sample. Work samples were collected in every session from the sustainability science-program. These consisted of various documents, one being

children's scientific diagrams. An example of this was: the Year-2/3 children labelled diagrams of earthworms completed in Session-4. The children completed this task after having seen, handled, discussed and read about earthworms.

Another type of work sample collected was a 'teacher-made note-taking sheet'. These sheets used heading to guide children's observations and allowed space for their note taking, for example, the Tadpole sheet used in Session-7 included the headings: habitat, diet, behaviour, life cycle, and diagram. These headings were spaced evenly down the side of two A4 pages so children could record observations through writing or drawing. The life cycle section provided children with a blank life cycle structure with spaces for children to draw the different stages.

A third type of work sample collected was child-generated pieces. An example of this was the habitat investigation results graph completed in Session-12. Children worked in groups to input their data from their records table into the form of a bar graph on an interactive whiteboard. This graph was then printed out and used as a work sample.

A fourth type of work sample collected was teacher-made habitat investigation evaluation sheet. This was used in Session-13 as a summative evaluation of children's learning from throughout the program and an evaluation of the habitat investigation. Children worked in groups to answer questions such as:

- What species did you find living in and around your habitat?
- List (3) things you found difficult in the investigation.
- List some ways that you could help care for the biodiversity at Clearwater Creek.

Teacher reflections

Another type of written document used as a method of data collection in this study was teacher reflections. Reflective thought can be defined as: "Active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it, and the further conclusions to which it tends" (Dewey 1910, p. 6). Dewey (1910) explained that all reflective thought consisted of two elements; one being a problem or a question that instigated reflection; and the other being the investigation of the evidence in support, or not, of the related belief. Within the teaching context, Dewey's focus on the consideration of evidence in reflective thought relates to McInerney and McInerney's (2002) suggestion that the types of evidence teachers could

influence their reflections include, “background experiences as a learner ... the ideas and theories presented to you by others and the constant flow of information and judgments from classroom experiences and other sources” (p. 22).

McInerney and McInerney (2002) underscore the identification of the ‘ideas and theories’ of others that contribute to teachers’ reflections. In addition, Atkinson (2012) recognised the social and cultural contexts affecting teachers’ reflections. Whilst identifying contexts within schools, professional communities, governing policies, mandatory testing, accountability, and other classroom pressures, Atkinson (2012) claimed:

reflection needs to be considered as thinking that emerges not solely from the mind of an individual teacher, but as thinking embedded in and emerging from these contextual and material conditions structured within competing ideological and discursive constraints. (p. 189)

Ottesen (2007) also claimed that the reflective process aims to solve problems and defined reflection within the teaching context as, “a discursive process in which an object is elicited from the flow of events and expanded in communicative action” (p. 42). This mirrored in part Dewey’s (1910) recognition of reflective thought being based on a problem, though Ottesen (2007) later suggested that these problems could be imaginary in order to encourage reflection in a ‘risk-free’ scenario. Again linking to Dewey’s early work and associated definitions, a more careful consideration of conclusions drawn from reflective objects was required (Ottesen 2007). Ottesen (2007) highlighted the ‘expanding’ of these objects through ‘communicative action’ as a means for solving the problem. This highlights the ‘social nature’ of Ottesen’s (2007) definition of reflection, in contrast to Dewey’s pioneer research. The identification of reflection as a ‘discursive process’ reiterates Ottesen’s (2007) views that teacher’s reflections are products of the social contexts surrounding them, as was also supported by Atkinson (2012).

One advantage to the use of teacher reflections as a method of data collection is that they provide a valuable source of information. Atkinson (2012) suggested that since the 1980’s there has been greater acceptance of the contributions that, “teachers’ voices and practical knowledge generated from practice” make to academic knowledge. Atkinson (2012) accepted teachers’ reflections used in her study, “as informed and intellectual feedback” (p. 176) and identified the social and cultural contexts surrounding them as important influencing factors. This suggests that teacher reflections

are valuable sources of information for use within the teaching context, and therefore, as data in this study.

A second advantage to this method of data collection is that it provides data directly related to research question two. When discussing the analysis of documentary evidence in ethnography, Caines (2010) asserts, “archive material can augment fieldwork by addressing a gap or exhausting an aspect of the research” (p. 433). This is relevant to the teacher/researcher’s study because teacher reflections were one of the main data sources providing information on the effectiveness of pedagogical strategies used to answer research question two:

How can a classroom based sustainability science-program facilitate young children’s engagement with and development of positive attitudes to issues of environmental sustainability?

This also relates to Ybema et al.’s (2010) recognition that the collection of documents for analysis should relate to the research question.

A third advantage to the use of teacher reflections is that their collection was unobtrusive to children in the study. Fetterman (2008) recognizes this important element in ethnography and claimed unobtrusive data collection allows, “the ethnographer to draw social and cultural inferences from physical evidence” (‘Unobtrusive measures’, para. 1). This is especially important given that the present study involved young children as participants. As well as being an unobtrusive method of data collection, teacher’s reflections provided an alternative data source addressing the thoughts and feelings of the teacher. O’Reilly (2012) claimed the ethnographic researcher should, “collect data on as many facets of life as possible” (p. 18), some of which could include data that help the researcher, “understand how people feel and think” (p. 14). The use of teacher reflections not only gave, “intellectual and informed feedback”, as described by Atkinson (2012, p. 176), but also provided insights into the teacher’s thoughts and feelings.

One limitation to the use of teacher reflections is their subjective nature. Atkinson (2012) claimed, “reflective thinking can be limited by ideological and discursive communities. These limitations shape teachers’ individual perspectives, as well as the professional and historical communities in which they work” (p. 189). This suggests that whilst teacher reflections should be accepted as valuable, intellectual sources of information, it is also important to recognise that teacher reflections are shaped by the surrounding influencing socio-cultural contexts.

Given that the written teacher reflections in this study were completed by the individual, and were, as Dewey back (1910) described, considerations of beliefs, one limitation is that reflections may have been biased. Although the reflections used in this study were guided by aspects relevant to the study, such as: science skills and understandings; the effectiveness of pedagogical strategies; and children's enjoyment of and participation in activities, teacher reflections were based on teacher perceptions and observations, and therefore were potentially biased, as identified by Bell (2005).

Another limitation to the use of teacher reflections for data collection is that they were time consuming. Given that teacher reflections were products of teacher observations, it follows that they too were time consuming to produce and to analyse. The researcher did not consider this to be a factor that should prevent the use of teacher reflections because of the advantages of this data collection method and because it was the teacher/researcher who would be responsible for completing and analysing the reflections.

The teacher engaged in written reflections at the end of 12 of the 14 sessions during the sustainability science-program. Written reflections did not occur after Session-10, which involved planning the children's habitat investigation. This did not occur because the session took longer than planned and was consequently spaced out over two time slots, which were broken with the school holidays in between. Combined with the teacher experiencing extra classroom pressures being the end-of-term and the beginning-of-term written reflections of this session did not occur. Reflections were also not made of Session-14, which involved tree planting, because this session was shifted to an earlier time in the morning. This meant the teacher did not have time to reflect immediately afterwards and forgot to complete this at the end of the day. Reflections were written in note and sentence form and varied in length from one to four paragraphs.

Reflections focused on the attitudes and behaviours of children to issues of environmental sustainability, for example, after Session-1, when children conducted the school walk and discussed acting responsibly, the teacher reflected:

Students showed great care for animals (e.g., by catching a cricket in their hand and then releasing, by walking quietly over to the magpies). We discussed drawing things instead of picking them, or just taking one flower or leaf instead of many. Also not killing or squashing things, not pulling bark from trees, etc. (09/06/2011)

The teacher also reflected on the children's enjoyment of particular activities, such as after Session-3. This session involved a class excursion to Clearwater Creek to investigate living and non-living elements of the environment:

The excursion to Clearwater Creek went well. The students were extremely excited to be outdoors and loved jumping off logs, looking for tadpoles and frogs, finding rabbit holes, etc. It was all very hands-on and fun. (16/06/2011)

Another consideration made during teacher reflections was on the effectiveness of pedagogical strategies. An example of this was after Session-1 when children were required to RallyRobin (take turns to share) ideas in pairs 'what makes things living?' The teacher reflected:

Session went well. The rally robin seemed to get all students excited and involved after having done silent reading first after lunch. (09/06/2011)

The teacher also reflected on issues or problems that occurred, or unexpected outcomes. An example of this was after Session-3 when the teacher wrote:

The student reflections were not as detailed. I think because we were outside and they were more interested in touching, looking and doing, rather than writing/drawing. (16/06/2011)

The teacher further noted reflections on changes to the planned program. Session-5, originally included an excursion with a local AaTSI elder to a cultural site of significance within the town to discuss the links between AaTSI culture and environment, however this could not occur so the teacher and AIEO planned an alternative yet related session. The teacher wrote:

Today we could not visit the planned site because Sandy [pseudonym] was busy so we improvised at school, with the help of our AIEO, Mary [pseudonym]. We read the poem 'Honey Ant' from Anna the Goanna (p. 28). The students acted out the poem as they read it allowed in 2 groups. They loved this activity to introduce the bush tucker them ... Mary then talked about some AaTSI language related to bush tucker and other common words. These were added to the word wall. I noticed that several AaTSI children were particularly engaged in this session, involving themselves more than usual in discussion, etc.

Another consideration of the teacher's reflections was the development of children's science skills and understandings. After the construction of witchetty grub models in Session-5, the teacher reflected:

This afternoon we made clay witchetty grub models after revising the structure learnt about this morning... I found all students obviously enjoyed this activity (they said so!!) and included many of the structures learnt about in the model. Students then drew a labelled diagram of their models in their Science books. Some also made models with the left over clay of moths, honey ants and wood/trees as homes for their grubs. This showed they obviously listened this morning to the habitat and life cycle discussion. (23/06/2011)

Finally, the teacher/researcher ‘self-evaluated’ the effectiveness of the combined sustainability sessions. Session-11, involved the children conducting their habitat investigation at Clearwater Creek. The teacher reflected:

This was a very valuable experience. I was worried that the students wouldn’t see much, would lose interest/focus, but it was not the case. All were engaged the whole time and focused their attention on looking at the one plant as a habitat, not everything surrounding them. Their pages were full and there was so much to see. The observation sheets designed by the students also worked well. It gave them a sense of ownership in the task too. (04/08/2011)

Survey

Quantitative methods were used to complete the data set. According to Bell (2005): “Quantitative researchers collect facts and study the relationship of one set of facts to another. They use techniques that are likely to produce quantified and, if possible, generalizable conclusions” (p. 7). A survey was used in this study to assess the attitudes of the children towards sustainability both ‘before’ (pre), and ‘after’ (post) the implementation of the sustainability science-program.

Defined simply: “A survey describes a population; it counts and describes ‘what is out there’” (Sapsford, 2007, p. 3). Fowler (2009) explains that: “Surveys are designed to produce statistics about a target population. The process by which this is done rests on inferring the characteristics of the target population from the answers provided by a sample of respondents” (p. 11). Sapsford’s (2007) suggestion of using survey data to describe ‘what is out there’ was furthered by Fowler’s (2009) recognition of the ability to make inferences about the population’s characteristics from the data. Each of these definitions highlights the empirical nature of surveys through the use of the words ‘counts’ and ‘statistics’. Bell (2005) defined surveys differently by explaining the aim of a survey is:

to obtain answers to the same questions from a large number of individuals to enable the researcher not only to describe but also to compare, to relate one

characteristic to another and to demonstrate that certain features exist in certain categories. (p. 14)

This definition elaborated on Sapsford's (2007) and Fowler's (2009) by focusing more on the ways data could be used, including not only to describe, but also to compare and relate characteristics found in survey data. Bell's (2005) identification of the need to survey many people related to a key feature of surveys, being that surveys should collect information from a representative sample of the population (Bell, 2005). This idea was also recognised in Fowler's (2009) work and loosely in Sapsford's (2007), by his recognition surveys describing the 'population'.

Another key feature of surveys is the need to use the same questions with all participants. Whilst surveys can be completed by the individual: as a questionnaire; or through the use of an interviewer; it is important that, "all respondents will be asked the same questions in, as far as possible, the same circumstances" (Bell, 2005, p. 14). Fowler (2009) also discussed the importance of question design and suggested the evaluation of questions before implementation of the survey.

An important advantage to the use of surveys is that they are versatile. When discussing surveys for educational research, Schutt (2011) explained that they could investigate a variety of areas, and that, "a well-designed survey can enhance our understanding of just about any educational issue" (p. 160). This versatility of surveys means that they can be adapted to specifically suit the purpose and needs of any study, as was the survey used in the present study. Another advantage to the use of surveys as a method of data collection is that once developed, they are not expensive to implement. This was recognised by Bell (2005) and Kelley, Clark, Brown and Sitzia, (2003), and was relevant to this study as the financial costs involved in the survey only included the cost of printing the surveys. Bell (2005), and Kelley et al. (2003) explain a third advantage to the use of surveys in that they are reasonably quick to administer. Kelley et al. (2003) claimed that the low cost, and quick completion of surveys, assisted researchers in planning and completing their projects within a shorter time frame. Although each survey in the teacher/researcher's study took a short time to complete (and was short compared to other methods of data collection), the overall time was lengthened by surveys being completed by the Year-2/3 children working one at a time with the AIEO.

One limitation to the use of surveys as a method of data collection is that the design of the survey and the wording of the questions is paramount to its effectiveness

and can be complicated. Bell (2005) claimed that: “Question wording is not as easy as it seems” (p. 14). Fowler (2009) further explained that error can occur with the answering of questions because of many reasons, some of which include, “misunderstanding the question, not having the information needed to answer, and distorting answers in order to look good” (p. 15). Each of these issues related to answering the questions can impact on the validity of the survey. Given that surveys are conducted with a sample of the population, another limitation to their use relates to how representative that sample is. Fowler (2009) suggested that sampling error can occur in surveys, as there would naturally be some variations between the sample and the population. In response to this issue, Bell (2005) claimed: “Great care has to be taken to ensure that the sample population is truly representative” (p. 14). Following from this, another source of error evident in surveys is bias. Fowler (2009) explained: “Bias means that in some systematic way the people responding to a survey are different from the target population as a whole” (p. 13). The identification of the ‘systematic way’ indicates that the source of error is not random, but is a result of the design of the survey.

Another limitation to the use of a survey is the closed nature of the survey items. This means that in a tick-a-box survey participants do not have the opportunity to elaborate upon their ideas or add detail and depth to their responses. A final limitation to the use of surveys is that the interviewer can influence answers if an interviewer is used. Fowler (2009) explained that, “it is important to avoid having them [the interviewer] influence the answers respondents give, and at the same time to maximize the accuracy with which questions are answered” (p. 5/6). The authors suggested that using the same questions with all participants and allowing standardised, yet limited feedback between the interviewer and the participant, could help to reduce inconsistencies.

Development of the survey

The CASS used in this study was designed to measure young children’s attitudes to issues of environmental sustainability. Several key themes were identified from a review of the literature, including: mutual responsibility, biodiversity, habitat conservation, resource use, water pollution, litter and rubbish, and air pollution. These themes informed the development of 14 items used in the survey. The ideas within each theme were simplified and linked to local contexts which children were familiar with. For example: the theme ‘resource use’, addressed issues of sustainability and consequences of using resources. These ideas were simplified and linked to children’s

contexts through Item-14 addressing fishing practices, an activity that all children in the class were familiar with.

Mutual responsibility

The theme 'mutual responsibility' contained two main ideas. The first is the idea of 'responsibility'. Dunlap (1994) highlighted this issue by viewing environmental deterioration in a serious way, and also by Leiserowitz et al.'s (2005) with their focus on 'responsibility' in environmental sustainability. The next main idea is the acceptance that everyone's individual input creates a mutual effort, and not blaming others, also identified by Dunlap (1994). This idea related directly to Eagles and Demare's (1999) moralistic attitudes.

Given the abstract nature of these ideas they could be difficult for Year-2/3 children to comprehend, so it was important to develop survey items that contextualised and simplified the ideas. The researcher did this by relating the theme to an environmental sustainability context familiar to all children that is, waste management through putting rubbish in the bin. The researcher then focused the items on children's behaviours and attitudes, including addressing their current behaviours in Item-2 and their attitudes to ideal behaviours in Item-3. Through the use of simple language in both items, and the inclusion of responsibility in Item-2 and mutual efforts in Item-3, the researcher suggested the following items:

Item-2. I never pick up other people's rubbish.

Item-3. It's important for us to work together to get rid of rubbish around the school.

Biodiversity

The second theme biodiversity encompassed ideas relating to the conservation of plant and animal life. This derived from Musser and Malkus' (1994) concern with animal protection and included related to the ecologicistic attitudes identified by Eagles and Demare's (1999). A further important aspect of the biodiversity theme involved consideration of the significant impacts of species loss, as noted by Leiserowitz et al. (2005). These elements were used to inform the development of five items relating to biodiversity. These items were based on three ideas derived from the theme, including: valuing and recognizing biodiversity; protecting biodiversity, and the potential impact of pests on species loss biodiversity.

The researcher chose to incorporate the value of biodiversity, with recognition that biodiversity includes a wide variety of species, into two items. These two items

addressed two categories, being plants and animals. Valuing biodiversity was addressed through the use of the words 'need' and 'should have'. The idea of biodiversity including a wide variety of species was simplified and addressed through the use of language, such as 'many types' and 'lots of types'. The items were contextualised with the term 'bush', a phrase that all children were familiar with. This led to the development of the following items:

Item-8. We don't need many types of plants growing in the bush.

Item-9. I think we should have lots of different types of animals in the bush.

Protecting biodiversity was also addressed in two items and broken into two categories, being plants and animals. This idea was simplified with the use of the phrase 'care for' and led to the development of the following items:

Item-6. We don't need to care for native animals.

Item-7. It is important that we care for all native plants.

The complex idea of the impact of species loss on biodiversity was adapted and simplified to suit the children in this context and was addressed in one item. The change meant that it focused on the impact that some animals can have on species loss. Animals were chosen as the cause for species loss given that children in this study were familiar with common pests such as foxes, feral pigs and feral cats. With the inclusion of simplified language, such as 'bad', the following item was developed:

Item-5. Some animals can be bad for the environment.

Habitat conservation

Habitat conservation was the third theme used to inform the development of the survey items. This theme related strongly to Eagles and Demare's (1999) investigation of ecologicistic attitudes in children and was broken into two parts. The first part to this theme relates to habitat. Habitat was addressed in the survey items through the use of the contextualised term 'bush'. This habitat was identified in two different, yet familiar settings to Year-2/3 children, being 'around town', and 'on farms'. The second part to this theme is conservation, which was also identified by Musser and Malkus' (1994) Children's Attitudes Toward the Environment Scale survey of children. The idea of conservation was broken down into three key ideas. Each idea was addressed in a separate item in the CASS.

The first key idea addressed in an item was the need to maintain habitat, which was simplified through the use of the phrase 'care for'. This item linked caring for habitat with the familiar setting of the bush around town, and stated:

Item-10. We don't need to care for the bush around our town.

The next item related to the key idea of habitat destruction and was addressed in the survey through the phrase 'get rid of'. The farm setting was included along with the town setting in this item to prevent children who lived in town feeling unable to answer the item in case they had not previously visited a farm. The farm setting was included because of Filson's (1993) identification of scepticism towards global warming and an unwillingness to conserve habitat amongst farmers. This item stated:

Item-11. It's okay to get rid of bush on farms or around town.

The third key idea of conservation targeted potential actions to rehabilitate cleared areas and promote habitat conservation. This was contextualised to Year-2/3 children through the use of an, 'example of action' that they were all familiar with, being tree planting. Children had all experienced tree planting at Clearwater Creek in previous years. This item stated:

Item-12. Planting trees where they have been cleared is a waste of time.

Resource use

Another significant theme identified in the literature was resource use. Reser (2007) identified the responsible use of fishing resources as essential to environmental sustainability. The activity behind this theme, that is, fishing, was already familiar with children in this study, as many children spent afternoons, weekends and holidays at the local beach. Children regularly discussed their 'catches' from the weekend while they were at school. The idea of responsible fishing practices was incorporated into an item through the phrase 'lots and lots of fish'. This was chosen because it is a neutral phrase and did not imply a moral judgment of the behaviour, yet repetition of the word 'lots' indicated a very large quantity. This led to the following item:

Item-14. It's great to catch lots and lots of fish.

Water pollution

The fifth theme water pollution derived from Leiserowitz et al.'s (2005) recognition of the significance of this as a public issue. It also related to Eagles and

Demare's (1999) moralistic attitudes as the issue signifies a lack of moral judgment through polluting and disregarding waterways. This idea was applied to the corresponding item in the CASS through the use of the phrase 'care for'. Water, as an element of the natural environment (Dunlap, 1994) was easily contextualised in the survey item and related to the children in the study. The location of the town near the coast as well as a river flowing through the town to the coast, meant that children were familiar with these water settings as they were used for recreational purposes, such as swimming and camping; a source of employment for parents, such as Cray fishing; and as a food source through fishing. The related survey item used both rivers and beaches to contextualise the theme, and the item stated:

Item-13. We should care for our rivers and beaches.

Litter and rubbish

The sixth theme litter and rubbish was chosen because of its contribution to water and air pollution and the consequential impacts this has on ecosystems. There is a high level of public concern with such issues (Leiserowitz et al., 2005), which relates closely to Dunlap's (1994) identification of the need to view environmental deterioration seriously. Given that the inappropriate disposal of waste through litter and rubbish can contribute to water and air pollution, thereby potentially affecting a variety of habitats and ecosystems, the theme further relates to Eagles and Demare's (1999) investigation of the ecologicistic and moralistic attitudes of children toward the environment. The ecologicistic element of this process was addressed at a basic and simplified level, being 'rubbish'. The moralistic element of litter and rubbish was incorporated through the relation of the item to children's behaviour that is, putting rubbish in the bin. This behaviour was chosen because of its familiarity with all children. The item was also made personally relevant with the use of the word 'I'. The item stated:

1. I always put my rubbish in the bin.

Air pollution

The final theme used to inform the development of the CASS was air pollution. The significance of this environmental issue, and the high levels of public concern regarding it, was identified by Leiserowitz et al. (2005). Related to the theme of air pollution is Eagles and Demare's (1999) study of the moralistic attitudes of children, as air pollution involves an element of morality. The existence of air pollution suggests lifestyle choices in favour of activities that contribute to the problem, instead of

activities that do not. The issue of decision-making and moral judgments was incorporated in survey Item-4, by offering children a potential choice. By starting the item with the phrase, 'we should', and offering an activity that pollutes the atmosphere and an activity that does not pollute the atmosphere, children were required to actively choose an option.

Dunlap's (1994) identification of air as a key element of the natural environment formed the second part of this theme. Given the wide variety of possible sources and methods of reducing air pollution, many of which would be complex and seemingly unrelated to Year-2/3 children's lives, it was important to relate the issue to children through the use of familiar examples. For this reason the teacher/researcher chose to include 'cars' as a method of transport that is a source of air pollution, and 'walking' and 'riding a bike' as methods of transport that do not pollute the atmosphere. This led to the following item:

Item-4. We should walk or ride a bike and use cars less.

Table 11 links the themes with their corresponding items, and gives a definition as well as an example for each theme.

Table 11: Development of survey items

Theme	Definition	Item numbers	Examples
Litter and rubbish	Effectively managing waste through putting rubbish in bins.	1	1. I always put my rubbish in the bin.
Mutual responsibility	Recognising the input individuals make in mutual responsibility of waste management through putting rubbish in bins.	2, 3	3. It's important for us to work together to get rid of rubbish around the school.
Air pollution	Considering alternative methods of transport to reduce air pollution.	4	4. We should walk or ride a bike and use cars less.
Biodiversity	Valuing the contributions of all plant and animal species and the need for diversity in local habitats.	5, 6, 7, 8, 9	9. I think we should have lots of different types of animals in the bush.
Habitat conservation	Considering activities that degrade, maintain and actively promote the conservation of local habitats.	10, 11, 12	11. It's okay to get rid of bush on farms or around town
Water pollution	Desire to act positively with local waterways including rivers and beaches	13	13. We should care for our rivers and beaches.
Resource use	Considering sustainable resource use through fishing.	14	14. It's great to catch lots and lots of fish.
Interconnections	Connections between and amongst the living and non-living elements of the environment.	<i>No relevant items in the survey as this theme emerged from data analysis</i>	

Steps used for the survey

Children completed the survey individually, but with the assistance of the AIEO. As with the formal interviews, The AIEO was chosen as an attempt to reduce children feeling they should give the 'correct' response instead of a truthful one. Surveys were conducted in the room next to the Year-2/3 classroom; providing a quiet space for children to consider their responses, the same room used for the formal interviews. All surveys were completed after lunch, between 1.30pm - 2.00pm. Surveys were completed twice by all children: firstly at the beginning of the study, before

implementation of the sustainability science-program; and secondly after completion of the program.

The AIEO gave them a practice question, before each child completed the survey. For example: “Tell me what your answer would be to ‘I like to clean my bedroom at home’”. She also explained to children that there was no right or wrong answer and that they should answer the questions honestly. Next, the AIEO instructed children to tell her if they did not understand the question. The statements used in the survey were based on a sound understanding of the children’s literacy skills. They were designed to assess the children’s attitudes to sustainability, not their reading ability. For this reason, the AIEO read each survey item and the response options to the children, and was allowed to briefly explain the meaning of any unknown words. Explicit instructions were given to the AIEO regarding how much assistance could be given to children if clarification of items was needed (see Appendix B i). She was further instructed to record if the children did not understand any of the words or items or wording of the items whilst the survey was being conducted.

The pre-program and post-program surveys were assessed using a Likert scale. Bell (2005) described that Likert scales, “are devices to discover strength of feeling or attitude towards a given statement or series of statement” (Bell, p. 142). In this study, the survey was used to determine children’s attitudes to items, contributing to an overall understanding of their attitudes to environmental sustainability. Surveys are able to indicate order as they, “ask respondents to indicate rank order of agreement or disagreement by circling the appropriate number” (Bell, p. 142). “A variable is measured at ordinal level if it is possible to arrange the observations in rank order” (Gray, 2010, p. 14).

The surveys included a four-point Likert scale. A four-point scale was chosen over a larger scale because it has been suggested, “that people are not able to place their point of view on a scale greater than seven” (O’Neil, 2007, para. 3). This project uses a four-point scale instead of a five-point scale because, “there are inconclusive results on the use of a middle or neutral point” (O’Neil, para. 6). By not having a middle point, the Likert scale in the present study required children to choose either a positive or a negative reaction.

Similarly, Eagles and Demare (1999) asked 10-11 year old children in their study to respond to a 5-point Likert scale ranging from Strongly Agree to Strongly Disagree, with, ‘Don’t Know’ being the middle option. Given the difference in age between the

children in this study and children in the present study, certain measures were taken to ensure children's comprehension, such as the assistance of the AIEO, consideration of the language used and the inclusion of emoticons symbolising the response options.

Musser and Malkus (1994) also assessed the environmental attitudes of children aged 8-12 years by asking them to respond to a Likert scale; however, their instrument presented only two response options, being 'really true' and 'sort of true'. The present study chose four response options to indicate a greater variety in the strength of children's attitudes.

The items used in the survey were designed with some reverse wording, as was Eagles and Demare's (1999) scale. Given the age of the children they may have simply answered 'positively' as they thought that would be what their teacher wanted. The use of reverse wording would "force the person taking the survey to carefully read the questions" (University of Northern Iowa, 1995-2010, para. 2). In the case of the Year-2/3 children in the teacher/researcher's study, it would encourage them to think carefully about the statement read aloud by the AIEO and about the responses they gave. The survey consisted of fourteen items, five of which were reverse (or negatively) worded.

Locker, Jokovic and Allison (2007) explained that the wording of items consists of four categories. The first includes items that focus on a positive event and that are worded positively. The CASS had six items of this nature, for example: Item-13. We should care for our rivers and beaches. The next category includes items that focus on a positive event, but are worded negatively. There were five items in the CASS from this category, for example: Item-6; We don't need to care for native animals. The third category consists of items focusing on a negative event, but that are worded positively. The CASS had three items of this nature, for example: Item-11; It's okay to get rid of bush on farms or around town. The final category included items that focused on a negative event and were worded negatively. The survey in the present study did not use any items of this nature because the wording can become complicated and inhibit comprehension. Table 12 outlines the items in each category.

Table 12: Wording of survey items

Positive events worded positively	Positive events worded negatively	Negative events worded positively
1. I always put my rubbish in the bin.	2. I never pick up other people's rubbish	5. Some animals can be bad for the environment
3. It's important for us to work together to get rid of rubbish around the school	6. We don't need to care for native animals	11. It's okay to get rid of bush on farms or around town
4. We should walk or ride a bike and use cars less	8. We don't need many types of plants growing in the bush	14. It's great to catch lots and lots of fish
7. It is important that we care for all native plants	10. We don't need to care for the bush around our town	
9. I think we should have lots of different types of animals in the bush	12. Planting trees where they have been cleared is a waste of time	
13. We should care for our rivers and beaches		

Another reason to include reverse wording in the survey is so that it does not encourage a response set as: "A response set is the tendency for a respondent to answer a series of questions on a certain direction regardless of their content" (Super survey, 1999-2007, para. 19). This could happen if the child noticed a pattern in their answers and completed the rest of the survey following that pattern, instead of thinking about their responses.

Locker et al. (2007) conducted a study regarding oral health related issues of 91, 10-11 year old children and their parents in Canada. This study focused on the use of positively and negatively worded items in a questionnaire consisting of eight items. The questionnaire responses were to a 5-point Likert frequency scale including: "never = 1; almost never = 2; sometimes = 3; fairly often = 4; almost all of the time = 5" (Locker et al., 2007, p. 257), as well as the inclusion of a 'don't know' option. Locker et al. (2007) assessed positive and negative question wording from items that were related to, "eating, oral self-care, appearance and self-confidence" (Locker et al., 2007, p. 257). Four of these items were positively worded and four were negatively worded. Locker et al. (2007) found that the positively worded questions did not 'function well' compared to negatively worded items through a much higher rate of 'don't know' responses. Whilst the context of this survey is different to the environmental attitudes measured in

the present study, the use of reverse worded items with children is relevant. It is also significant to note that the AIEO did not make any notes suggesting children did not understand the items in the survey.

Another way in which the survey was designed to best suit the age of the Year-2/3 children was the use of emoticon icons as the responses. These were used, along with words, to assist the children in comprehending what each response actually meant. The strongly disagree response included an emoticon character with a very sad face and a thumbs down gesture. The 'disagree response', also included a character with a 'sad face' icon. The agree response included a character with a happy face. The strongly agree response included a character with a very happy face and a thumbs up gesture. The AIEO read and discussed these response choices and explained how and where to record their choices on the survey sheet with every child prior to completion of the survey.

Consideration of the survey design was also given to the language level used. Given the young age of the Year-2/3 children, survey items were worded in simple, common and contextualised language. The AIEO was given a set of instructions and definitions that she could read to the children if they queried the meaning of particular words. These measures helped to minimise any confusion felt by the children relating to survey item comprehension.

A final consideration of the survey design was the colouring and size of the font. Three coloured fonts were used to break the block of text and make the survey more visually appealing to the children. The inclusion of the sized 14 font (was reasonably large) and appeared clearly on the page, helping to keep the children interested in the text. The coloured icons further added to the visual appeal of the survey.

Data analysis

This section of the chapter describes the data analysis. This study incorporated the analysis of both qualitative and quantitative data sources.

Qualitative data

Qualitative data were analysed through a process of analytic induction. Goldenberg (1993) explains that in analytic induction groups who differ in the dependent variable are compared. In this study, Year-2/3 children's attitudes to sustainability act as the dependent variable, which has been observed and measured to

differ. After completion of the pre-program and post-program survey the development of children's attitudes were investigated.

Preissle (2008) explains that analytic induction is based on formulating a theory after examining evidence. She also claims that it can involve the development of categories and generalisations and that classification is a key aspect of analytic induction. Qualitative data sources included in this study were the Year-2/3 children's written and illustrated reflections in science journals, work samples, teacher reflections, teacher observations, and interviews completed throughout and at the conclusion of the sustainability science-program. These data sources were read through thoroughly and categorised in lists according to the original themes that were used in the development of the survey: mutual responsibility; biodiversity; habitat conservation; resource use; water pollution; litter and rubbish, and air pollution. It was ensured that every piece of listed datum was dated and labelled with the individual child's pseudonym that it related to as categorising occurred. It should be noted that analysis of qualitative data suggested slight changes to the themes. An example of this is the theme mutual responsibility. This theme originally focused on acting responsibly through putting rubbish in the bin; however data suggested that this theme developed to include broader ideas related to pollution of the environment and the destruction of habitat. After classifying the qualitative data it became apparent that there were several responses that did not fit any of the original themes. Some of these were not relevant to the study and were not further analysed. Others were related and were categorised into one new theme, interconnections. Table 13 gives examples of qualitative data categorised in each theme.

Table 13: Qualitative data in themes

Theme	Definition	Examples
Litter and Rubbish	Effectively managing waste, for example through putting rubbish in bins.	<p>24/6/11: Helen's journal Picture 3 [stimulus image] shows we must not let our world go messy. If someone went and got some rubbish and chucked it in the ocean they don't have respect...If we pollute our world even people will die.</p> <p>31/6/11: Teacher observations discussing stimulus Image-5 (polluted waterway): Grace- 'People threw their rubbish in there when they were drinking' Helen- 'It could be a rubbish tip that flooded'</p>

Theme	Definition	Examples
Mutual responsibility	Acting responsibly in the environment and recognising the input that individuals and groups of people make, such as through picking up other people's rubbish.	<p>9/6/11: Betty's journal (reflecting on acting responsibly) I drew the flower instead of picking them. Picked a nut off the ground. Didn't kill anything.</p> <p>24/6/11: David's journal I don't like number 2 the way our environment is being treated. That is just awful. Everyone in this world wants the ocean looking MAGNIFICENT. Stop polluting our world now! Who wants the world looking like that because I don't like it? I hate it. No one likes it. So all those people that are doing it just think how you would like to be treated. If you were a sea animal would you like to get caught up in the rubbish?</p>
Air pollution	Considering potential causes of air pollution, such as cars, and alternative methods to reduce air pollution, such as riding a bike.	<p>30/6/11: Teacher observations discussing stimulus Image-8 (riding a bike): Fay- It tells you to wear a helmet. Ella- He's riding with no pollution. Colin- It's bad because he's riding with one hand.</p> <p>1/7/11: Gary's journal Picture 7 tells me that people put chemicals in the air.</p>
Biodiversity	Valuing the contributions of all plant and animal species, the need for diversity in local habitats and recognizing ways to assist biodiversity.	<p>5/8/11: Brian's journal The wheat crop has hardly any biodiversity because it's only one species. On the other side it's a good crop for the farmers because you make lots of money to keep us all alive. If there were no farms you wouldn't have toast or you wouldn't be able to make cakes.</p> <p>5/9/11: Formal interview with Alan: <i>Can you tell me what biodiversity is?</i> 'All the sorts of different living things'. <i>What could we do in other places to look after biodiversity?</i> 'Well we could bring umm seeds over and plant some stuff over there for them, we could like bring trucks full of water and then like aeroplanes with full of different kinds of seeds'.</p>

Theme	Definition	Examples
Habitat conservation	Identifying activities that degrade, maintain and actively promote the conservation of local habitats.	<p>16/8/11: Cathy's journal The habitat protection is when people help the environment by planting trees in the bush and caring for our community like watering trees because animals live in trees. Like caterpillars because it is their homes.</p> <p>2/9/11: Anne's journal I've learnt that spiders use eucalypts tree bark for their homes. I'm happy about that.</p>
Water pollution	Identifying causes of water pollution and ways to act positively to help local waterways, including rivers and beaches.	<p>24/6/11: Edward's journal We need to stop chucking rubbish in the sea because the sea animals will die.</p> <p>24/6/11: Teacher observations discussing stimulus Image-3 (turtle caught in plastic ring) David- 'It won't hurt it because it's on its shell'. Colin- 'It might get caught on its fins under its shell'.</p>
Resource use	Considering sustainable resource use through fishing.	<p>7/7/11: teacher observations discussing stimulus Image-23: Henry- Umm, they're getting greedy Ella- They're catching too many David- If it's too small don't get it or the fisheries will get you</p> <p>7/7/11: Gary's journal Picture 23 tells me to fish responsibly. I think fishing responsibly is to not catch the little fish because they won't grow up and when they grow up they have babies.</p>
Interconnections	Connections between and amongst the living and non-living elements of the environment.	<p>17/6/11: Colin's journal On the excursion yesterday we learnt that the outside world is connected, but there's a dark side to it. If the water gets polluted, everything that drinks the water will die or get infected and then will die later, then it will carry on. So when you go to a lake that is fresh water and it's brown and murky try not to drink it.</p> <p>28/6/11: Denise's journal Other animals need to eat animals or they will die. Birds need worms and other insect to live.</p>

Once all qualitative data had been categorised it was read through again to check the classification by the researcher. This was necessary as some data contained elements relating to multiple themes. In these cases the data were classified according to the dominant theme. An example of this was: “I learnt that we can’t throw rubbish in the water” (Brian’s journal, 17/06/2011). Although it can be inferred that this written comment is related to water pollution, it was categorised into the rubbish and litter theme because the main idea expressed in it was about throwing away rubbish, and the issue of water pollution was not specifically mentioned.

Data from the formal interviews were all categorised into the biodiversity theme and were further analysed. Children responded to three questions. Question one was: “Can you tell me what biodiversity is?” The responses to this question were transcribed and common wording and phrases were identified. Question two was: “Can you think of anything you have done to help look after the biodiversity at Clearwater Creek?” and question three was: “What could we do in other places to look after biodiversity?” After transcribing and reading through the responses to these questions 10 key actions that were suggested by the Year-2/3 children were identified as categories. These included picking up rubbish; plant trees, plants or seeds; protect current environment; pull up weeds; spray weeds; water trees; save individual species; stop water pollution; research; and beautify the area. Children’s responses to questions two and three were then classified into these 10 categories. After checking the classification of data into categories generalisations were drawn about the development of children’s attitudes to environmental sustainability.

The narrative vignettes were created to illustrate the development of individual children’s attitudes to environmental sustainability. After reading through the categorised data relating to particular themes, individual children were chosen to exemplify the development of attitudes through the creation of narrative vignettes. Children were chosen who had large numbers of data in particular themes, or who stood out as having data responses that supported or rejected the general ideas in the themes. Two children were chosen to illustrate the development of attitudes in each of the themes. Once children were chosen, data from multiple sources was synthesised and a narrative vignette was written in a way that was consistent with the child’s voice.

Renold (2002) explained that vignettes can, “enable an exploration of issues or incidents” (Renold, 2002, p. 5). The aim of using narrative vignettes in this study was to create a rich text that encapsulated the 15 Year-2/3 children’s attitudes to environmental

sustainability. The narratives highlighted the development of attitudes amongst children and their reasoning as they came to their own conclusions regarding issues of environmental sustainability.

Quantitative data

Quantitative data involved the assessment of attitudes to environmental sustainability through a pre-program and post-program survey. The survey was coded numerically (1 to 4). Responses that indicated a 'low' attitude scored 1 and responses that indicated a 'high', or positive attitude score 4. For example: Item-1; I always put my rubbish in the bin, was scored: Strongly agree = 4, Agree = 3, Disagree = 2 and Strongly disagree = 1. Items with reversed wording were reverse scored too. For example: Item-10; We don't need to care for the bush around our town, was scored: Strongly agree = 1, Agree = 2, Disagree = 3, and Strongly Disagree = 4. The survey was then analysed as an interval scale as, "it is assumed that the intervals between the options are about the same" (Gray, 2010, p. 15). The numerical responses, which form the data, were used as the input to the SPSS program: 'PASW Statistics Student Version 18.0', and this data were displayed on a data matrix. It was then further described and analysed by using the frequency of response choices and ranking the survey items in order of which showed the most to the least positive change from pre- to post-program. Given the small sample size it was not possible to make valid comparisons between genders or demographic subgroups. It was also not possible to conduct a dependent paired samples t-test on the sets of pre-program means and post-program means to establish whether or not the difference between the two were statistically significant or not given the small sample size.

Quality criteria

This section of the chapter describes the quality criteria for the present study with links to current literature. The qualitative data is described in terms of its trustworthiness, whilst the quantitative data includes discussion of validity and reliability.

Qualitative

The quality criteria for qualitative data relate to trustworthiness. Williams and Morrow (2008) suggest that there are three categories of trustworthiness that the qualitative researcher should consider: integrity of the data; balance between participant meaning and researcher interpretation; as well as a clear communication and application

of findings. These three categories have been used as a guide for reflection upon the trustworthiness of the present study.

Integrity of the data

One important aspect of the integrity of the data is its ability to be replicated. This can be referred to as its dependability (Given & Saumure, 2008) and is where the, “researcher lays out his or her procedure and research instruments in such a way that others can attempt to collect data in similar conditions” (Given & Saumure, 2008, p. 896). Williams and Morrow (2008) suggest that whilst procedures may be replicated, participants and findings may not be. This relates to the present study as the methods of data collection, the phases of research and the participating children were detailed in Chapter Three; however, it is acknowledged that this replication of the procedures and instruments in a different context could lead to very different findings.

Further, Williams and Morrow (2008) suggest that, “a critical component of integrity is a clearly articulated and referenced design or analytic strategy” (p. 578). This was addressed in the present study through the discussion of analytic induction for qualitative data analysis in Chapter Three.

Another aspect of the integrity of the research is the quality and quantity of the data. The quality of data is essential for establishing trustworthiness in the research. Given and Saumure (2008) relate this issue to credibility and claim that, “accurately and richly described” (p. 896) phenomena indicate a credible study. Williams and Morrow, (2008) elaborate on the idea of rich description when they suggest that researchers should, “recognize that diverse perspectives, shared in a variety of ways, are likely to provide rich data overall” (p. 578). The various data collection methods used in the present study incorporated the perspectives of the teacher/researcher and 15 Year-2/3 children involved in different ways, including: children’s written reflections in their science journals; children’s attitudes and thoughts during class discussions and activities collected through teacher observations; children’s attitudes obtained through informal interviews; the teacher’s written reflections; children’s ideas and environmental learning collected in their work samples; and children’s knowledge of biodiversity collected during formal interviews. These data collection methods, along with the survey, allowed for the triangulation of data sources, which assisted to provide quality data (Williams & Morrow, 2008). The sample in this study also included culturally and socio-economically diverse demographics, another contributor to rich data (Williams & Morrow, 2008).

Along with quality data, it is also important that there is enough data for each category or theme, so that, “the reader is able to grasp the richness and complexity of the constructs under investigation” (Williams & Morrow, 2008, p. 578). Sufficient quantity of data was achieved in the present study through the use of several different methods of data collection. This was contributed to, by the collection of data over a 10-week period, allowing for extensive data collection relating to children’s attitudes to sustainability.

A final consideration in relation to the integrity of the data is how evidence is presented. Given and Saumure (2008) explain this idea as confirmability, where “interpretations and findings match the data” (p. 896). They explain the significance of this is that data must support all claims that are made. In order to achieve this, Williams and Morrow (2008) suggest that qualitative researchers should, “emphasize the sample as a whole and use quotes as highlights and exemplars” (p. 578). The present study addressed this through the inclusion of the Year-2/3 children’s vignettes and other examples of qualitative evidence in the findings chapter, and examples of the coding of children’s comments in the data analysis. These examples were used to support the broader discussion of the development of attitudes in children throughout the study.

Balance between participant meaning and researcher interpretation

The second category of trustworthiness relates to the balance between the participants’ meaning and how the researcher interprets that data. Williams and Morrow (2008) identify that this balance depends on subjectivity and that whilst subjectivity is evident in any research study, researchers should, “attempt to explore or manage their biases through reflexivity” (p. 579). They continue that the researcher should reflect upon the contributions the participants made to the data and what the researcher contributed, for example through the use of a research journal, participant feedback or an external auditor. It is recognised that the present study is subjective given the active role of the teacher/researcher. However, the researcher attempted to manage biases throughout the study by trying to not impose meaning on the study, as suggested by Brewer (1994), and Ybema et al. (2010). This occurred throughout data collection, as the teacher/researcher was conscious of observing and prompting children without suggesting personal attitudes and ‘correct’ responses. A balance was also aided by the support of the teacher/researcher two supervisors to check the balance between participant meaning and researcher interpretation. Further related to reflexivity, the researcher noted other variables that may have affected the results of the study. If the

children participated in extracurricular programs with an environmental focus their attitudes may have changed as a result of this. If the children's families became actively involved in environmental community projects this may also have influenced the data. In order to keep track of extraneous variables, a list of any significant community events, media campaigns, or other school projects that may have affected the results was kept throughout the duration of the teaching study. The dates on which these events occurred were also recorded. This list can be found in Appendix I.

Clear communication and application of findings

It has been suggested that the clear communication and application of the findings of a study are essential to its trustworthiness (Williams & Morrow, 2008). Williams and Morrow (2008) described the significance of social validity in qualitative research as description of the purpose and uses for the study. The present study outlined the rationale for its completion in Chapter One, as making a contribution to learning about how Year-2/3 children can work towards environmental sustainability. The purpose of the study was also outlined, as were the research questions focusing on assessing the development of the Year-2/3 children's attitudes to issues of environmental sustainability and investigating how these can be promoted.

Clear communication suggests that the reader should be able to understand findings and interpretations with the support of quotes and examples. However, describing the context from which data are collected is an essential part of communicating and applying findings as it helps the reader's interpretations (Williams & Morrow, 2008). Given and Saumure (2008) also identify the need to describe the context of the study for potential transferability. They suggest that this contributes to the trustworthiness of a study, "so that its applicability to different contexts (broad or narrow) can be readily discerned" (p. 896). The teacher/researcher's study aimed to clearly communicate the context of the study through a description in Chapter One and through detailed information of the participating Year-2/3 children being given in Chapter Three. The context was further described in the findings chapter as supporting details were given for examples of children's data to assist the reader to understand the experience.

Williams and Morrow (2008) further suggest that this category involves recognizing the theoretical framework for the study by linking findings to current literature. The development of the present study was based on a review of related

current literature. Literature was further used to link findings with current theories and practices in the discussion chapter.

Quantitative

Whilst qualitative research should be considered in terms of its trustworthiness, quantitative research should be considered in terms of its validity and reliability. The discussion for validity includes: analysing concepts; consideration of the items in the survey; objectivity; and using evidence to support claims. Discussion of the reliability of the study focuses on: temporal reliability; representative reliability; generalizability and consideration of the context; and other influencing factors.

Validity

Bell (2005) suggested that definitions of validity generally involve, “whether an item or instrument measures or describes what it is supposed to measure or describe” (p. 117), similarly defined by Given and Saumure (2008). Adcock and Collier (2001) explained that one type of validity is measurement validity, which considers: “Do the observations meaningfully capture the ideas contained in the concepts?” (p. 529). This can be measured through content validation, meaning, “does a given indicator...adequately capture the full content of the systematized concept” (Adcock & Collier, 2001, p. 538). Central to this process is the need to thoroughly analyse concepts. The present study attempted to address validity by using current and relevant literature as a base for conceptual development and inclusion in the survey.

Further, Adcock and Collier (2001) claimed that the researcher should ask two questions to assess the capturing of content: “First, are key elements omitted from the indicator? Second, are inappropriate elements included in the indicator?” (p. 538). These questions relate to the present study and were considered during the development of the survey and the piloting phase. Firstly, key elements of concepts were included in survey items except where the researcher chose to simplify the environmental sustainability concept to suit the young participating children, for example, elements to the theme mutual responsibility were simplified in both Item-2 and Item-3. Secondly, inappropriate elements were not included in survey items. It should be noted, however, that subjectivity was involved here by the teacher/researcher, deeming the contextualisation of survey items to be ‘appropriate’ and therefore including such elements; for example: the theme resource use was simplified and contextualised to focus on fishing responsibly.

An important element of validity in quantitative research is objectivity. Given and Saumure (2008) write that objectivity means that a study is not considered to be biased. Whilst the active role of the teacher/researcher in the present study has already been acknowledged, so too were the measures taken to ensure the 15 Year-2/3 children's responses to the survey were not influenced by the role of the teacher in an attempt to manage biases. For example, the AIEO conducted the surveys with children and explicit instructions given to the AIEO so that implementation was consistent.

Continuing, Given and Saumure (2008) suggested that one way objectivity can be demonstrated is through all claims being supported by data as evidence. Adcock and Collier (2001) claimed that: "Validity assessment is the search for this evidence" (p. 532). The teacher/researcher's study attempted to explain and support findings with data collected from the survey (i.e., changes in attitudes to sustainability themes were explained through the provision of information on changes in relevant survey items). In this way the data collected from the survey supported the findings on the development of the 15 Year-2/3 children's attitudes to sustainability.

Reliability

Reliability can be defined as, "the extent to which a test or procedure produces similar results under constant conditions on all occasions" (Bell, 2005, p. 117). This definition is similar to others' (Given & Saumure, 2008; Miller, 2008; Payne & Payne, 2004), through the common identification of consistency in results by repeating the study. Given and Saumure (2008) refer to the idea of consistency by using the term 'reproducible' when they describe reliability as whether or not the findings of the study could be replicated.

Payne and Payne (2004) suggest that one type of reliability is temporal reliability. They explained that if a study has this type of reliability it will, "get the same answer at different time-points" (p. 197). It should be noted that the aim of the present study was to measure the 15 Year-2/3 children's attitudes to environmental sustainability and to promote them through the implementation of the sustainability science-program. For this reason, children's attitudes to sustainability could change, therefore meaning that temporal reliability was not appropriate for this study.

Another type of reliability is representative reliability. This means that, "findings from other similar samples will be basically the same as those for the original study" (Payne & Payne, 2004, p. 197). Given and Saumure (2008) discuss this issue of reliability, as associated to the generalisability of the study, as well as the meaning the

application of the findings to other contexts, or as ‘external reliability’ (Lecompte & Goetz, cited in Payne & Payne, 2004).

Given that generalisability of the study is one key aspect to its reliability, the present study attempted to achieve representative reliability through the rich description of the context. By including such information on the 15 participating Year-2/3 children, the surrounding contexts, the methods of data collection and data analysis it is hoped that the findings of this study could potentially be applied to a similar context. It should be noted however, that the replication of this study would be extremely difficult given the triangulation of data sources and the strong contextual links between the research design and the participating children; for example: the contextualisation of survey items through familiar wording; the inclusion of stimulus images depicting familiar settings and people; and making the sustainability science-program culturally appropriate for the children.

Payne and Payne (2004) suggest one way that reliability can be tested is through test-retest. This was attempted through conducting the surveys with children both before and after implementation of the sustainability science-program and testing for Cronbach’s alpha. Santos (1999) states: “Cronbach’s alpha determines the internal consistency or average correlation of items in a survey instrument to gauge its reliability” (Santos, para. 1). An alpha coefficient (number between 0 and 1) was given as output and, “the higher the score, the more reliable the generated scale is” (Santos, para. 9). Cronbach’s alpha for the pre-program survey was 0.28 and the post-program survey was 0.58. Yurdugul (2008) states that literature indicates the minimum effective sample size for the use of Cronbach’s alpha is 200, but that his investigation suggest that a sample size of 30 can be effective under particular circumstances. Cronbach’s alpha score in the present study could have been compromised given that the sample size was 15.

Bell (2005) warned that if questions are asked relating to the participants’ opinions, then the responses may vary due to other influencing factors, such as television programs. This is of significance to the present study as the survey addressed children’s attitudes, which could have been affected by various factors. In an attempt to manage this issue, the researcher kept note of significant events that occurred throughout the sustainability science-program.

Ethical Considerations

Several key ethical considerations have been made in the design and conduct of this research study. These include the 15 Year-2/3 children's anonymity, confidentiality, managing the relationship between teacher and children, seeking of informed consent, the right to withdraw from the study, the AaTSI involvement and environmental responsibility. This section elaborates on each of these considerations. This study was granted ethics approval by Edith Cowan University Human Research Ethics Committee (the approval number is: 6560). The study was also granted approval by the Government Western Australia Department of Education (May, 2011).

Anonymity

One ethical consideration that was addressed is the use of children in the study. This means that necessary protocols were taken throughout the project. This included seeking parental permission for involvement in the project, considering anonymity of the children and adhering to DoE WA guidelines regarding excursions and Working With Children checks. It was also necessary to ensure that children felt as though their own values and those of their families were respected. Allocating pseudonyms to each of the children ensured anonymity. There was also no disclosure of any identifiable information about the children, their families, or the town in which they live (Oceanside Clearwater Creek).

Confidentiality

It was ensured that all data collected in the study were kept confidential. This was achieved through all data being kept in a locked filing cabinet and a password protected computer in a locked room. All data will be kept for a minimum of five years, after which it will be destroyed through the deletion of computer files, the shredding of paper and the erasing of audiotapes.

Teacher/ child relationship

Managing the nature of the relationship between teacher and children was carefully considered throughout the study. One way this was achieved was through the AIEO conducting the pre and post-program surveys and interviews so the children did not feel that they had to give the teacher/researcher a 'correct' response.

Another way the relationships were managed was through discussion and written reflection of sustainability issues. Children discussed issues together as a group so they could hear each other's opinions and attitudes and discuss their reasoning if they liked. After discussion, children wrote reflectively about their own attitudes. This reduced

pressure on the children having to verbalise their attitudes to the class and the teacher if they did not feel comfortable doing this.

Informed consent

Informed consent was an important consideration given that children were used in the study. The introductory information letter explained the purpose of the study, what would be required of participants and where parents could get more information. Consent was sought from the parents of all participants in the study. Parents indicated their consent by returning signed forms to the class teacher/researcher. The teacher initially informed the children (verbally) in a whole class situation. Parents were further encouraged to discuss the study with children and assist children in reading and choosing to participate or not. Children gave permission by circling 'yes' or 'no' and writing their name on a consent form.

Withdrawal rights

Parents were informed of the voluntary nature of involvement in this study, and of the right to withdraw their child in the introductory information and consent letter. Children were also informed of this when the teacher explained the study to the class and in further discussions with their parents. This was reiterated in the children's information letter that was sent home to parents. It was explained that withdrawal from the study could occur at any time; that data relating to that child would be destroyed unless otherwise agreed upon and that withdrawal from the study would have no impact on relationships between the child and the teacher, or the child and the school.

AaTSI involvement

An important ethical consideration was the involvement of local AaTSI people. This study involved the integration of AaTSI cultures and therefore also involved local AaTSI people. Consideration was given as to who was involved so that people did not feel disrespected. Those chosen were approached personally. The AIEO was involved in conducting the pre-program and post-program surveys and formal interviews as well as assisting in sessions throughout the sustainability science-program. Another local AaTSI woman assisted through discussion of the context and the community in the early stages of the study.

Environmental responsibility

A final ethical consideration is the use of natural environment. The sustainability science-program in this study involves sessions that were undertaken in local natural environments. Every effort was made to ensure that the environment was used

responsibly. One example of this was during Session-1. The Year-2/3 children conducted a school walk and collected specimens and recorded information about living and non-living things. Before conducting this session the children discussed behaving responsibly by not collecting and removing animals, but by instead taking photos or drawings of them.

A second example of responsible use of the environment in the sustainability science-program was during Session-7. The children collected tadpoles at Clearwater Creek and recorded information about the diet, habitat, behaviour and life cycle of tadpoles. The class then discussed responsible behaviour and returned the tadpoles to the creek.

Summary

This study was based on ethnography, using mixed methods. The research design consisted of eight key phases: seek approvals; pilot survey; seek permission from those involved; conduct pre-program survey; implement sustainability science-program and collect qualitative data; conduct post-program survey; conduct formal interviews, and data analysis. Integral to the study was the implementation of a 10-week environmental sustainability science-program with 15 Year-2/3 children from a rural government school, five of whom were AaTSI. A key participant in the study was the AIEO who conducted the surveys and formal interviews and who assisted in planning and implementing the sustainability science-program. Qualitative data collection methods included: teacher observations; children's work samples; teacher reflections; informal interviews; formal interviews, and children's science journals. The quantitative method used was the survey conducted with children before and after the sustainability science-program. The analyses and triangulation of these data sources has contributed to understandings of children's attitudes to environmental sustainability. This chapter has further discussed anonymity, confidentiality, teacher/child relationships, informed consent, withdrawal rights, AaTSI involvement and environmental responsibility as the ethical considerations made throughout the teacher/researcher's study.

Chapter Four

Findings

Introduction

Chapter Four highlights the critical findings that emerged from both qualitative (Part A) and quantitative (Part B) data. Part A describes the findings evident within the qualitative data by discussing the themes that were planned for in the sustainability science-program and which emerged from the data. Qualitative data includes child reflections in science journals (both written and illustrated), observations made by the teacher, notes on informal interviews, formal interview transcripts, teacher reflections and vignettes from the 15 Year-2/3 children. Part B relates specifically to the survey used as a pre-program and post-program tool for measuring children's attitudes to sustainability. It discusses the reliability of the scale and changes noted in the survey items from pre-program to post-program.

Part A: Qualitative Data

This mixed methods study triangulates qualitative data with quantitative data. After the completion of the pre-program survey, children were involved in a sustainability science-program. During this program the Year-2/3 children were required to reflect in their science journals about sessions completed or about stimulus images. These images were aimed at eliciting attitudes to environmental sustainability and involved class discussion before individual reflection. Children were encouraged to write or draw about things that they considered to be important in their journals. During class discussions and informal interviews the teacher/researcher also took anecdotal notes on significant points, such as comments made, or behaviours demonstrated. At the completion of the sustainability science-program the children were formally interviewed about some of their understandings of biodiversity and related behaviours. This qualitative data was combined to produce child vignettes that are also used in the discussion of qualitative findings. The vignettes were written in the child's voice at the end of the sustainability science-program after analysing and synthesising the various forms of qualitative data. A summary of the vignettes can be found in Table 14. Through analysis of the qualitative data several themes have emerged and will be used to structure the findings.

Table 14: Summary of vignettes

Sustainability theme	Vignettes	
	Child	Title
Mutual responsibility	Helen Ella	‘Being responsible’ ‘Responsibility at home’
Biodiversity	Henry Helen	‘Biodiversity is special’ ‘A part of nature’
Habitat conservation	Alan Anne	‘The wattle tree’ ‘More trees and plants’
Resource use	Denise Grace David	‘Greedy’ ‘Do the right thing’ ‘Be careful’
Water pollution	David Colin	‘Think about it’ ‘Pollution hurts animals’
Litter and rubbish	Edward Grace	‘Pick up rubbish’ ‘Look after the environment’
Interconnections	Betty Cathy	‘Everything is connected’ ‘Why we should help biodiversity’
Air pollution	Colin Denise	‘Toxic air’ ‘Dirty air’

Mutual responsibility

Qualitative data suggested positive changes to attitudes regarding mutual responsibility. In the first session the children were required to conduct a school walk to collect and record as much information as they could about the living things they saw. The class first discussed what made things living or non-living, and also how to act responsibly when collecting specimens and moving around the school. Later, the children reflected in their science journals on how they acted responsibly.

Helen

Helen’s vignette describes her attitudes to mutual responsibility and specifically, being responsible. This narrative is based on her reflections from the first session (09/06/2011), her reflections after an excursion to Clearwater Creek in the third session (16/06/2011/) and other reflections from the sustainability science-program.

Helen's attitude: Being Responsible

When I was at school I was responsible. I didn't rip one thousand leaves off a tree. I didn't step on any plants. When I caught a grasshopper, I didn't hurt it. I just put it back into the safety of the environment. I didn't kill any living animals. I didn't hurt anything you see, I was being responsible. At Clearwater Creek I found a small frog. I was very careful with it. I found a safe home amongst the rocks in the creek.

You don't always see spider orchids. It is special for us to find them, so if you step on a spider orchid it is very bad! If you are careless and step on an orchid you are showing no manners to biodiversity. If you squish any plant you really need to think about what you might have just killed! And if you got some rubbish and chucked it in the ocean you don't have respect. Respect isn't just a word! If we pollute our world even people will die!

Helen was able to identify the ways in which she had acted responsibly at school and at Clearwater Creek. These indicated her sense of moral responsibility for protecting the environment and the species that live in it; for example, the frog that she found a home for. She also used strong words and phrases, such as 'careless', 'killed' and 'respect isn't just a word'. These words indicated how passionately Helen felt and how positive her attitudes were towards environmental sustainability. Helen understood that mutual responsibility refers to all people. By stating, "*if we pollute our world*" she recognised the joint effort that it takes by her and others, in working towards environmental sustainability. She is not just directing other people to act responsibly, but is identifying herself within the group that needs to do that.

Ella

Qualitative data from the sustainability science-program further suggested that both positive attitudes and behaviours were developed. Ella spent a lot of time outdoors with her family, for example, going camping at the river and beach, and riding motorbikes. This narrative is based on Ella's reflection of Session-1 (09/06/2011) and anecdotal teacher notes (08/08/2011) made relating to a story she told in class.

Ella's attitude: Responsibility at home

We talked about acting responsibly. I acted responsibly by drawing pictures of things on my sheet or listing them, not picking them all. I picked some things, but not too many leaves off trees.

I act responsibly at home too. I told 'Miss Teacher' about the orchids I found. Me and 'Jake' ride our motorbikes out the back all the time in this patch of bush. We have jumps out there. We were riding on the weekend and I saw some orchids near some trees. They were beautiful! They were looking right at me. Then we got some wire and Dad helped me make a little fence so we don't run them over.

In her science journal entry Ella identified the ways she had acted responsibly at school by drawing pictures instead of taking living specimens and restricting the number of leaves she picked from trees. This indicated that she understood the need to act responsibly during class and at school and had positive attitudes towards caring for the environment around her.

This positive attitude and behaviour was replicated in a much greater way at home. Ella identified an opportunity to act responsibly on her own, without teacher guidance and class members to follow. This indicated that she understood that mutual responsibility for the environment means that everyone, including herself, should behave in responsible ways. It also indicated that she was willing to act on this understanding. She has developed positive behaviours along with positive attitudes towards environmental sustainability.

Biodiversity

Biodiversity is a significant theme through which positive attitudes to environmental sustainability have been developed. In the sustainability science-program the children reflected on several stimulus images that relate to biodiversity. Images (9-13) were used after Session-9 (28/06/2011). The ninth session focused on defining the term 'biodiversity'. Image-9 (Sporting and Shooters Association of Australia, 2013) was a close up photo of a cat eating a native bright coloured bird. Image-10 (original photo) was a photo taken from the area and showed a flock of white cockatoos flying up from several large gum trees that had been stripped of their leaves. This photo also showed farming sheds in the background. Image-11 (original photo) was a photo of a smiling Year-4 girl from the same school, holding a small frog in her hands. She was at Clearwater Creek. Image-12 (Ozwildlife, n.d.) showed a large python wriggling on top of some leaf litter. Image-13 (original photo) showed a small native bird perched in the trees at Clearwater Creek.

Images 14-16 also related to biodiversity and were used after the eleventh session (05/08/2011). Session-11 involved the children conducting their own investigation into habitats at Clearwater Creek. Image-14 (original photo) was a photo of lots of dead weeds (Rye grass and wild oats) at Clearwater Creek. The weeds looked similar and appeared to be taking over the area. Image-15 (original photo) was a close up photo of a spider orchid from the area. Image-16 (original photo) showed a large farming paddock that is cropped with wheat. The wheat is dried off and a couple of trees are visible in the distance.

After the children conducted their habitat investigations at Clearwater Creek, they were required to reflect on their investigation. Part of this involved listing the ways that they could care for the biodiversity at Clearwater Creek. This was done after small group and class discussion had taken place. Every child in the class was able to list some things they could do at Clearwater Creek. These comments have been used in the qualitative analysis and production of narrative vignettes in this section.

At the completion of the sustainability science-program children were also involved in formal interviews. They were asked:

1. Can you tell me what biodiversity is?
2. Can you think of anything you have done to help look after biodiversity at Clearwater Creek?
3. What could we do in other places to look after biodiversity?

Every child in the class was able to describe what biodiversity is and used the word ‘living’ in their responses. A common and typical answer was, “*it’s the living things*”, although some children expanded on this slightly. For example: “*It’s the living things and things that aren’t one type of plant*” (Denise, 05/09/2011) and: “*All the different types of living things around the world*” (Gary, 05/09/2011). One child, Henry, sung his answer: “*It’s the living things*” to the tune of the song called ‘Biodiversity’. The class wrote and performed this song for a school assembly during the term. The children worked in groups to each write a verse of the song. Henry’s response indicated that this learning experience resonated with him and it helped him to remember the meaning of ‘biodiversity’. This activity was not originally planned as a part of the sustainability science-program; however, it has impacted the children’s understandings and proved to be a valuable one.

When the Year-2/3 children were reflecting on what they had done to help the biodiversity at Clearwater Creek there were several common responses as shown in Table 15. Fourteen of the 15 children suggested planting trees or plants, 12 children suggested pulling up weeds and nine suggested picking up rubbish. These responses were overwhelming and indicated positive attitudes to biodiversity through habitat conservation. Also, two children suggested watering trees, one suggested they had protected the current environment, one had researched the creek area and one claimed beautifying the area would help biodiversity.

Table 15: Interview responses to questions two and three (n=15)

Suggestion	Done to help biodiversity at Clearwater Creek	How to care for biodiversity in other places?
Plant trees/plants/seeds	14	7
Pull up weeds	12	2
Pick up rubbish	9	5
Water trees	2	3
Protect current environment	1	2
Spray weeds		2
Beautify the area (park benches, etc.)	1	1
Researching	1	
Save individual species		1
Stop water pollution/oil		1

When responding to how they could protect biodiversity in other places the answers were slightly more varied. Whilst the most common responses were planting trees or plants and picking up rubbish, other ideas were suggested. Three children suggested watering plants; two children suggested protecting the current environment, pulling up weeds and spraying weeds; and one child each suggested saving individual species, stopping water pollution and beautifying the area. These results suggested that children were able to draw on their experiences from the excursions to Clearwater Creek, as well as what they had learnt in class to suggest ways that they could help care for biodiversity in other places. This again indicated the development of awareness and of positive attitudes to environmental sustainability through biodiversity.

Henry

Henry demonstrated sound understandings of, and positive attitudes to biodiversity. This narrative addresses biodiversity and is based on Henry's reflections to stimulus images 9-13 (28/06/2011) and images 14-16 (05/08/2011), as well as his investigation reflections and his interview responses.

Henry's attitude: Biodiversity is special

I think white cockies are really bad to gum trees because they can kill them. When they kill the gum trees they kill a part of the environment, and then other birds can't make nests in the trees. Other animals need the trees too. This is not good for biodiversity. We need biodiversity to

live. We need lots of animals to live. We use land animals and sea animals because we eat them. Orchids are one type of biodiversity. They are really rare and you don't see them just anywhere. They can be very hard to find. You can sometimes find them in a place where they're safe from animals and they won't get stomped on. There are lots of types of orchids, but there's not many of them. Biodiversity is special. It's all the living things. To help look after biodiversity we should not litter, keep the waterways clean, not chop down trees and not pull out the reeds. We need to make sure people don't destroy the environment. I have already helped by planting trees and by pulling weeds out.

Firstly, Henry was able to explain what biodiversity is. He stated, "*it's all the living things*" (Henry's interview, 05/09/2011). He also demonstrated positive attitudes relating to biodiversity by describing biodiversity as 'special' and 'really rare'. Henry also gave an example of biodiversity, when he reflected on the orchid. This demonstrated understandings of and positive attitudes towards biodiversity.

Henry was able to identify that some animals are threats to biodiversity. He stated, "*white cockies are really bad to gum trees because they can kill them*" (28/06/2011). Henry understood that the cockatoos can destroy trees, but also that this can be the destruction of habitat for other species. By recognising that some animals can be threats to biodiversity, and that habitat conservation is essential to biodiversity, Henry has indicated strong positive attitudes to this theme.

Henry further identified that biodiversity is essential for us to survive. He explained that we need a variety of animals as food sources (land and sea animals) to survive. In this sense Henry viewed humans as any other species on Earth that require varying food sources to survive. This indicated an understanding of how biodiversity, or lack of, can affect food webs, and the interconnected nature of species on Earth. These understandings indicated strong positive attitudes.

Henry demonstrated an understanding of the ways that people can care for biodiversity. He stated that we should, "*not litter, keep the waterways clean, not chop down trees and not pull out reeds*" (Henry's investigation reflection, 18/08/2011). Given his understandings of biodiversity and of the threats to biodiversity, he was able to draw logical conclusions that not chopping down trees, and not pulling out reeds would assist habitat conservation, and that would therefore also protect biodiversity. These attitudes and suggested ideas were common amongst other children in the class.

Helen

Helen displayed quite passionate attitudes to environmental sustainability, and biodiversity, yet also slightly differing ones to Henry. This narrative, like Henry's is based on her reflections to stimulus images (9-13) (28/06/2011) and images (14-16) (05/08/2011), her investigation reflections and her interview responses.

Helen's attitude: A part of nature

I think that biodiversity is a great thing. It's all the living things. Biodiversity can be plants, trees, little animals and mammals. We did a song about it and I think it is very special! If you had no biodiversity there would be no such word as pets. Biodiversity is a good thing. One picture showed a mob of white cockatoos. They ate every piece of leaf on that tree. It's okay because in spring the leaves will grow back again. A different picture showed a honeyeater. The honeyeater is good because it eats honey, flies and mosquitoes. Another picture showed spider orchids. They are not bad. Spider orchids are just great living things to show biodiversity! To help biodiversity we should plant trees, lots of trees. And makes sure that they are native trees growing, not weeds. We should make sure they survive by watering them. We should also stop cutting down trees, do some weeding, help the wildlife, don't pull out the reeds and don't spill liquids in the waterways. I have done some research at Clearwater Creek and I learnt that a tree has lots of living things in it. I think that there is lots of biodiversity at Clearwater. I love Clearwater a lot because of all the living things such as plants and animals. I like animals because they are very special. Animals are part of nature.

Helen, like Henry, had a thorough understanding of what biodiversity is. She understood that it refers to the variety of living things, when she states, "*biodiversity can be plants, trees, little animals and mammals*" (Helen's interview, 05/09/2011). She responded in a passionate way to biodiversity by using words such as 'great thing' and 'very special'. In this regard, she valued biodiversity and demonstrated positive attitudes to it.

Helen also identified passionately with Clearwater Creek as a place for habitats. She stated: "*I learnt that a tree has lots of living things in it*" (Helen's journal, 02/09/2011). She then continued to explain how she 'loves' Clearwater Creek because of all of the things that live there. However, Helen failed to go the step further and make the same connections that Henry made, by recognising the importance of conserving habitat in order to protect biodiversity.

A difference in interpretation of the stimulus images was apparent between Henry and Helen. Henry viewed the cockatoos as having killed the gum trees, where as Helen stated: "*They ate every piece of leaf on that tree. It's okay because in spring the leaves will grow back again*" (Helen's journal, 28/06/2011). Neither response is incorrect, but

both were based on the child's own experiences. Helen's comments suggested that she understood that leaves can grow back on trees and was therefore less concerned with the damage done by the cockatoos. For this reason she may not have linked this image to her understandings of biodiversity.

Another difference between Henry and Helen is that Helen did not identify the need for variety of species, and genetic diversity, for the survival of other species. Helen explained her reasoning for why biodiversity is a 'good thing' as: "*If you had no biodiversity there would be no such word as pets*" (Helen's journal, 28/06/2011). Helen was a child who had many pets at home and she showed how much she values animals when she reflected: "*I like animals because they are very special*" (Helen's journal, 02/09/2011). This reasoning for the importance of biodiversity was quite simplistic and related directly to herself and her own experiences. Although Helen did demonstrate positive attitudes to biodiversity, and environmental sustainability, she was still developing her understandings in this area.

Edward and Ella

One contrasting attitude that reoccurred was related to the idea of some animals being bad for the environment. Edward stated: "*I think the snake [is] bad because it can eat other animals and kill too*" (Edward's journal, 28/06/2011). Ella expressed a similar attitude. She reflected: "*Snakes are bad because they eat other animals and eggs. I will not be an egg because I will get eaten. I'm not joking. It is true animals are bad*" (Ella's journal, 28/06/2011). These attitudes were based on the python illustrated in stimulus Image-12 (Ozwildlife, n.d.). It is likely that some children reacted this way because of their understandings of safety around animals such as snakes especially in the Australian bush. These ideas may have been supported at home.

David

This negative attitude was contrasted with David's attitudes towards snakes. He stated: "I reckon picture 12 is fine. It's just in the snake's nature like we live in our nature. Leave snakes alone. If you don't you will get bitten" (David's journal, 28/06/2011). David understood that snakes can be dangerous animals, but also understood that snakes kill other animals for food. This attitude, like Edward and Ella's may have been supported at home. These comments indicated that he had a thorough understanding of this topic and positive attitudes regarding biodiversity.

Habitat conservation

During the sustainability science-program children were required to plan, conduct and evaluate a group investigation into a habitat of their choice at Clearwater Creek. When children had begun to process the data from their investigation they were required to reflect on stimulus images 17-20 (16/08/2011). Image-17 (Diggawest, n.d.) showed a bulldozer pushing over some native trees and bush. Image-18 (original photo) was a picture taken in the local area and showed a pile of branches and leaves next to a cleared open space. Image-19 (Kaak, 2007, January 16) was a photo of a large open cut mine. It showed the different layers in the mine and very minimal vegetation. Image-20 (original photo) was a photo of a Year-4 and a Year-8 child from the teacher/researcher's school, planting a tree together at Clearwater Creek.

Henry

One issue that arose throughout classroom discussion and child reflection of these images was that of land use. Henry identified this issue in his written reflection after discussion of the four stimulus images. He wrote:

If you get a big truck and destroy habitats you're destroying homes, animals and killing baby animals. Sometimes you have to do it but we still have to protect habitats for animals. (Henry's journal, 16/08/2011)

Henry further supported his written reflection with this illustration of a bulldozer clearing vegetation.



(Henry's journal, 16/08/2011)

Henry understood that by clearing vegetation, habitat and animal life are being destroyed. He also understood that people must sometimes do this because of their work, but still considered habitat conservation to be very important. This indicated an

awareness of real-life issues, but also a positive attitude to environmental sustainability, through habitat conservation.

Alan

Alan was an active participant in class and demonstrated a thorough understanding of habitat conservation. The following narrative is based on the attitudes shown through his written reflections of images 17-20 (16/08/2011), his data and his reflections from the group investigation and the interview at the end of the sustainability science-program.

Alan's attitude: The wattle tree

I think habitat protection is when you care for animals' homes and if you do that you are protecting the biodiversity. We should keep planting lots of plants and not cut down any more trees. We could also plant seeds, lots of different kinds of seeds and water them using trucks. One picture showed 'John' and 'Brad' planting trees at Clearwater Creek. They are making more habitats for the animals, so they are protecting birds, insects and all sorts of bugs.

I learnt that in the wattle tree you could find the brown song lark, the white plumed honeyeater, ants, the leaf bug and other bugs. The bird's nest in the wattle tree and the ants live here for protection. I also learnt that tadpoles live in the reeds. These are both habitats.

Alan demonstrated a thorough understanding of what habitats are. He was able to list bird species that he found living in and around the wattle tree (04/08/2011) and he identified reeds as a habitat for tadpoles (02/09/2011). This understanding allowed him to then explain what habitat conservation was. He stated, "*I think habitat protection is when you care for animals homes*" (Alan's journal, 16/08/2011).

Alan then highlighted the connection between habitat conservation and biodiversity. He stated, "*if you do that you are protecting the biodiversity*" (Alan's journal, 16/08/2011). Through this reflection, Alan identified habitat conservation as one of the key ways that biodiversity can also be protected. This also suggested he has a good understanding of what biodiversity is. These understandings formed the basis of developing positive attitudes towards environmental sustainability, through habitat conservation.

Alan suggested things that could be done to protect habitats and biodiversity. For example, planting lots of different kinds of seeds and watering the plants (Alan's interview, 05/09/2011). He also suggested planting lots of plants and not cutting down trees (18/08/2011). Alan's ability to recognise ways that he has already helped and can

continue to help care for biodiversity and habitat suggests he has positive attitudes to environmental sustainability, through habitat conservation.

Anne

The following narrative is written from the point of view of Anne. It too is based on her written reflections of the stimulus images (16/08/2011), her data and her reflections from the group investigation and the interview at the end of the sustainability science-program.

Anne's attitude: More trees and plants

One picture doesn't show habitat protection, but I think there is a reason for it. We talked about this area being used as a gravel pit. Then another picture did show habitat protection because they are planting more trees and plants. More trees and plants mean a better planet! We should care about trees and plants. No chopping down trees! We should keep planting trees and plants and pull out the weeds.

My group investigated the eucalypt tree. I learnt that spiders use the bark in eucalypt trees for shelter, for their homes. I'm happy about that! I also learnt that wood moths live in eucalypt trees. I found the monarch butterfly, the white plumed honeyeater, and the black faced cuckoo shrike, a tick, a spider, a magpie lark and many more in and around the eucalypt tree. I enjoyed looking at the different types of bugs and finding all the animals. I've learnt that spiders use eucalypts tree bark for their homes. I'm happy about that.

Anne, like Alan, was able to demonstrate a good understanding of what habitats are. She explained that the spider she found at Clearwater Creek used the bark of the tree for shelter (18/08/2011). She then recognised habitat protection as being shown in picture twenty by stating, "*they are planting more trees and plants*" (Anne's journal, 16/08/2011). This indicated that Anne understood that trees and plants can be habitats for other animals and that by planting more, they are creating more habitats. Anne did not link this idea of habitat protection to the protection of biodiversity, like Alan did.

Anne recognised that the issue of land use can impact habitat protection. The class discussed that Image-18 (original photo) was taken in the local area and showed land being cleared for a gravel pit to be made in a section of bush. Anne explained that this picture did not show habitat protection and that she thought there was a reason for it (Anne's journal, 16/08/2011). This further reinforced that she did understand what habitat protection is, and that she also understood that sometimes different land uses would impact on this.

Anne used several emotive words throughout her reflections. She wrote that, “*more trees and plants is [means] a better planet*” (Anne’s journal, 16/08/2011), “*no chopping down trees*” (Anne’s journal, 18/08/2011) and: “*I’m happy about that!*” (Anne’s journal, 02/09/2011) When reflecting on her group investigation, Anne answered the question: “*What did you enjoy about the investigation?*” by writing, “*finding the animals and looking at the different types of bugs*” (Anne’s journal, 18/08/2011). Anne’s responses and word choice indicated active participation in the program and strong positive attitudes towards habitat conservation and environmental sustainability, throughout the sustainability science-program.

Qualitative data further suggests that children developed understandings of how to assist habitat conservation. Importantly, 100% of the children (n = 15) were able to identify ‘planting trees’ as something they have done, or could do to assist the survival of species, by the end of the sustainability science-program, as indicated on the children’s investigation evaluations (18/08/2011). This was also reinforced in the qualitative examples given above where Alan and Anne both suggested planting vegetation as a way of protecting biodiversity and habitat conservation.

Resource use

Qualitative data from science journals and classroom observations suggested that mostly positive attitudes relating to responsible fishing practices have been developed during the children’s engagement with the sustainability science-program. After the tenth session (07/07/2011) the children were shown stimulus images 23 and 24. Image-23 (Curtsinger, 1996-2013) showed fishing net underwater that was packed tightly with small fish. You could see some fish’s heads and fins being squeezed through the holes in the net. Image-24 (AgireOra Network, n.d.) showed a close up shot of a small fish as its head was coming out of a hole in the fishing net. The net was out of water and the fish’s mouth was open. Both of these images engaged the children’s emotions.

Henry, Ella, David and Brian

The children discussed these images and were clearly engaged by them. When discussing Image-23 (Curtsinger, 1996-2013):

Henry- “Umm, they’re getting greedy.”

Ella- “They’re catching too many.”

David- “If it’s too small don’t get it, or the fisheries will get you.”

When discussing Image-24 (AgireOra Network, n.d.):

Brian- “It looks like it’s praying to get out.”

Henry and Brian

The Year-2/3 children grasped the idea of only catching what you need, for example, by making comments such as, “*they’re getting greedy*” (Henry, 07/07/2011). They also identified emotionally with fish by saying, “*it looks like it’s praying to get out*” (Brian, 07/07/2011). Group discussions lead to the need for quotas and size restrictions, as well as consequences, if you are caught breaking the rules. All of these ideas related directly to the theme of responsible fishing.

Denise

The following narrative is based on Denise’s journal reflections to stimulus images 23 and 24 (07/07/2011) and her reflection on the class excursion to Clearwater Creek after the third session (16/06/2011).

Denise’s attitude: Greedy

We looked at the pictures about fishing and one showed all the fish being squashed in the net. There’s too many in there. They cannot breathe! The people are just being greedy! I know that you can only get the right sized fish. It can be middle sized or big. You cannot get the little ones because if you do, then there will be none left. This isn’t being responsible. Another picture showed that the fish is trying to breathe but the net is too tight for the fish. Fishing is fun but you cannot be greedy. Some people are greedy and some people are not greedy at all. If you are greedy, don’t be! We should save the environment and the animals!

In these reflections Denise demonstrated positive attitudes towards responsible fishing. She related emotionally to the fish being caught in the net. Denise stated: “*They cannot breathe!*” (Denise’s journal, 07/07/2011) She thought that there were too many being caught in the net and she empathised with the fish.

Denise also focused on the issue of greed. She repeated the word several times throughout her journal reflections and stated: “*Fishing is fun, but you cannot be greedy*” (Denise’s journal, 07/07/2011). This indicated her understanding that responsible fishing doesn’t involve being greedy, but taking only what you need. This was a strong positive attitude towards responsible fishing and resource use.

Denise also demonstrated a positive attitude to responsible fishing through the understanding of size limits. She stated: “*You cannot get the little ones because if you do, then there will be none left*” (Denise’s journal, 07/07/2011). Denise acknowledged an understanding of the fact that you shouldn’t catch undersized fish, but also the reasoning behind this. She understood that taking smaller fish might deplete stocks and

affect future fishing. This is another significantly positive attitude towards fishing responsibly and resource use.

Grace

The following narrative addresses fishing responsibly and is based on Grace's reflections of stimulus images 23 and 24 (07/07/2011), as well as her reflections throughout the sustainability science-program.

Grace's attitude: Do the right thing

One picture showed that they are putting too many fish in the net and they are not fishing responsibly at all! They are not doing the right thing! I think they should get less fish and then they will be more responsible. I like being responsible because of all the nature that is around us. In the bush, I like watching all the birds fly around with joyful faces!

Another picture showed that they are allowed to fish because the background looks like it's a fishing zone. They might work there or something like that. But I still don't think they should be killed otherwise they won't grow up and be big strong fish at all.

Grace also demonstrated a positive attitude towards sustainable fishing. Like Denise, Grace identified that the number of fish being caught is related to sustainable fishing. Grace stated that there were, "*too many fish*" (Grace, 07/07/2011) being caught in the net. She acknowledged that responsible fishing involves limiting the number of fish caught. This is similar to the issue of greed that Denise highlighted in her reflections.

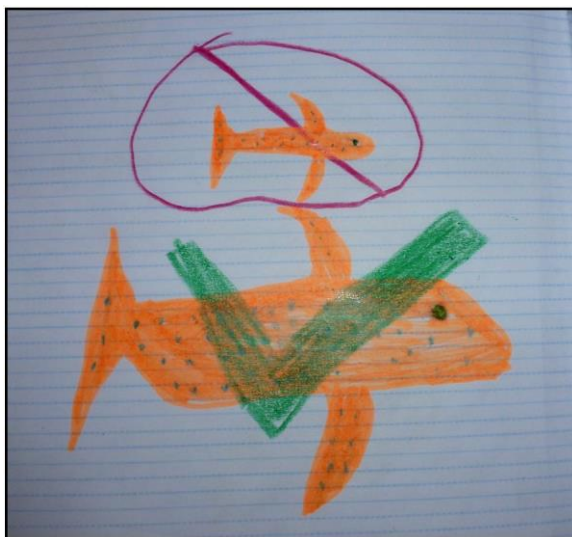
A difference in the two narratives is the issue of workplace fishing. Grace identified that Image-24 (AgireOra Network, n.d.) appears to be a, "*fishing zone*" (Grace, 07/07/2011). She understood that people are allowed to fish in certain areas and that fishing is a job for some people. Despite this, Grace responded emotionally to fishing. She did not feel comfortable with fish being caught at all because they would not be around in the future. Grace demonstrated a positive and very strong attitude towards sustainable fishing and resource use.

David

David demonstrated quite differing attitudes towards sustainable fishing. This narrative is based on his reflections on images 23 and 24 (07/07/2011) and teacher observations during the class discussion of these images.

David's attitude: Be careful

This picture isn't showing people that are fishing responsibly, even though they are doing their job. They should always check on the fish in the net. If the fish are trying to get out then you should just carefully push them back in. Don't push them around roughly! If you catch small fish, crayfish, crabs or sharks you might lose your boat or car. You could even go to jail for five years and get a humongous fine! You should be careful when you go fishing. If the fish are too small don't get them, or the fisheries will get you!



In his reflections David's understanding of responsible fishing differed to both Denise's and Grace's. He reflected that if the fish were getting out of the net you should, "*carefully push them back in the net*" (David, 07/07/2011). Here he identified that pushing them back in carefully, not roughly, is a factor in responsible fishing. Through this comment David was demonstrating some empathy for the fish caught in the net by not wanting them to get hurt. However, he did not comment on the number of fish being caught as a factor in responsible fishing.

David, like the girls, highlighted the need to catch fish of the correct size in order to fish responsibly. This was also illustrated in his drawing. However, he did not identify the issue of 'sustainability' as the reasoning behind this. David stated: "*If you catch small fish, crayfish, crabs or sharks you might lose your boat or car*" (David, 07/07/2011). This indicated that David was aware of potential consequences that could occur if you don't fish responsibly. It suggested that David's attitudes towards sustainable fishing were focused on and shaped by the consequences, not by his understanding of why size, number and species limits are in place.

Water pollution

Water pollution also proved to be a key theme and shows significant development of positive attitudes. After the sixth learning session the children were involved in class discussion of stimulus images one to four (24/06/2011). This set of images addresses the themes litter, water pollution and mutual responsibility. Image-1 (original photo) showed a squashed can of cool drink lying on the grass. Image-2 (Skinnader, 2010, July 2) showed a fish cut across its body by a plastic cool drink ring holder. Image-3 (Cole, 2011, February 14) showed a swimming turtle with a plastic bag attached and hanging from its shell. Image-4 (Geometrics, n.d.) was a digital image of people standing around the Earth in a circle, holding hands together.

During discussion of these images a contrast of attitudes was apparent. Children largely ignored Image-1 (original photo). Some children indicated that they felt sympathy for the fish and the turtle in Image-2 (Skinnader, 2010, July 2) and Image-3 (Cole, 2011, February 14) and others indicated a sense of apathy.

The following vignette illustrates how David's attitude to water pollution changed as a result of discussion of the stimulus images. This narrative is based on teacher notes of stimulus image discussion (24/06/2011) and David's science journal reflections (24/06/2011).

David's changing attitude: Think about it

At first I didn't think the rubbish in the ocean would hurt the animals. Like, the turtle with a plastic bag caught on its shell wouldn't get hurt because its shell is tough. But we talked about it and looked at other pictures. There's more rubbish and other animals are getting hurt too. It made me think about the environment and I don't like the way our environment is being treated. It's just awful that fish are being trapped and cut by plastic ring can holders. Everyone in this world wants the ocean looking MAGNIFICENT. Stop polluting our world now! Who wants the world looking like that because I don't like it! I hate it! No one likes it! So all those people that are doing it just think how you would like to be treated. If you were a sea animal would you like to get caught up in the rubbish?

During the discussion David commented: *"It won't hurt it because it's on its shell"* (teacher notes, 24/06/11), referring to the plastic bag caught on the turtle. David later reflected in his journal that people shouldn't pollute the world.

This change in attitude from the beginning to the end of the learning session indicated that class discussion and the opportunity for reflection have contributed to stronger and much more positive attitudes towards water pollution and moral

responsibility. David showed empathy for the sea animals in his journal entry by asking the question at the end of his reflection. He also felt a sense of moral responsibility as he commanded people to 'stop' and re-think their ways. David's word choice indicated that he felt very emotional about the themes. Words such as 'Magnificent', 'hate' and 'I don't like it' express very strong, positive attitudes.

After the seventh learning session the children discussed stimulus images five to eight (31/06/2011). These images also addressed the pollution theme, with images five and six specifically focusing on the sub-theme water pollution. Image-5 (Grebinger, 2012, October2) was a photo of a water body covered with rubbish and sticks. Image-6 (iStock, n.d.) was a cartoon image of a drain emptying a green substance into a creek with unhappy looking fish.

Grace, Helen, Henry, Gary

During discussion of these images children's litter was the cause of the water pollution, after first discussing other options:

Grace: "People threw their rubbish in there when they were drinking."

Helen: "It could be a rubbish tip that flooded?"

Henry: "It could be a bin that's tipped over."

Gary: "People's rubbish has come out of the drain and into the sea."

(Teacher notes: 31/06/2011)

Ella

Whilst reflecting in their journals about these images, children demonstrated positive attitudes towards water pollution. Ella wrote in her journal:

Picture 5 shows pollution. Pollution is bad for the tadpoles. They could die. It is a shame that they will die. Picture 6 shows pollution. The pond, the fish could die. (Ella's journal, 31/06/2011)

Ella was able to identify that the water pollution would affect tadpoles and fish, and indicated a positive attitude using words such as 'bad' and 'it would be a shame'. This word choice also indicated an emotional response to the images.

Colin's attitudes to water pollution are illustrated through the following vignette. It is based on his reflections to stimulus Image-3 (24/06/2011) and his reflections from the third session (16/06/2011).

Colin's attitude: Pollution hurts animals

Dumping rubbish into the ocean is called polluting. Animals get caught in old fishing nets and plastic bags. They can get caught on their fins or on their shells. It's very, very bad! I learnt while I was on excursion, that the outside world is all connected. If the water gets polluted it might be made toxic. Then if the animals drink the water they might get

sick, or die. Then if animals eat those ones, they might die too. This will carry on and on. I think it's a nightmare and the poor animals are probably thinking it is too, so save our animals or they'll become extinct. I feel very sad for anything that is hurt like that. Let Mother Nature be in peace. I've drawn a picture showing these people who don't care about the animals at all!



(Colin's journal, 24/06/2012)

As earlier identified, Dunlap (1994) claims, “environmental deterioration is seen as very serious by citizens of all types of nations” (p. 125). Through involvement in this sustainability science-program children have indicated that they view water pollution, as a type of environment deterioration, in a very serious way. This was evident in Colin's journal entry and his contributions to class discussions.

Colin used language that reflects how seriously he views water pollution. For example, words such as ‘poor thing’ and ‘sad’, and the repetition of the word ‘very’ add to the emotion in his written voice. Colin explained extinction as a potential consequence of water pollution, which further highlighted the serious nature of this type of environmental deterioration.

Litter and rubbish

Qualitative data suggested that very strong, positive attitudes have been developed throughout the program to litter and rubbish. Qualitative data that relates to this theme consists largely of child reflections on stimulus images one through to six. As discussed previously, Image-1 (original photo) showed a squashed can of cool drink laying on the grass; Image-2 (Skinnader, 2010, July 2) showed a fish cut across its body by a plastic cool drink ring holder; Image-3 (Cole, 2011, February 14) showed a swimming turtle with a plastic bag hanging from its shell; Image 4 (Geometrics, n.d.) was a digital image of people standing around the Earth in a circle; Image-5 (Grebinger, 2012, October 2) was a photo of a water body covered with rubbish and sticks; and Image-6 (iStock, n.d.)

was a cartoon image of a drain emptying a murky, green substance into a creek with unhappy looking fish. The children also reflected on what they had learnt throughout the sessions at the end of the sustainability science-program.

Edward

Edward demonstrated some positive attitudes towards litter, representative of others in the class. The following narrative is based on his reflections of the stimulus images (24/06/2011 and 31/06/2011) and of his learning throughout the program, and also on his interview at the end of the program.

Edward's attitude: Pick up rubbish

We looked at some pictures of rubbish. One picture shows a can on the ground. It has been left on the ground, not put in the bin. Another picture shows you lots and lots of rubbish in the water. It is making the water dirty. A different picture shows a dead fish and rubber circles stuck on it. The last picture shows a turtle with a plastic bag. We need to stop chucking rubbish in the sea because the sea animals will die. Don't leave rubbish lying around and don't poison our waterways. Picking up rubbish can help the animals. We should care for the environment.

Edward recognised the need for people to dispose of litter and rubbish correctly and he indicates his attitudes to litter when he explained: *"Picture five shows you lots and lots of rubbish in the water that's making the water dirty"* (Edward's journal, 01/07/2011). This suggested he understood that people should put their rubbish in the bin and a potential consequence of not doing so, is that it may end up in the waterways. Edward recognised another potential consequence of littering when he wrote: *"We need to stop chucking rubbish in the sea because the sea animals will die"* (Edward's journal, 24/06/2011). These comments both indicated positive attitudes to environmental sustainability, through litter and rubbish.

Edward reflected that it is important to, *"care for the environment"* (Edward's journal, 18/08/2011). He also identified things that we can do to help biodiversity such as, not leave rubbish around and not to poison the waterways. Edward clearly demonstrated positive attitudes towards litter and rubbish, but he also understood the connections between litter and biodiversity in the context of environmental sustainability.

Denise, Grace, Helen, Gary and Henry

During the interviews at the end of the program children were asked: "Can you think of anything you have done to help look after biodiversity at Clearwater" and

“What could we do in other places to look after biodiversity”? Ten of the 15 children identified picking up rubbish or litter as something they had done or could do to help biodiversity. The other five children each still demonstrated positive attitudes towards litter and rubbish, or pollution, in the journal reflections (24/6/2011); for example:

Denise: “You must not pollute the world or everything will be dirty.”

Grace: “Always put your rubbish in the bin.”

Helen: “If we pollute our world even people will die.”

Gary: “Picture one tells me not to litter.”

Henry: “If you pollute the sea it is really bad and chuck rubbish in the ocean, then you will kill sea animals and then you will be arrested.”

This suggested that most children, like Edward, were able to make the connections between litter and rubbish and biodiversity, but that all children demonstrated positive attitudes.

Grace

Grace demonstrated some very strong attitudes towards litter. The following narrative was based on her reflections of the stimulus images (24/06/2011 and 01/07/2011) and of her learning throughout the program.

Grace’s attitude: Look after the environment

We looked at some pictures and talked about rubbish and litter. One picture shows a pipe with lots of rubbish in it. This told me that you are not supposed to pollute our Earth. I think you should always put your rubbish in the bin, not on the ground. If there isn’t a bin then keep your rubbish, don’t throw it away. You should always pick up the bad stuff. You never know, people might be watching to see if you do litter. You could tell other people not to litter. You can even help sea animals by not littering! I’ve learnt a couple of different ways to look after the environment and it is great fun!



(Grace's journal: 01/07/2011)

Grace recognised the importance of not littering when she stated, "*always put your rubbish in the bin*" (Grace's journal, 24/06/2011). Her language choice was strong and commanding, as she uses words such as 'don't', 'always', 'great fun' and 'bad stuff'. This suggested she felt quite strongly about the issue and indicated positive attitudes towards litter.

Grace's illustration showed a person putting their rubbish on the ground and a girl telling them: "*Hey, there's a bin around here*" (Grace's journal, 01/07/2011). This suggested that she is aware that it is everyone's responsibility to put his or her rubbish in the bin and that not all people do this. It also indicated the understanding that we should educate others about what is right to do and that children themselves can do this. This is a further development of a strong positive attitude to environmental sustainability, through litter and rubbish.

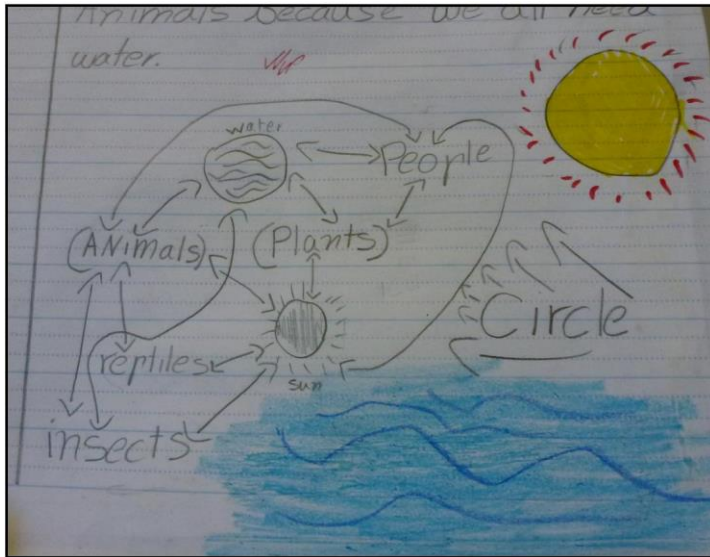
Grace also recognised that there are consequences to littering. She stated: "*Help sea animals by not littering*" (Grace's journal, 24/06/2011). This showed an understanding that litter could get into the waterways and endanger sea animals. She also stated: "*People watch to see if you litter*" (Grace's journal, 24/06/2011). This suggested that she understood that it is the wrong thing to do and if you are caught you may be punished. These understandings of consequences indicated more positive attitudes towards littering.

Interconnections

The 'environmental interconnections' was a theme that emerged throughout qualitative data analysis only. It was not planned for in the pre-program and post-program survey; however, the development of positive attitudes to this aspect of environmental sustainability was apparent. In Session-3 (17/06/2011) children were taken on an excursion to Clearwater Creek. They were required to observe and list all the living and non-living aspects of the local environment. Children were then involved in an activity that required them to identify links amongst these aspects, particularly their relationship to water. After this session children reflected in the science journals about their experiences. The following diagram and written reflection is based on this experience.

Grace

I learnt that everything connects to water especially animals because we all need water.



Grace's Journal (17/06/2011)

In her written reflection Grace identified the essential link between animals and water, and alludes to the fact that water is linked with other aspects. However in her diagram, Grace was much more descriptive. Grace drew a complex environmental 'web' showing the links between various aspects. The class had been introduced to webs through the discussion following the interdependence activity in the third session. She recognised that all living things (insects, reptiles, animals, plants and people) need the sun. She showed the links between water and people, plants, animals and insects. She highlighted the links between insects and animals, and reptiles and animals, suggesting that they feed from each other. Grace also showed the link between plants and people and animals and people, suggesting that we may eat plants and animals, or that our behaviour affects them. These complex understandings indicated an awareness of the interconnections present in the environment.

Betty

The following narrative shows Betty's attitudes towards environmental interconnections. It is based on her journal reflection from third session (17/06/2011), and from other sessions throughout the sustainability science-program.

Betty's attitude: Everything is connected

At Clearwater Creek we talked about the connections to the creek. Grace was the water and my brother, Brian was the air. We pretended something happened to the water and once Grace let go it all broke. Everything was connected to the water. When we investigated the eucalyptus tree we found the monarch butterfly, a spider, a tic and a black faced cuckoo shrike. They live there because it's their habitat; they have food and water there. I saw a spider living in the bark. There is lots of biodiversity at the creek and in the bush. We should have lots

of biodiversity and I think that biodiversity is very good! I think it's horrible if you wreck an animal's home! Or if the fish die - because they get cut by plastic in the water. Habitat protection is good! We should keep planting trees and not pull out any reeds. We should also keep the water clean and no littering! This can help the biodiversity at Clearwater Creek.

In her reflections Betty is able to identify several key relationships amongst environmental aspects. Firstly, Betty identified the significance of water. She stated: *"Once water let go it broke"* (Betty's journal, 17/06/2011). This activity obviously highlighted the importance of water in the environment for Betty, and she was able to see how it affected all of the other aspects once it was damaged. This was a significant understanding of the interconnections between living and non-living aspects of the environment.

Betty also identified some relationships between animals and plants. She stated, *"tics live in trees"* (18/08/2011) and she was able to identify several species of insects and animals that use the eucalypt tree as a part of their habitat. Betty indicated her attitudes by stating: *"Habitat protection is very good!"* (Betty's journal, 17/08/2011). She also wrote that it was 'horrible' that the tractor in stimulus Image-17 (Diggawest, n.d.) was destroying animals' homes. These comments indicated that she has developed positive attitudes to habitat conservation and that she understood the connections between animals and plants in terms of habitat. These understandings allow for positive attitudes to environmental sustainability through understanding environmental connections.

Finally, Betty recognized the interconnections between biodiversity and human behaviours. Early in the sustainability science-program and after discussing what biodiversity is, she wrote: *"I think that biodiversity is good"* and, *"We should have lots of biodiversity"* (28/06/2011). This indicated positive attitudes towards biodiversity. By the end of the sustainability science-program Betty suggested planting trees, not pulling out reeds, keeping the creek water clean and not littering as ways of helping the biodiversity at Clearwater Creek (18/08/2011). This indicated that she developed an understanding of the links between biodiversity and habitat conservation, and also between biodiversity and the water as a non-living element of the environment. Through developing these understandings, Betty has developed positive attitudes towards environmental interconnections and environmental sustainability.

Cathy

This narrative vignette shows Cathy's development of understandings related to environmental interconnections and is based on her journal reflection from the third session (17/06/2011), as well as from other sessions throughout the sustainability science-program, and her reflection of stimulus images (17-20) dated (16/08/2011).

Cathy's attitude: Why we should help biodiversity

I learnt about caring for the environment and nature. At first I thought we should care for the environment just because it's good to care for the animals, but I didn't understand why. Later I realised why. Habitat protection is when people help the environment by planting trees in the bush and watering the trees. This helps the animals because animals live in trees, like caterpillars. At Clearwater Creek I found bugs under the bark on trees. They live there because it is dark and wet and it is a good spot to hide. I also know that spiders make their webs in trees. This is why we should plant trees and water the plants to help the biodiversity.

The above narrative highlights the change in Cathy as she developed her understandings of the interconnections. After the third session Cathy wrote, "*caring for the environment is good because we are caring for the animals*" (Cathy's journal, 17/06/2011). Although Cathy demonstrated positive attitudes to caring for the environment, she lacked the understanding of how and why people should care for the environment.

After the twelfth session, the children reflected on stimulus images (17-20). In this reflection Cathy expanded on her earlier ideas. She explained what habitat protection was and how it could be done. Then later, when she was reflecting on her group's investigation of the eucalyptus tree as a habitat, Cathy was able to give specific examples of how bugs and spiders use the tree. The learning that had taken place allowed Cathy to then list '*planting trees*' and '*watering the plants*' (Cathy's journal, 18/08/2011) as specific ways she could help biodiversity. She clearly understood the connection between animals and their habitats, and also between people's actions. This indicated the development of positive and informed attitudes to environmental sustainability through environmental connections.

Air pollution

Air pollution is the final theme through which positive attitudes to environmental sustainability have been developed. After seventh session the children were required to discuss and reflect on stimulus images (5-8) dated (31/06/2011). Images seven and eight related to the theme air pollution. Image-7 (China3732, n.d.) was a photo of a crowded city street in a foreign city with lots of cars lining up in the traffic, and some bicycles

and motorbikes. The air looked noticeably smoggy. Image-8 (Macmillan, n.d.) was a cartoon picture of a young boy riding a bicycle.

David, Colin and Gary

Discussion of Image-7 (China3732, n.d.) focused on the air pollution and also on the idea that the photo could have been taken in Japan. Earlier in 2011 (March 11th) Japan experienced an earthquake and tsunami. There had been much discussion in the media about the affected nuclear power plants and this was also quite likely discussed in the children's homes.

David: "It shows the pollution from all the cars".

Colin: "It could be the toxic air in Japan".

(31/6/2011: teacher notes)

In this discussion David identified the cause of the air pollution as the traffic, or specifically, the cars. Then Colin referred to the nuclear disaster of Japan as a potential cause for the air pollution.

Another child, Gary, wrote in his journal: "*Picture seven tells me that people put chemicals in the air*" (Gary's journal, 31/06/2011). He, like David, was able to identify that the air is polluted and doesn't look healthy, but suggest that it comes from chemicals. He was not able to identify a source for these chemicals finding their way into the air, like David identified the cars as a source of pollution.

The following narrative is from Colin and addresses air pollution. It is based on his reflections of: Images seven and eight (31/06/2011), and Image-19 (16/08/2011) showing a photo of a large open cut mine.

Colin's attitude: Toxic air

One picture shows a big mine. I would not like to live there because there is no fresh air. It's all dust! Another picture shows toxic air flowing through the streets in Japan. This toxic air is unbreathable! Also the air is making a fog. That makes a huge traffic jam. You can see that something like the toxic air has got into the sewers and has been mixed with the dirty water. If a lid on the road was accidentally opened the toxic air would escape and it would be fatal! I do care for the environment. I wish we didn't pollute the environment.

Colin was able to identify two sources of air pollution. When referring to the photo of the mine, he wrote: "*I would not like to live there because there is no fresh air. It's all dust!*" (Colin's journal, 16/08/2011) This indicated an awareness of air pollution not being limited to chemicals and toxins, and also positive attitudes to air pollution.

Colin was the only child to recognise dust as a source of air pollution throughout the sustainability science-program.

After discussing Japan's tsunami when the children were first shown the stimulus images, Colin then wrote about this issue in his reflection. By writing: "*This toxic air is unbreathable!*" (Colin's journal, 31/06/2011) he indicated his awareness of the nuclear issue and that is very dangerous to humans. This suggested positive attitudes to air pollution.

Colin then demonstrated his understandings of how the environment is connected. He explained that if the air is toxic, then it could also make the water and sewers toxic too. He then wrote that this could affect humans in a drastic way. This explanation showed an awareness of the interconnected nature of the environment and indicates positive attitudes to environmental sustainability.

Colin made bold statements about his wishes for the environment. He wrote: "*I do care for the environment. I wish we didn't pollute the environment*" (Colin's journal, 16/08/2011). By using the word 'I', Colin was involving himself in the issue. He clearly felt passionately about it, which showed he has developed very strong, positive attitudes to environmental sustainability.

Denise

Denise's air pollution narrative is based on reflections of stimulus images seven (China 3732, n.d.) and eight (Macmillan, n.d.) dated (31/06/2011), as well as other reflections from the completed sustainability science-program.

Denise's attitude: Dirty air

Cars are very bad for the environment because the gas is bad to breath. One picture showed a boy riding the bike. He looked happy because no one has polluted the air. You must not pollute the world or everything will be dirty and yucky. If one thing in the environment is polluted then all the other things in the environment will be polluted. Do not poison the environment!

Denise, like David, identified cars as a source of air pollution when she wrote, "*cars are very bad because the gas is bad to breath*" (Denise's journal, 31/06/2011). She then linked this understanding gained from Image-7 (China3732, n.d.) and Image-8 (Macmillan, n.d.). She explained that the boy was happy because there was no air pollution surrounding him. This suggested that she empathised with people in Image-7 (China3732, n.d.) as not feeling happy with the air pollution, and indicated positive attitudes to environmental sustainability through air pollution.

Denise also used strong, commanding language in her written reflections. Phrases such as, “*do not poison the environment*” (Denise’s journal, 18/08/2011) indicate very strong, positive attitudes to air pollution.

Grace and Fay

Whilst some children were able to link stimulus image seven and eight to the theme air pollution, not all children made these connections. Some children commented on other issues relating to Image-8 (Macmillan, n.d.), such as bicycle safety. Grace wrote:

I think number eight shows to wear a helmet, but he’s going to have a crash because he’s not looking and he’s riding one handed. (Grace’s journal, 31/06/2011)

Fay also made similar comments, she wrote:

Picture eight shows you to hold on to the bike with two hands. (Fay’s journal, 31/06/2011)

The image below is taken from Helen’s journal and also relates to bicycle safety.



(Helen’s journal, 31/06/2011)

These children were clearly concerned with safety aspects shown in the image. A stimulus image that was more explicitly directed towards air pollution may have proved to be more effective in encouraging discussion and reflection, and in developing positive attitudes to air pollution.

Summary

Qualitative data included the analysis of children’s journal entries, work samples, informal and formal interviews, teacher reflections and teacher observations. Another key part of the qualitative data was children’s narrative vignettes. Analysis of this data found the development of positive attitudes to environmental sustainability in the

themes: mutual responsibility, biodiversity, habitat conservation, resource use, water pollution, litter and rubbish, and air pollution. Data further suggested that children have developed an awareness of, and extremely strong positive attitudes towards, environmental sustainability through the themes biodiversity and resource use. Positive changes in behaviours were also indicated in the data relating to mutual responsibility, biodiversity and habitat conservation. The theme of 'interconnections' was not originally planned for in the pre-program and post-program survey, yet still emerged as a key theme in the qualitative data through which positive attitudes to environmental sustainability were developed.

Part B: Quantitative Data

Quantitative data in this study was used to support the qualitative data and consisted of a pre-program and post-program survey aimed at assessing children's attitudes towards sustainability. The survey was designed to address particular themes related to sustainability that were focused on in the sustainability science-program. The survey included a 4-point Likert scale for children to respond 'strongly agree', 'agree', 'disagree' or 'strongly disagree' to 14 statements relating to environmental sustainability. This section of the chapter discusses the reliability of the scale and describes the changes within the survey items from pre- to post-program.

Analysis of scale

This survey was originally analysed for reliability using Cronbach's alpha. The pre-program score for Cronbach's alpha was 0.28 (see Table 16a) and the post-program score was 0.58 (see Table 16b). Given that scores can range between zero and one, these scores were both considered 'low', indicating that the survey items have a low internal consistency. One reason for this may have been that the survey items were not a closely related set of items. Although all items related to environmental sustainability, groups of items addressed different sustainability themes. Another reason for this may have been that the sample size was very small with 15 participating children. Given the small size of this group it was not appropriate to make gender comparisons or comparisons between different demographic variables, such as if the children lived on farms or in the town, or the employment type of children's parents. The low reliability of this scale limits the generalisations that can be drawn from the data in relation to pre-program and post-program changes in attitude; however, each individual item can reliably be compared 'pre' and 'post' for shifts in attitudes around the specific sub-themes.

Table 16a: Reliability Pre-program survey

Reliability Statistics	
Cronbach's Alpha	N of Items
.282	14

Table 16b: Reliability Post-program survey

Reliability Statistics	
Cronbach's Alpha	N of Items
.578	14

Survey Item-5 (“Some animals can be bad for the environment”) produced interesting results when conducting the reliability analysis in both the pre-program and the post-program. In the pre-program Cronbach’s alpha would have risen from 0.28 to 0.46 (see Table 18a in Appendix J) if the item were deleted. In the post-program Cronbach’s alpha would have risen from 0.58 to 0.63 (see Table 18b in Appendix J). Although these changes would still not have increased the reliability of the survey enough to consider it ‘reliable’, changes to or deletion of this item could improve the reliability. Although other items indicated some changes to Cronbach’s alpha if deleted, this item was the most significant and produced increased values if deleted in the pre-program and in the post-program.

The most significant limitation of the study also relates to the survey, that is, the small sample size. With only 15 children participating in the study a dependent paired-samples t-test could not be applied to check for statistically significant differences between pre-program and post-program means. Further the small sample size meant that outlying scores would have had a larger impact on the calculated means.

Rank order of items

Despite the small sample size and that the low reliability score were limitations of the pre and post-program survey, data collected from the scale could still be used to assess movement of individual survey items as summarized in Table 17. This shows the frequency with which the responses: ‘strongly agree’, ‘agree’, disagree’ and ‘strongly disagree’, were chosen for each survey item as a percentage of the total responses. In analysing this frequency table items (14, 6 & 10) emerge as having shown significant change from pre-program to post-program.

Table 17: Survey item frequency

Item	Pre- /Post-	% responses			
		Strongly disagree	Disagree	Agree	Strongly agree
1. I always put my rubbish in the bin.	Pre-			33	67
	Post-			40	60
2. I never pick up other people's rubbish.	Pre-	27	33	13	27
	Post-	47	27	13	13
3. It's important for us to work together to get rid of rubbish around the school.	Pre-			33	67
	Post-			20	80
4. We should walk or ride a bike and use cars less.	Pre-	7	13	40	40
	Post-	13	7	33	47
5. Some animals can be bad for the environment.	Pre-	20	40	20	20
	Post-	40	40	7	13
6. We don't need to care for native animals.	Pre-	50	20	13	13
	Post-		87	7	7
7. It is important that we care for all native plants.	Pre-			20	80
	Post-			7	93
8. We don't need many types of plants growing in the bush.	Pre-	47	33	13	7
	Post-	67	20	7	7
9. I think we should have lots of different types of animals in the bush.	Pre-		7	7	87
	Post-			13	87
10. We don't need to care for the bush around our town.	Pre-		53	27	20
	Post-		87	7	7
11. It's okay to get rid of bush on farms or around town.	Pre-	40	33	27	
	Post-	27	40	13	20
12. Planting trees where they have been cleared is a waste of time.	Pre-	47	27	7	20
	Post-	33	40	13	13
13. We should care for our rivers and beaches.	Pre-			27	73
	Post-			13	87
14. It's great to catch lots and lots of fish.	Pre-	27	20	27	27
	Post-	67	20	7	7

Survey Item-14 (“It’s great to catch lots and lots of fish”) showed the largest positive shift from pre-program to post-program. In the pre-program survey 47% of children indicated a positive attitude and 54% of children indicated a negative attitude. This changed to 87% of children indicating a positive attitude and 14% of children indicating a negative attitude. This increase in positive attitudes by 40%, suggests that very strong and very positive attitudes to environmental sustainability through fishing responsibly and resource use were developed as a consequence of participation in the sustainability science-program. This finding supports the qualitative data also suggesting the development of strong, positive attitudes to resource use through responsible fishing.

Item-6 (“We don’t need to care for native animals”) also showed a large positive shift from the pre-program to the post-program. In the pre-program 70% of children indicated positive attitudes and 27% of children indicated negative attitudes. In the post-program 93% of children indicated positive attitudes and 7% of children negative attitudes. This meant the overall percentage increase in positive attitudes was 23%. Within this item children who chose ‘strongly disagree’ indicated the most positive response and those who chose ‘strongly agree’ indicated the least positive response. In the pre-program 50% of children chose ‘strongly disagree’ and in the post-program 87% of children chose this item. Similarly to qualitative data, this suggests that children developed much stronger and more positive attitudes to environmental sustainability through caring for biodiversity.

Item-10 (“We don’t need to care for the bush around our town”) also showed significant positive change from the pre-program to the post-program. In the pre-program 80% of the children indicated positive attitudes and 20% of children indicated negative attitudes. In the post-program 93% of children indicated positive attitudes and 7% of children indicated negative attitudes. This suggests that attitudes to caring for habitat were already largely positive, but that there was still an increase in positive attitudes throughout the program. A choice of ‘strongly disagree’ indicates the most positive response to this item. In the pre-program 53% of children chose ‘strongly disagree’. In the post-program 87% of children chose ‘strongly disagree’. This increase by 33% suggests that within the overall increase in positive attitudes there was specifically the development of very strong positive attitudes to sustainability through caring for habitat. This finding supports qualitative data through the children’s

development of positive attitudes and behaviours regarding caring for habitat at Clearwater Creek.

In survey Item-2 (“I never pick up other people’s rubbish”) a positive attitude towards sustainability was indicated by a response choice of ‘strongly disagree’. This ranged through to a negative response by the choice of ‘strongly agree’. In the pre-program 40% of the children chose a negative response and 60% of the children chose a positive response. In the post-program 27% of children chose a negative response and 73% of children chose a positive response. This suggested a shift of some children from a negative attitude to a positive attitude. Within the positive responses to Item-2, there was also a change. In the pre-program 33% of children chose ‘disagree’ and 27% of children chose ‘strongly disagree’. In the post-program 27% of children chose ‘disagree’ and 47% of children chose ‘strongly disagree’. This indicated that positive responses became stronger throughout the sustainability science-program, to the point that nearly half of all children indicated the strongest possible positive response in the post-program to this item. This supports qualitative data also suggesting very strong, positive attitudes to mutual responsibility.

In Item-8 (“We don’t need many types of plants growing in the bush”) a choice of ‘strongly disagree’ suggested a positive attitude and a choice of ‘strongly agree’ suggested a negative attitude. This item also showed minimal changes from pre-program to post-program, but again the changes were positive. In the pre-program 80% of children demonstrated positive attitudes to this item and 20% of children demonstrated negative attitudes. In the post-program 87% of children demonstrated positive attitudes and 13% of children demonstrated negative attitudes. These results indicated that attitudes were already positive to begin with, and that they became slightly more positive throughout the duration of the sustainability science-program. These high levels of positivity amongst children’s attitudes to biodiversity were also reflective of the qualitative data findings.

Item-3 (“It’s important for us to work together to get rid of rubbish around the school”) also addressed mutual responsibility. In the pre-program 67% of children chose ‘strongly agree’ and 33% of children chose ‘agree’. This changed in the post-program to 80% choosing ‘strongly agree’ and 20% choosing ‘agree’. The changes suggested that children’s attitudes remained positive, but became stronger throughout the duration of the sustainability science-program, reflective of the qualitative data related to this theme.

Item-7 (“It is important that we care for all native plants”) addressed the theme biodiversity. This item showed minimal changes from pre-program to post-program, but indicated that attitudes remained positive. In the pre-program 80% of children chose strongly agree and 20% of children chose ‘agree’. In the post-program 93% of children chose ‘strongly agree’ and 7% of children chose ‘agree’. These changes suggested that attitudes remained positive, and developed more strongly during the sustainability science-program. This finding was similar to qualitative data that also suggested largely positive attitudes to biodiversity.

Survey Item-9 (“I think we should have lots of different types of animals in the bush”) also addressed sustainability through biodiversity. In the pre-program 93% of children indicated a positive attitude and 7% of children indicated a negative attitude. In the post-program 100% of children indicated positive attitudes to this item. These results suggested that children did already have positive attitudes to this item, and that there was a shift of one child from a negative to a positive attitude between the pre-program and the post-program. This supports the qualitative data also finding a large presence of positive attitudes to sustainability through biodiversity.

Item-13 (“We should care for our rivers and beaches”) addressed the theme water pollution. All children responded positively to this item in the pre-program and in the post-program. In the pre-program, 73% of children chose strongly agree and 27% of children chose agree. This compared to 87% of children choosing strongly agree and 13% of children choosing agree in the post-program. This change suggested that the children maintained a positive attitude to water pollution, but that there was a development of stronger attitudes throughout the sustainability science-program. This reinforced qualitative data that also indicated very strong, positive attitudes to water pollution.

In Item-4 (“We should walk or ride a bike and use cars less”) 80% of children indicated positive attitudes and 20% of children indicated negative attitudes in the pre-program and in the post-program. However there were minor shifts within this item. A choice of ‘strongly agree’ indicates the most positive response and in the pre-program 40% of children chose ‘strongly agree’ while 7% of the children chose ‘strongly disagree’. In the post-program 47% of the children chose ‘strongly agree’ and 13% of the children chose ‘strongly disagree’. This suggests that attitudes to air pollution started very positively and remained mostly positive, but also that children became slightly more polarised in their views to air pollution. This is largely consistent with

qualitative data as it also suggested that children demonstrated positive attitudes to air pollution.

In Item-1 (“I always put my rubbish in the bin”) 100% of children indicated positive attitudes in the pre-program and the post-program survey. There was a slight change however in the strength of children’s attitudes to this item. In the pre-program 67% of children chose ‘strongly agree’, the most positive response. This compared to 60% of children choosing ‘strongly agree’ in the post-program. This drop of 7% suggests that attitudes to litter and rubbish were very positive and remained positive, but became slightly less strong. Qualitative data discussed earlier contrasts this finding by suggesting that very strong attitudes relating to litter and rubbish were developed.

Item-12 (“Planting trees where they have been cleared is a waste of time”) addressed habitat conservation. In the pre-program 73% of children indicated positive attitudes and 27% of children indicated negative attitudes. In the post-program 73% of children indicated positive attitudes and 27% of children indicated negative attitudes, suggesting that attitudes to this item remained positive. A choice of ‘strongly disagree’ indicated the most positive attitude to this item. In the pre-program 47% of children chose ‘strongly disagree’ and 20% of children chose ‘strongly agree’. In the post-program 33% of children chose ‘strongly disagree’ and 13% of children chose ‘strongly agree’. This suggests that although attitudes to rehabilitation of habitat were largely positive and that they remained largely positive, children’s attitudes became weaker. This is strongly contrasted by qualitative data discussed later that suggests that children developed passionate attitudes to environmental sustainability through habitat conservation.

Item-11 (“It’s okay to get rid of bush on farms or around town”) also addressed habitat conservation. In the pre-program 73% of children indicated positive attitudes and 27% of children indicated negative attitudes to this item. In the post-program 67% of children indicated positive attitudes and 33% of the children indicated negative attitudes. This shows a reduction of positive attitudes by 7% from the pre-program to the post-program, yet also those attitudes remain mostly positive to caring for habitat. Qualitative data discussed earlier contrasts this finding as it suggests the development of stronger and more positive attitudes to environmental sustainability through the conservation of habitat.

Item-5 (“Some animals can be bad for the environment”) addressed biodiversity; however, given the reliability scores discussed earlier, it did not prove to effectively

assess the attitudes of children to environmental sustainability. This may have been because of the wording of the item or of children's interpretations of it. Given that the scale would be stronger without the inclusion of the item, the results of this item will not be considered relevant.

Summary

Analysis of the scale has highlighted that a key limitation to this project is its low sample size. Despite this, analysis of the quantitative data has suggested that there was an overall development of positive attitudes amongst children indicated by some large shifts in the development of children's attitudes to environmental sustainability relating to particular survey items. The three items showing the most positive change relate to the themes responsible use of resources and biodiversity. These findings further support the qualitative data analysis in the development of positive attitudes to sustainability amongst children.

Chapter Five

Discussion

Introduction

UNESCO (1995-2010) identifies the need for all children in schools to be working towards sustainability by claiming the United Nations Decade of Education for Sustainable Development (2005-2014). This aims to, “address the social, economic, cultural and environmental problems we face in the 21st century” (UNESCO, 1995-2010, para. 4). UNESCO (1995-2010a) explains the importance of environmental sustainability in order for social and economic development to occur. UNESCO (1995-2010a) identifies water, climate change, biodiversity and natural disaster prevention as four themes relating to environmental sustainability and suggests that education for sustainable development must also address natural resource use. These key ideas formed the basis of the pre-program and post-program survey of 15 Year-2/3 children’s attitudes to environmental sustainability and of the sustainability science- program. Analysis of the qualitative and quantitative data suggested the development of positive attitudes to environmental sustainability through the themes: mutual responsibility, biodiversity, habitat conservation, resource use, water pollution, litter and rubbish, interconnections and air pollution. This chapter discusses each of the themes by connecting them to the current literature.

Mutual Responsibility

Leiserowitz, Kates and Parris (2005) highlighted the, “moral duties and obligations” (p. 25) to care for the environment. Similarly, Dunlap (1994) claimed that there is, “widespread acceptance of mutual responsibility for environmental problems” (Dunlap, p. 122). The theme mutual responsibility was addressed in the sustainability science-program as a means of developing positive attitudes towards environmental sustainability. Both qualitative and quantitative data suggested there had been the development of more positive attitudes regarding mutual responsibility throughout the sustainability science-program.

Qualitative data suggested that very positive and passionate attitudes were developed to mutual responsibility (e.g., Helen’s emotive language choice in her reflections). This language choice indicated she felt a sense of ‘moral duty’ to caring for

the environment as referred to by Leiserowitz, et al. (2005) and also highlighted by Eagles and Demare (1999). This sense of 'moral duty' falls within the highest level of Maslow's (1954) description of the hierarchy of needs, being self-actualisation. Her strong sense of responsibility in caring for the environment and her understanding of the need for mutual responsibility indicated the development of self-actualisation. It is interesting to note that given the Year-2/3 children's engagement with the sustainability science- program, qualitative data suggested that they were able to develop some aspects of self-actualisation despite their age of seven to eight years. The qualitative data also showed that the children were able to identify the ways in which they had acted responsibly during class activities and that they understood that mutual responsibility involved them working with others. This relates to Lewis, Karnes and Knight's (1995) finding that intellectually gifted senior high school students (Years-10, 11 and 12) did not show more traits associated with self-actualisation than younger intellectually gifted students in elementary (Years=4, 5 and 6) or junior (Years=7, 8 and 9) levels. Similarly, Stutler (2011) found that eight verbally gifted 11 and 12-year-old girls demonstrated self-actualisation through finding a sense of purpose in their lives and striving towards their ideal self whilst they engaged in reading fictional texts. Although each of these findings regards gifted students, they do suggest the development of self-actualisation in young children. Also related is Croft, Boyer and Hett's (2009) development of an Individual Education Plan for a 6-year old girl, Sarah, who has multiple disabilities and chronic illness. The plan focused on Sara's unique needs and assisted her to work to her potential in life skills. The authors claimed: "The child with disabilities may be guided toward her goal of self-actualization by being encouraged to find her individual strengths and capacities, and by being assisted to successfully interact with her environment" (p. 43). This suggests that although children differ in their needs and potential development, striving for self-actualisation in all young children is a worthy pursuit, regardless of their abilities.

Qualitative data further suggested that changes in behaviours had occurred as in the example of Ella acting at home to care for orchids near her house. Ella's behaviour suggested the presence of very strong attitudes to environmental sustainability through mutual responsibility given that stronger attitudes are more likely to lead to supportive behaviours (Eaton & Visser, 2008). Her behaviour also indicated she felt a sense of moral obligation as discussed by Leiserowitz, et al. (2005). This supports Maslow (1954, p. 100) as he explained that, "the pursuit and the gratification of higher level needs have desirable civic and social consequences". Ella's actions were not only

beneficial for self-fulfilment but they also benefited plant biodiversity and environmental sustainability. This also relates to the principle, 'participation', from ARIES principles of education for sustainability. By initiating this act on her own, Ella demonstrated that she had developed self-reliance and self-organisation. ARIES (2004-2013) lists these as benefits of increased levels of participation.

Further, Ella's behaviour was deliberate, or conscious, as described by Bardi and Schwartz (2003). It was also reflective of her values and seemed to serve the purpose of communicating her values to her brother and father. This supports the assertion that behaviours are influenced by values and attitudes, and that values can be pursued through supportive behaviours (Bardi & Schwartz, 2003).

Quantitative data supported the qualitative data as it suggested that the 15 Year-2/3 children started with positive attitudes to mutual responsibility, but also developed much stronger positive attitudes, specifically relating to picking up other peoples rubbish throughout the sustainability science-program. This included a shift of some children from negative to positive attitudes, indicating that a change in attitudes and in behaviours had occurred and that children had begun to take responsibility for the environmental problem that is litter and rubbish. This supports Dunlap's (1994) assertion of 'widespread acceptance' for environmental problems. It also indicated progress towards one of AuSSI's key goals with, "young people shares ownership of sustainability initiatives and decision making" (DSEWPaC, 2010b). The children began to take ownership by making responsible decisions in relation to picking up other people's rubbish.

Quantitative data also suggested a shift in attitudes relating to children understanding the importance of working with others to get rid of rubbish. Although attitudes started positive they became much stronger and remained positive. This indicated that there was understanding by the children in this sample of the mutual need to work together to reduce litter and rubbish. This further supports Dunlap's (1994, p. 122) claims of, "widespread acceptance of mutual responsibility" for people throughout the world. It also relates to ARIES principals of education for sustainability, namely 'partnerships'. ARIES explain that commitment to, and ownership of problems can be improved by sharing the workload through partnerships (ARIES, 2004-2013). Whilst not necessarily fully understanding the benefits of creating partnerships, the children have identified the need to work with others towards a common goal.

Biodiversity

The loss of biodiversity is a significant threat to environmental sustainability in the future (Leiserowitz et al., 2005). Biodiversity is the most significant theme that was addressed in the sustainability science-program, the survey and in the interviews at the conclusion of the program. Qualitative data suggested large developments in awareness of and positive attitudes to biodiversity. This was supported by quantitative data suggesting the development of some positive attitudes.

Qualitative data showed that all children in the class were able to define biodiversity and suggest ways to promote it by the end of the sustainability science-program. It also indicates an understanding of ecology and the connections within the environment. This is significant as these understandings form the basis from which positive attitudes were developed. The development of children's attitudes to biodiversity in the present study relates to the Eagles and Demare's (1999) study of ecologicistic attitudes and to Musser and Malkus' (1994) use of the themes conservation and animal protection in guiding their study of children's attitudes. Qualitative data also suggested that some of the children were able to identify threats to biodiversity, such as Henry's identification of cockies destroying trees. This related to Sutton's (2000) identification of the need to stop the 'non evolutionary' loss of biodiversity.

Further, the need for genetic diversity in the survival of species was identified. An example of this was when Henry highlighted the way humans need a variety of food sources to survive. This idea is consistent with Leiserowitz et al. (2005) when they identified the loss of biodiversity as a significant threat to environmental sustainability in the future. Henry's example also highlights the link that biodiversity has with agriculture and fisheries. This is consistent with UNESCO's DESD as it too focuses on the issues and links that biodiversity has with agriculture and fisheries, but also livelihoods, livestock and forestry (UNESCO, 1995-2010b).

Whilst there were varying levels of complexity in the children's reasoning and understanding of biodiversity, positive attitudes were still apparent in much of the qualitative data. There were some examples in the qualitative data of children demonstrating negative attitudes to biodiversity through the image of the python. Data suggested that these children viewed the animal as a threat to their own safety and the safety of other animals. Other children reacted in contrasting ways and showed an understanding of the snake as just another species of animal. This was the only situation where negative attitudes to biodiversity were indicated. Consistent with Dohman et al.

(2012) and Grønhøj and Thøgersen's (2009) findings relating to the transfer of attitudes from parents to children, children's attitudes in the present study could have arisen through the process of socialization with parents and other community members.

Other qualitative data showed the development of strong positive attitudes to biodiversity and environmental sustainability; for example, Helen's use of passionate language. Helen's emotive language indicated that she was "developing values that support a sustainability ethos" (DSEWPaC, 2010b), which AuSSI identified as a key goal for schools and communities. Her strong language further highlights the evaluative nature of attitudes, an aspect of attitudes suggested by several authors (Bohner & Dickel, 2011; Dowds, 2003; Eaton & Visser, 2008; Petty et al., 1997). Given Eaton and Visser's (2008) suggestion that strong attitudes can predict behaviours, Helen's attitudes could further be an indicator of potential changes in behaviours related to environmental sustainability through biodiversity.

Quantitative data relating to biodiversity, but specifically to caring for native animals, showed the presence of positive attitudes at the beginning of the program, but also the development of positive attitudes throughout the program. Children's prior learning and development that occurred outside of school could explain the presence of positive attitudes to biodiversity at the beginning of the sustainability science-program. This is consistent with the recognition that children's development is influenced by the interactions between the child and their socio cultural community (Fleer, 2006; Howitt & Blake, 2010). The development of positive attitudes to caring for native animals throughout the sustainability science-program relates to Musser and Malkus' (1994) their use of the theme animal protection in their study of children's environmental attitudes. The significance of the development of positive attitudes to caring for animals was also highlighted through Dunlap's (1994) inclusion of animals as one aspect when defining the natural environment. Quantitative data in the present study supported the qualitative data by suggesting that children in the sample did recognise that caring for native animals is an important part of biodiversity and environmental sustainability.

Similarly, quantitative data relating to biodiversity, but specifically to caring for native plants, also showed the presence of positive attitudes at the beginning of the sustainability science-program, and the further development of positive attitudes in children. The development of these attitudes relates to the theme conservation used by Musser and Malkus' (1994) in their study of children's attitudes and the influence of cultural interactions on the child's development (Fleer, 2006; Howitt & Blake, 2010;

Robbins, 2005; Vygotsky, 1978) must again be mentioned as an influence of existing positive attitudes to caring for native plants. The significance of the development of positive attitudes towards caring for plants was also highlighted through Dunlap's (1994) inclusion of plants as one aspect when defining the natural environment. This quantitative data supported the qualitative data, including interview responses relating to caring for existing environments, and suggested that children in the sample did recognise that caring for native plants is as an important part of biodiversity and environmental sustainability.

Although quantitative data suggested children originally understood the need to care for native plants, the understanding of the need for habitat conservation for biodiversity was developed throughout the sustainability science-program. Qualitative data indicated that children began to understand the link between habitat conservation and biodiversity. This was evident in Henry's narrative. It was also evident by the end of the sustainability science-program with the overwhelming child interview responses that highlighted planting trees and plants as one way of helping biodiversity at Clearwater Creek or elsewhere. This suggests that the sustainability science-program offered children opportunities to expand their knowledge and experiences, allowing for the development of their beliefs (Crow & Liggett's, 2014). It is this development of beliefs, or children's perceived 'truths' that has fostered the development of positive attitudes given that attitudes can be shaped by beliefs (Dowds, 2003). Further, Leiserowitz et al. (2005) described one of the key points in environmental sustainability is the ability to maintain the 'life-support systems' of the environment. It was evident that the children in this study understood that one of the important links in the environment's life support systems is that between habitat conservation and biodiversity. This also indicated the development of a sustainability ethos amongst children, which assisted in working towards AuSSI's related goal: "Schools and communities developing values that support a sustainability ethos" (DSEWPac, 2010b).

The need to have many types of plants growing in the bush was another aspect of biodiversity addressed by the quantitative data. The development of positive attitudes was indicated through the analysis of survey Item-8. This also links to the identification of species loss as a potential major problem in the future, as discussed by Leiserowitz et al. (2005). The data supports the finding of positive attitudes to this theme in qualitative data analysis by suggesting that the 15 Year-2/3 children in this sample were aware of

the need for diversity of plant life and they demonstrated positive attitudes relating to environmental sustainability through this.

The need for diversity of animal life as an aspect of biodiversity was further addressed in quantitative data. It showed slight development of positive attitudes through a shift in one child from a negative to a positive response; however, attitudes were already largely positive. This relates to the identification of species loss by Leiserowitz et al. (2005) as a potential problem in the future. It also relates to the assessment of environmental attitudes in children by Musser and Malkus (1994) through the use of their theme animal protection and to Eagles and Demare's (1999) study of the ecologicistic attitudes in children. Data from the survey suggested that children were already mostly aware of the need for diversity of animal life for biodiversity and environmental sustainability.

Lowe and Pinhey (cited in Filson, 1993) explain that rural adults feel less concerned environmentally than non-rural adults. Given that research suggests that attitudes are transferred from adults to children (Dohman et al., 2012; Grønhøj & Thøgersen's, 2009), it could be inferred that this too would be relevant for the young children involved in study. Although it is not possible to compare the attitudes of farming and non-farming children, nor the attitudes of children in this study to children living in large metropolitan areas, the qualitative and quantitative data from this study suggested the development of very strong, positive attitudes to environmental sustainability through biodiversity in these rural living children. Even if this degree of environmental concern is indeed 'lesser' than non-rural children, attitudes were still very positive.

Habitat Conservation

Habitat conservation may be considered one of the essential 'life support systems' that Leiserowitz et al. (2005) suggested must be maintained in order to ensure that development is sustainable. The protection of habitat may also be considered as something which environmental conservationists work towards, and that Filson (1993) suggested Australian farmers might not support. Qualitative data strongly suggested that the sustainability science-program achieved the aim of developing positive attitudes towards habitat conservation, and therefore to environmental sustainability; however, this evidence contrasts some quantitative data from the study.

Qualitative data showed that children have a solid understanding of what habitats are. Both Alan's and Anne's narratives demonstrated an understanding of habitats. As well as this, Alan was able to identify that plants form an important part of habitats. Participation in the sustainability science-program fostered the development of these understandings as children worked collaboratively to construct knowledge during activities, such as in the habitat investigation. These experiences required interactions and formed the basis for children's learning, reflective of socio cultural learning as described by Robbins (2005). These understandings are crucial as they form the basis for the development of beliefs and consequential attitudes (Crow & Liggett, 2014) relating to environmental sustainability through habitat conservation.

Participation in the sustainability science-program has given children opportunities to develop their knowledge and experiences related to habitat conservation, and to give consideration to each of these. Crow and Liggett (2014) explain that this process allows for the development of beliefs. Participation in the program has further fostered the development of consequential positive attitudes to habitat conservation. Positive attitudes were shown in the qualitative data by emotional language, for example in Anne's narrative. Her reflection shows that she was actively involved in the sustainability science-program and thoroughly enjoyed herself. In this sense this study has achieved one of the key goals in learning for sustainability. Tilbury et al. (2005) suggested that learning for sustainability science-programs motivate and equip children with the skills needed to become active, informed citizens. It was evident from her narrative that Anne had been actively involved in the sustainability science-program and felt passionate and motivated by it. This also indicated that she had been engaged in the principle of education for sustainability, 'Envisioning'. ARIES (2004-2013) explain that envisioning a better future can involve "harnessing our deep desires" to make changes. Anne's emotive language clearly indicated her involvement in this process.

Qualitative data allowed an insight into the children's understanding of issues related to habitat conservation. Henry exemplified this when he identified the need for land to be cleared sometimes for work purposes, but still considered habitat conservation to be important. Anne also showed an awareness of this issue as she explained that there could be a reason for clearing of land, but then described more trees and plants as equalling a better planet. This data suggested that children were aware of the real life issues that face society, such as clearing land for development, but that they

also held positive attitudes to environmental sustainability through habitat conservation. This relates to the very definition of sustainable development. UNESCO (1995-2010) stated: “Sustainable development is seeking to meet the needs of the present without compromising those of future generations”. The 15 Year-2/3 children in this study showed an awareness of the need for development, but not at any cost.

The identification of real life issues related to habitat conservation is also reflective of the socio cultural environment surrounding the children. Parents of the children work in a variety of sectors, including: mining; farming; housing; and community services such as police, health and education. There are also particular interest groups in the community, such as the Oceanside Environmental Group. Children’s recognition that different people within their community use the land in different and sometimes competing ways is supportive of socio-cultural learning theory that suggests children’s learning is a collaborative process involving interactions between children and their community (Fleer, 2006; Robbins, 2005).

Qualitative data also allowed for a deeper understanding of the connections that the children are making in their learning. Alan’s narrative highlighted the link between habitat conservation and biodiversity. He reflected that habitat conservation is one way of caring for biodiversity. Alan’s and Anne’s narratives, as well as other children’s interview comments, suggested the development of positive attitudes to habitat conservation and a greater awareness of environmental connections, by mentioning activities such as protecting current environments, not chopping down trees and planting more trees. This suggests that the 15 Year-2/3 children in this study are starting to understand that complex systems operate in the environment. Leiserowitz et al. (2005) refer to the essential ‘life support systems’ and importantly, the children demonstrated an initial understanding of the links between habitat conservation and biodiversity that form a part of a ‘system’.

Quantitative data relating to habitat conservation, but specifically to caring for the bush around town, showed the development of very positive attitudes throughout the duration of the sustainability science-program. This supported the qualitative data in both Anne’s and Alan’s narratives which showed very strong positive attitudes to caring for vegetation, for example both children strongly suggesting not cutting down any more trees. It also supports Leiserowitz et al. (2005) in their claim that people feel an obligation to care for vegetation, amongst other living and non-living things. The children in this study demonstrated positive attitudes to caring for bush around their

town and felt a sense of obligation in the need to look after it. The development of positive attitudes in children to caring for vegetation relates to the conservation theme used by Musser and Malkus (1994) in their CATES project.

Interestingly, quantitative data relating to getting rid of bush on farms or in town suggested that children developed slightly more negative attitudes to this throughout the sustainability science-program. This was surprising given that planting trees was such a common interview response when discussing biodiversity and that three children proposed protecting current environments in the interview as ways of helping biodiversity. It is possible that children did think it was okay for farmers or people in town to get rid of bush given Filson's (1993) assertion that Australian farmers may not support some of the things that environmental conservationists work towards, and that parents attitudes can be transferred to children (Dohman et al., 2012; Grønhøj & Thøgersen's, 2009). This finding could also possibly be reflective of children's understandings of competing land uses. However, given that a large amount of qualitative data contrasts this quantitative data by suggesting the development of positive attitudes to habitat conservation, the significance of this quantitative finding is reduced.

Quantitative data also suggested children's attitudes to whether or not they thought it was a waste of time planting trees where they had been cleared commenced positively and remained positive with slight changes suggesting attitudes became less extreme throughout the program. This data supports the qualitative data through the finding of largely positive attitudes to habitat conservation and relates to the ecologicistic attitudes of children studied by Eagles and Demare (1999). It was interesting that quantitative data did not indicate large shifts in attitudes to this aspect of habitat conservation given that children did engage in planting trees at Clearwater Creek. This could be because attitudes were already positive at the commencement of the study. It could also be due to the reliability of the survey given that strong qualitative data suggested children saw the value in planting trees and made connections between habitat conservation and planting trees.

Resource Use

Another critical theme in this project is the responsible use of natural resources. Reser (2007) sighted the depletion of fisheries stocks as a significant threat to the natural environment. This theme of resource use is linked to mutual responsibility. The idea of responsibility is central to both sustainable fishing and natural resources

generally. It is also a key feature of the theme mutual responsibility. Qualitative and quantitative data both suggested the development of strong positive attitudes towards environmental sustainability through the responsible use of resources, particularly by engaging in responsible fishing practices.

Qualitative data indicated that one way children developed positive attitudes to resource use and fishing responsibly, was because they were able to identify emotionally with fish. Denise exemplified this by the use of her emotional language in her written reflections. Brian also showed this in the comments made during class discussion. The children demonstrated empathy towards fish caught in the net and then responded emotionally. They considered whether or not the fishing practices being discussed were humane, which lead to the development of positive attitudes to responsible fishing, through the types of fishing practices.

The process of children's development of positive attitudes to resource use can be explained through social constructivism. Vygotsky's (1978) suggestion of language as a tool to develop higher cognition and to communicate children's perceptions is particularly relevant as responsible fishing practices were explored largely through class discussion of stimulus images and children's reflections of these discussions. Through engaging with others, children contributed their ideas and perceptions, and listened to others. Reflection upon this discussion fostered the development of higher cognition, or attitudes.

Qualitative data relating to responsible use of resources, and particularly to fishing responsibly, indicated an awareness of the issue of greed amongst children in the class. Many children, including Henry, Ella and Denise identified greed as a motivation for catching too many fish and identified this as a negative practice. The idea of greed relates to Eagles and Demare's (1999) investigation of the moralistic attitudes in children. This suggested an understanding of the need for quotas to restrict the number of fish that are caught and an understanding of the very nature of environmental sustainability. UNESCO (1995-2010) explained that sustainability involved meeting the needs of the present whilst not compromising the needs of future generations. This qualitative data suggested that children have developed an understanding of sustainability and have developed strong positive attitudes to responsible fishing through restricting the number of fish that are caught.

Qualitative data analysis allowed for a deeper understanding of attitudes in terms of the complexity and reasoning behind the attitudes to responsible use of resources,

through fishing responsibly. Some children, such as David, focused on the negative consequences of irresponsible fishing in their reflections. David showed an awareness of these consequences, and this awareness seemed to shape the development of his attitudes to responsible fishing. This was opposed to many other children, such as Kevin, Grace and Denise, who showed an understanding of why size restrictions exist. Denise was able to clearly link the over fishing of small and young fish with the potential exhaustion of fishing stocks in the future. Each of these children's paths to attitudinal development is consistent with the process of attitudinal development through beliefs described by Crow and Liggett (2014). The development of positive attitudes to fishing responsibly is important given Reser's (2007) claim of the depletion of fishing stocks as a significant and real threat to fishing in the future. This data suggested that children have developed positive attitudes relating to size limits in fishing and that some children have developed quite complex understandings of the need for resources to be used in sustainable ways.

Additionally, qualitative data suggested an awareness of the need to use resources for work purposes, specifically through fishing. Several children, including Grace and David, identified that fishing was a type of employment for some people and therefore had to occur. However both of these children still thought that the fishing practices being discussed weren't responsible. This suggested that the children were aware of real life issues facing society relating to resource use for economic and social development, but it also indicated the development of positive attitudes to environmental sustainability in relation to this. UNESCO (1995-2010a) highlighted these ideas: "There can be no long term social or economic development on a depleted planet" (Environment section, para. 2).

Quantitative data further supported qualitative data by suggesting the strong development of very positive attitudes to environmental sustainability through resource use and specifically, fishing responsibly. Data suggested that attitudes were mostly negative at the commencement of the sustainability science-program and that throughout the program much stronger and more positive attitudes to responsible fishing were developed. This suggested that children developed an understanding of the need to fish in ways that does not deplete the 'life support systems' that Leiserowitz et al. (2005) claimed as essential in maintaining for sustainable development. It also suggests that children in this study began to develop moralistic and ecologicistic attitudes relating

to fishing responsibly as investigated in Eagles and Demare's (1999) study of children's attitudes.

The development of strong, positive attitudes to responsible fishing suggested by both qualitative and quantitative data could indicate that these attitudes will remain relatively more stable than other attitudes over time, a characteristic of attitudes described by Bohner and Dickel (2011). It may also mean that these stronger attitudes lead to attitude congruent behaviours, as suggested by Eaton and Visser (2008). It could further be interpreted that given the suggested large change in children's attitudes, children may not have previously given much consideration to responsible fishing or reflected critically upon it. This is consistent with Eaton and Visser's (2008) claim that prior knowledge, consideration and personal relevance are factors in determining the strength of attitudes. It could be inferred that participation in the sustainability science-program may have offered children such opportunities and consequently fostered positive attitude development to responsible fishing practices.

Water Pollution

Dunlap (1994) identified water as one aspect of the natural environment. Water pollution is one of the key themes addressed in the survey and throughout the sustainability science-program. Both qualitative data from the program and quantitative data indicated the development of stronger and more positive attitudes towards environmental sustainability through water pollution.

Qualitative data allowed us to understand much more accurately how attitudes developed throughout the sustainability science-program. For example: David initially demonstrated apathy when first discussing water pollution and commented that he thought waste in the ocean wouldn't hurt sea animals. This could be explained by Filson's (1993) suggestion that Australian farmers viewed issues relating to environmental sustainability with scepticism and that these attitudes could have been transferred from parents to their children (Dohman et al., 2012; Grønhøj & Thøgersen's, 2009).

Later in David's written reflections his attitudes became very strong and very positive, indicated by his emotive and commanding language choice. This suggested that participation in the sustainability science-program, and specifically the opportunity to discuss with others and reflect on stimulus images, assisted the development of positive attitudes. The significance of children's active involvement in the sustainability

science-program was recognised and specifically planned for as Tilbury et al. (2007) explained participation as a key element in the Learning for Sustainability Approach. The suggestion that active participation in the sustainability science-program fostered the development of David's positive attitudes to water pollution supports social constructivist learning theory whereby children learn through the interactions that they have with others (Fleer, 2006; Howitt & Blake, 2010). It also suggests that David's understandings of water pollution were scaffolded by his peers through listening to the ideas of others, and through reflecting upon what he had heard and his own previous understandings. In this situation David's 'more capable' peers guided him through the ZPD as described by Vygotsky (1935) and Fleer and Robbins (2006). .

Qualitative data suggested that one way in which children developed positive attitudes to water pollution was by recognising the effects of water pollution. Ella, David and Colin recognised that water pollution could lead to the death or injury of animals, such as tadpoles and turtles. By identifying with the animals on an emotional level, children developed positive attitudes regarding water pollution. The emotional language used by the children indicated this. Tilbury et al. (2005) explained that encouraging children to reflect on how they currently live and work assists them in making informed decisions about their environment, a key part of the Learning for Sustainability Approach. This qualitative data suggested that child reflection of current real life practices developed strong, positive attitudes to environmental sustainability through water pollution.

The analysis of qualitative data indicated that children in this study viewed environmental sustainability, through water pollution, very seriously. This was evident in Colin's language choice in his written reflections. He clearly understood the implications of water pollution and showed great concern about these. David and Ella also expressed similar ideas and Dunlap (1994) supported this. He suggested that people from many different countries view environmental deterioration seriously. Qualitative data indicated that the children in this study also viewed environmental deterioration, specifically water pollution in a very serious way.

Qualitative data also suggested the development of positive attitudes to water pollution by developing understandings of environmental links and connections. Colin's narrative exemplified this when he explained the affect of water pollution on animals in relation to the food chain. ARIES (2004-2009) suggested one important process, which the Learning for Sustainability Approach is based on, is systems thinking. This refers to

understanding the relationships and viewing the whole process. Qualitative data showed that Colin was able to develop positive attitudes to environmental sustainability through water pollution, by viewing the environment as a system with links and connections. These understandings of the environmental connections further relate to the ecologicistic attitudes Eagles and Demare (1999) investigated in their study of young children.

Quantitative data suggested the existence of positive attitudes to water pollution at the commencement of the sustainability science-program and the strengthening of these positive attitudes throughout the program. Quantitative data specifically addressed water pollution through caring for rivers and beaches, which relates to Musser and Malkus' (1994) use of the theme pollution in the CATES. It also suggested that the children in this study considered water to be an important part of the natural environment that is worth caring for, as does Dunlap (1994). This data is supportive of qualitative data as they both indicated that participation in the sustainability science-program contributed to the development of strong, positive attitudes to environmental sustainability, through water pollution.

Litter and Rubbish

Dunlap (1994) described how people from around the world view environmental deterioration as a serious concern. One type of deterioration of concern is litter and rubbish. This theme was addressed in the survey and also in the sustainability science-program. Qualitative data was supported with quantitative data as they suggested the development of positive attitudes towards environmental sustainability, through litter and rubbish.

Qualitative data suggested children have developed positive attitudes to litter and rubbish by gaining an understanding of the potential consequences of littering highlighted by the stimulus images used. Many children, including Edward and Grace, identified litter reaching the waterways and affecting animals as a potential negative impact. By recognising this impact children then responded emotionally and passionately. This was seen for example, in Grace's strong, commanding language. This qualitative data suggested that the children viewed littering and the consequences of littering as very serious, as highlighted by Dunlap (1994). It also indicated that the children were able to think about littering in a systemic way by considering the consequences of people's actions. This identification of connections and relationships is one aspect of the 'systemic thinking' principles described by ARIES (2004-2013). Further children's passionate responses indicate strong attitudes to the issue of littering.

These attitudes could have been strengthened through greater consideration of the implications of littering and through children's personal and emotional responses. This is consistent with Eaton and Visser's (2008) suggestion that attitude strength can be influenced by previous experiences, greater consideration of the attitudinal object, and personal relevance to the object.

Furthermore, qualitative data showed positive attitudes were evident in relation to litter and biodiversity. In the interviews, 10 of the 15 children were able to link the reduction of litter to helping biodiversity. Edward exemplified this in his written reflections. Despite not making these connections, each of the other five children still demonstrated positive attitudes to litter and rubbish. This meant that all of the children demonstrated positive attitudes to environmental sustainability through litter and rubbish, which was very significant. ACS Education (2007) described environmental sustainability as being able to maintain the state of the physical environment. The qualitative data suggested that children in this study also considered maintaining the physical environment in terms of litter and rubbish to be important, therefore valuing environmental sustainability.

Another key aspect of litter and rubbish highlighted in both qualitative and quantitative data was the link to mutual responsibility. Qualitative data suggested that children developed their understandings of this link as seen in Grace's illustration. She drew a picture of a child reprimanding another child for not putting their rubbish in the bin. This content in the illustration suggested very strong attitudes to litter and rubbish, which could indicate potential related behaviour changes, as described by Eaton and Visser (2008). This suggested that she acknowledges that it is everyone's responsibility to reduce waste, with all children helping. ARIES (2004-2009) suggested that in the Learning for Sustainability Approach, children should be given an opportunity to be involved in several processes including envisioning a better future. This suggests Grace has envisaged a better future and is willing to act in a way that will help to make this happen. This indicated the development of strong, positive attitudes and behaviours relating to environmental sustainability through litter and rubbish.

Quantitative data also supported the development of a link in children between litter and mutual responsibility. Data referring to children picking up other people's rubbish suggested that children were mostly positive at the commencement of the sustainability science-program, but that many more positive attitudes were developed and existing positive attitudes were strengthened throughout the sustainability science-

program. This suggested the development not only of positive attitudes, but also of positive behaviours which is very important and which supports qualitative data. It indicated that children were motivated to make informed decisions and were willing to work towards a more sustainable world, an aim of the learning for Sustainability Approach described by Tilbury et al. (2005). Children's changed behaviours also indicated that they were actively involved in the sustainability science-program at deeper levels, beyond simply raising awareness. This supports AuSSI's principle, "seeking to go beyond awareness raising to action learning and integration with school curricula" (DSEWPac, 2010b).

Quantitative data also addressed responsibility and litter, but specifically children putting their own rubbish in the bin. The data indicated minimal changes as all children responded positively at the beginning and at the completion of the sustainability science-program. These strong attitudes suggested that children had already experienced learning related to putting their own rubbish in the bin given that prior learning is one factor in attitude strength (Eaton & Visser, 2008). It can also be inferred that this learning could have taken place at school, given that putting rubbish in the bin is a commonly emphasised practice in schools, or that learning could have been influenced by the children's families and broader community practices (Fleer, 2006; Robbins, 2005). Data also indicated that children were able to make responsible decisions relating to litter and rubbish thereby working towards the achievement of AuSSI's ninth goal: "individuals supported to make effective sustainability decisions and choices" (DEEWPac, 2010c, Goals section, para. 1).

Interconnections

Leiserowitz et al. (2005) identified a loss in biodiversity as a significant threat to the sustainability of life. This indicated the interconnected nature of biodiversity with other living and non-living aspects of the environment, such as resource use, habitat conservation and water quality. Leiserowitz et al. (2005) also highlighted the need to conserve the planets 'life-support systems'. This too, suggests that elements of the environment do not operate individually but in complex systems that are linked with other systems. The interconnections and interdependence of various environmental aspects is a sub-theme that is related to each of the other themes in this study. This sub-theme was not addressed in the survey, but was covered in the sustainability science-program and evidence related to it did emerge in the analysis of qualitative data. It

showed that the children developed understandings and positive attitudes to environmental sustainability through environmental interconnections.

Qualitative data showed that many children were able to develop their understandings of the interconnections in the environment. Grace's diagram highlighted these connections. She identified that all living things need the sun, that all living things need water and the food chain relationships between some animals. Betty identified the importance of water and how the living and non-living elements are linked, and the link between animals and plants as habitats. These understandings formed the basis for children's beliefs (Crow & Liggett, 2014) and the consequential strong positive attitudes to interconnections, which were evident in the children's emotive language choice. The children's indication of their feelings towards environmental attitudes is reflective of the evaluative nature of attitudes, as suggested by Bohner and Dickel (2011) and Eaton and Visser (2008). Further, UNESCO (1995-2010) explained that some of the parts of sustainable development include animal and plant species, ecosystems and natural resources. The children in this study demonstrated understandings of each of these elements, particularly the interconnected nature of ecosystems. This qualitative data suggested that the development of positive attitudes to environmental sustainability has occurred through developing understandings about and attitudes towards environmental interconnections.

Qualitative data also supported the development of positive attitudes to environmental interconnections, through understanding the link between biodiversity and habitat, and the affect that humans have on each of these. There was much qualitative data to support child awareness of this, for example in Betty's written reflections. She, as many other children were, able to identify ways in which she had helped, or could help care for biodiversity. These suggestions involved habitat conservation and indicated an awareness of the link between the two. She also suggested things that people shouldn't do because they would negatively influence biodiversity and habitat conservation. When describing the importance of water and the interdependence activity in Session-3 in her vignette, Betty referred directly to the learning that occurred with her peers, indicating the significance of these social interactions during the task. This further supports social cultural learning theory as it recognises that children can learn through their interactions with peers (Howitt & Blake, 2010; Robbins, 2005). The qualitative data suggested the development of awareness of important environmental links and very strong positive attitudes to environmental

sustainability, through interconnections. Sutton (2000) listed the conservation of biodiversity and ecological integrity as an important part of sustainability. Qualitative data from this study showed that children had developed a sound understanding of the conservation of biodiversity as an essential part in environmental sustainability.

Analysis of the qualitative data has allowed for a deeper understanding of the way children's attitudes have developed throughout the sustainability science-program. Cathy's written reflections indicated that although her initial attitudes to environmental sustainability were positive, they lacked reasoning and understanding. This was indicated when she explained that caring for animals was a good thing but didn't elaborate on why. Her written reflections later on suggested that she understood the connections between animals and plants as habitats, and also the connections between people's actions and habitats. This indicated that through gaining an understanding of environmental connections, Cathy has strengthened her positive attitudes towards environmental sustainability. Eaton and Visser (2008) explain the importance of the process of the strengthening of attitudes through: gaining related knowledge, and engaging; for example, (in consideration of the attitude) as outlined by Cathy's understandings of the interconnections. Cathy's example also relates to Leiserowitz et al. (2005) reference to the 'life support systems', as Cathy now views the environment as; a complex and interrelated system. ARIES (2004-2013) explain that 'systems thinking' involves identifying relationships within systems. Cathy and other children showed evidence of developing systems thinking skills as they identified and developed understandings of various aspects within ecological systems.

Air Pollution

Dunlap (1994) identified air as one aspect of the natural environment. Leiserowitz et al. (2005) list air pollution as an environmental issue that the public feel strongly about. The theme air pollution is a minor theme within the program, but was still addressed in the survey and in the sustainability science-program. Qualitative data showed predominantly positive attitudes developed in children to air pollution, yet this included some varying attitudes, as well as suggesting the influence of current world issues on children's attitudes. The positive attitudes indicated in qualitative data were supported through the quantitative data as it suggested that mostly positive attitudes to environmental sustainability through air pollution were present.

Qualitative data suggested that positive attitudes have been developed to air pollution. The children identified a variety of pollutants, for example, Denise recognised

that cars contribute to air pollution; Gary reflected that chemicals pollute the air, and Colin identified both dust and toxic chemicals. Importantly, the qualitative data indicated that world issues affected the children. This was shown through Colin's reference to the nuclear disaster in Japan that occurred earlier in the year. By reflecting upon the potential causes of air pollution children were demonstrating 'critical thinking'. ARIES (2004-2013) explain that critical thought can involve looking for causes of environmental problems, rather than just focusing on the symptoms. Whilst reflecting on these sources of air pollution children demonstrated positive attitudes relating to them, suggesting that they, like Dunlap (1994) considered air as an important aspect of the environment worth caring for. These attitudes related directly to the questions used by Musser and Malkus (1994) in the CATES project that were based on the theme pollution. The qualitative data indicated that the children developed positive attitudes towards environmental sustainability covering air pollution. In addition, it was found that children's attitudes were affected by current world issues covered in the media.

Qualitative data also showed the development of positive attitudes to air pollution through the use of strong language in the children's written reflections. This was evident in Denise's use of commanding language. Another example was the way that Colin involved himself in his reflections by using the word 'I' and writing passionately about his wishes for the environment. By relating to issues of air pollution on a personal level Colin was involved in the values clarification process explained by ARIES (2009); it involves, "creating a sense of personal relevance in, and connection to, change for sustainability" (p. 4). Colin's personal engagement with the issue of air pollution also indicated the internalisation of the concept and the formation of an attitude. Vygotsky (1978) explained that children learn higher order functions through experiencing them socially and then individually. This occurred for Colin: firstly, as he was involved in class discussions of the stimulus images relating to air pollution and through exposure to media relating to the nuclear disaster in Japan; and secondly, as he reflected individually about these issues and attitudes and formed his own attitude to air pollution. This process of social learning is centred on the social and cultural interactions between children and their communities. Along with reflection upon their values, this data also suggested that children developed very positive attitudes to air pollution and that they felt a sense of responsibility for the environment. ARIES (2004-2009) explained that one of the key processes in the Learning for Sustainability Approach is partnerships for change. The children in this study have demonstrated that

they are operating within this process as they have created a vision of how they would like the environment to be and they felt a sense of ownership and responsibility for it.

Qualitative data also suggested that recognition of the affects of air pollution lead to the development of positive attitudes regarding it. Colin exemplified this when he discussed air pollution as being ‘unbreathable’ and how air pollution may affect other aspect of the environment. Denis also reflected on the impact that polluting one aspect of the environment has on other aspects. This data supported the development of understandings of the interconnected nature of the environment, and indicated the development of positive attitudes to air pollution. ARIES (2004-2009) discussed that another key process in the Learning for Sustainability Approach is critical thinking and reflection. Qualitative data suggested that children in this study were involved in critical reflection of unsustainable practices. It also suggested they were involved in creative thought as they applied their understanding of the environment as a set of systems and looked for links amongst this. Further, this demonstrates the development of ‘systems thinking’ amongst children. They were able to view air pollution as a process with implications and affects, instead of as a ‘thing’. This is another indication of the development of ‘systems thinking’ (ARIES, 2004-2013).

An interesting finding from the qualitative data indicated that there were some differing interpretations of stimulus Image-8 (Macmillan, n.d.), some of which related to environmental sustainability. Denise reflected on the picture of the boy riding his bike in relation to air pollution and demonstrated positive attitudes in her writing. However many other children, including Grace, Fay and Helen, focused on the issue of bicycle safety in relation to this image. This data suggested that the replacement of this particular image with an alternative one might have been more productive in developing positive attitudes to environmental sustainability, through air pollution.

Quantitative data supported qualitative data as it also suggested that positive attitudes to air pollution were present amongst the children in this study. This data indicated that the overwhelming majority of children commenced the sustainability science-program with positive attitudes to air pollution and that while these attitudes remained positive, some children became stronger in their views. This relates to the ‘life support systems’ that should be considered in sustainable development, referred to by Leiserowitz et al. (2005), as the children have also demonstrated positive attitudes to caring for this aspect of the environment.

Summary

Elliott and Davis (2009) explain the significance of young children learning about environmental sustainability. Tilbury et al. (2005) reinforce that there is a need for environmental education programs to encourage learning for sustainability. In addition, DSEWPaC (2010b) describe the associated goals and principles that guide the implementation of such education programs. This chapter summarized and synthesised the qualitative and quantitative data from this study, and highlighted the ways in which mostly positive attitudes have been developed to issues of environmental sustainability through the themes: mutual responsibility; biodiversity; habitat conservation; resource use; water pollution; litter and rubbish; interconnections; and air pollution. It explained the interconnected nature of many of the themes and identified the ways children have developed understandings of the environment as a complex set of systems. Further, this chapter discussed the relevance of social constructivism, specifically: the role of social interaction; the ZPD; and scaffolding as they form the basis from which children's learning occurred during participation in the sustainability science-program. The development of attitudes, beliefs and behaviours; attitudinal strength; and the transfer of attitudes from parents to children were also discussed and linked to the findings.

Chapter Six

Conclusion

Introduction

Chapter Six presents a synthesis of information from the study as it draws conclusions from the discussion and makes recommendations for environmental sustainability teaching. It also highlights the implications for pedagogy and future research directions. The conclusions are framed around the research questions that guided this study.

Research Question One

Research question one related to the development of attitudes in 15 Year-2/3 children regarding environmental sustainability, and asked:

What are Year-2/3 children's attitudes to issues of environmental sustainability in a small rural town, as a consequence of a sustainability science-program?

Participation in the social constructivist based environmental sustainability science-program has resulted in young children's development of stronger and more positive attitudes to issues of sustainability. Children also developed a sense of environmental responsibility, positive attitudes to responsible fishing practices, an appreciation of biodiversity and an understanding of the complexities of real life issues. Participation in the sustainability science-program facilitated the development of attitudes initially through developing understandings and beliefs. Further, positive changes in behaviours were a result of this process.

Firstly, it must be noted that children's participation in the sustainability science-program contributed to the development of more positive attitudes to issues of environmental sustainability. This was evident in each of the themes: mutual responsibility, biodiversity, habitat conservation, resource use, water pollution, litter and rubbish, interconnections, as well as air pollution. Larger positive changes were noted particularly in biodiversity and resource use. Consistent with socio-cultural learning theory (Fleer, 2006; Howitt & Blake, 2010; Robbins, 2005; Vygotsky, 1978), it must be mentioned that whilst the sustainability science-program is credited with impacting largely on children's attitudes, evidence also indicated that children were influenced by external factors, including the media, their families and the broader community.

Secondly, as well as Year-2/3 children developing positive attitudes to issues of sustainability, their attitudes also developed in strength through participation in the sustainability science-program. Children reflected passionately and emotively in science journals and responded with empathy to issues of environmental sustainability, for example, animals affected by water pollution. This development of attitude strength is particularly relevant as it could potentially be an indicator of behaviour changes, according to Eaton and Visser (2008).

One important attitude developed as a consequence of the sustainability science-program in Year-2/3 children was a sense of environmental responsibility. This was evident across much of the data and in many of the themes, for example, water pollution and protecting biodiversity. It is suggested that participation in the sustainability science-program resulted in children feeling a sense of ownership specifically for the environment at Clearwater Creek, as well as other areas, and a strong desire to protect them. This moral and environmental responsibility indicates support for the teaching of environmental sustainability with young children and for the study of environmental attitudes in young children. It also indicates that the study did successfully impact positively on children's attitudes to environmental sustainability, as the study originally aimed to do.

A second significant attitude held by the 15 Year-2/3 children in this study was the support for responsible fishing practices. Through much discussion and reflection upon stimulus images, children's own experiences, and discussion of size limits and fishing quotas, children developed passionate and positive attitudes to this aspect of resource use. This indicates the development of positive attitudes to issues of environmental sustainability as a result of participation in the sustainability science-program.

Positive attitudes towards biodiversity were also developed in Year-2/3 children as a consequence of the sustainability science-program. Children recognised the need for diversity of plant and animal species and identified emotionally with wildlife during discussions of environmental issues concerning them, such as, the destruction of habitats. Children understood environmental connections between biodiversity and habitat conservation, and also with pollution. Not only did children suggest ways in which they could help protect biodiversity, but they also demonstrated a strong desire to do so.

This study also confirmed that children developed their understanding of the complexity of environmental sustainability issues by acknowledging different peoples perspectives. Whilst children were largely empathetic to issues of environmental sustainability, evidence indicated their awareness of several real life issues that face society. Participation in the sustainability science-program contributed to children's understanding of these issues and the development of positive attitudes towards them, for example, balancing resource use with the need for employment through fishing responsibly. This was achieved through a process of firstly developing the young children's understandings of issues, which contributed to development of their beliefs and consequently, also their attitudes. Further, this indicates achievement of one of the study's original aims to increase awareness of environmental sustainability issues amongst children.

Given the recognition that attitudes and values can affect behaviours (Bohner & Dickel, 2010; Dowds, 2003; Eaton & Visser, 2008; Rokeach, 1971), it is important to note that changes in the 15 Year-2/3 children's behaviours also occurred as a consequence of participation in the sustainability science-program. This study identified positive behavioural changes within the themes: mutual responsibility, biodiversity and habitat conservation and it is assumed that these behaviours are reflective of children's attitudes as behaviours can be used to communicate values and attitudes (Bardi & Schwartz, 2003). This is a significant result and indicates the achievement of another of the study's aims in equipping children with the skills needed to change their actions to practicing principles of sustainability.

This study was based around the implementation of a sustainability science-program in a small rural town aimed at promoting positive attitudes to issues of environmental sustainability. Through participation in this sustainability science-program, the 15 Year-2/3 children developed stronger and more positive attitudes to issues of environmental sustainability. The significant positive attitudes developed included: a sense of environmental responsibility; responsible fishing practices; biodiversity and the related environmental interconnections; and an understanding of the complexities and real life issues associated with sustainability.

Research Question Two

Research question two identified the implementation of the sustainability science-program as a key part in the development of attitudes to environmental sustainability and asked:

How can a sustainability science-program facilitate young children's engagement with and development of positive attitudes to issues of environmental sustainability?

Evidence confirmed the development of strong, positive attitudes to environmental sustainability through the themes mutual responsibility, biodiversity, habitat conservation, resource use, water pollution, litter and rubbish, environmental interconnections and air pollution. The sustainability science-program facilitated children's engagement with, and development of, positive attitudes to these themes through: cooperative learning strategies; a contextualised program designed to suit the participating children; the use of stimulus images; engaging children in critical reflection through the use of science journals; encouraging a high level of participation and responsibility in children through a child-centred approach; catering for different learning styles; excursions; problem-based instruction; and through providing a supportive environment.

As the sustainability science-program was based on social constructivist learning theory, its pedagogy largely featured strategies that facilitated cooperative learning. Some cooperative learning strategies that were used, included RallyRobin, RallyTable, Pairs Compare, RoundRobin and group swap. Whole class and small group discussion was also used throughout the sustainability science-program and activities were structured in a way that required children's collaboration, such as the group habitat investigation. Evidence suggested that the social interactions that occurred between and amongst children, the teacher, the AIEO and other community members during these activities: enhanced children's learning; facilitated children's engagement with tasks; and contributed to their development of positive attitudes to issues of environmental sustainability.

A key feature of the sustainability science-program is that it was contextualised to suit the young participating children. One way it did this was by providing culturally appropriate links with AaTSI perspectives and education. It also made links to familiar people through the involvement of community members (AaTSI and non-AaTSI). The sustainability science-program was further contextualised through the use of local environments (i.e., at the school and at Clearwater Creek) for excursions, investigations and productive action. Each of these strategies enhanced the grounded nature of the sustainability science-program within the context of the children's Oceanside Clearwater Creek community. This helped children relate to and engage in local issues

of environmental sustainability, such as local pollution, as they had greater personal significance to them.

An important strategy in the sustainability science-program was the use of stimulus images. These included some images of familiar people and places and were used to present issues of environmental sustainability and to prompt discussion and children's thoughts. Evidence indicated that children greatly enjoyed this aspect of the program as it lent itself to a more cooperative approach. It also suggested that this strategy was highly effective in engaging children with issues of environmental sustainability, and after discussion and reflection, was also effective in promoting the development of positive attitudes to these issues.

Another important feature of the sustainability science-program was encouraging critical reflection in children. This was supportive of the learning for sustainability approach and was facilitated through children's social interactions where they listened to each other and shared their ideas and attitudes. The children also engaged in individual reflection upon issues presented in class and learning experiences through the use of their science journals. The children's reflections throughout the program indicated engagement in sustainability issues. These reflections also lead to the development of positive attitudes to issues of environmental sustainability. The use of the science journals was an effective tool for facilitating this process.

Completion of this study has also confirmed the significance of a high level of child participation as was featured in the sustainability science-program. Children's input into the direction of their learning was encouraged and they took a more active role as decision makers in their learning at various points in the sustainability science-program, for example: children planned, conducted and evaluated their investigations into a plant of their choice as a habitat. This child-centred approach fostered children's responsibility for their learning and their sense of ownership as they were involved at higher levels. Children's active participation in the learning process encouraged their engagement with the issues of environmental sustainability and promoted the development of positive attitudes to these issues, such as habitat conservation.

This sustainability science-program further facilitated the engagement of young children with issues of environmental sustainability by implementing a range of strategies that cater for the different learning styles of the children. Throughout the program children participated in many hands-on shared experiences, such as investigating and handling earthworms in a worm farm. These activities engaged

children in the tasks and provided a common experience as a platform for children's exploration of scientific ideas. Similarly, model building and role-play were used in the sustainability science-program and fostered children's engagement by providing them with opportunities to demonstrate their understandings in different ways. Science concepts were also reinforced through strategies that link science with literacy, for example, the use of a word wall and shared reading of an informational text. Technology was further integrated into the sustainability science-program through the children's use of computers and an interactive whiteboard. These strategies assisted young children's learning by fostering the development of science understandings, children's beliefs and consequently positive attitudes to issues of environmental sustainability.

The use of excursions and outdoor learning was another critical aspect of the sustainability science-program. Children were provided with the opportunity to engage first-hand with the environment as some sessions were conducted out of the classroom, but within the school and other sessions involved excursions to the local creek. This meant that children learnt about the environment and for the environment within the setting of a local, natural environment, reflective of the learning for sustainability approach. The use of excursions and the participation in activities in this setting assisted in making the content of the program meaningful and relevant, for example: children learning about tadpoles by collecting them and seeing their habitat first hand. It also provided a familiar setting for which discussion about local issues of environmental sustainability could be linked to, for example, the water pollution at Clearwater Creek. It is this process that is based around excursions that supported children in their learning and in the development of positive attitudes to issues of environmental sustainability.

Evidence from the study confirmed that problem-based instruction was an effective strategy in engaging children with issues of environmental sustainability. This strategy was used when children were involved in a science investigation of the biodiversity supported in plants as habitats found at a local Clearwater Creek. This strategy afforded children the opportunity to participate in a meaningful investigation of habitats that relates directly to the real-life issues surrounding habitat conservation and the need to care for biodiversity. It was also contextualised and made personally relevant by taking place at an area that was familiar with children and that they began to demonstrate an affinity with. Through working collaboratively to conduct a meaningful and authentic investigation into habitat and biodiversity, the 15 Year-2/3

children engaged with the related issues and consequently developed positive attitudes to these issues.

A final way in which the sustainability science-program facilitated the 15 Year-2/3 children's development of positive attitudes to issues of sustainability was through the establishment of a supportive environment. This included consideration being given to children at each of the levels of Maslow's hierarchy of needs, for example making sure children had eaten breakfast and lunch to meet the physiological needs of the children. It also included creating a safe, friendly environment within the class so children felt comfortable to share ideas and listen to each other. This meant the children needed to understand the rules within the class and the need for respecting others' opinions. The creation of this environment was critical because it allowed for meaningful and constructive social interactions amongst children, thereby contributing to their learning and to the development of positive attitudes to issues of sustainability.

The sustainability science-program used in this study employed various pedagogical strategies and approaches, including: cooperative learning strategies; providing a program that was contextualised to suit the children; stimulus images; engaging children in reflection through science journals; a child-centred approach; supporting different learning styles; excursions; problem-based instruction and providing a supportive environment. These strategies and approaches reflected social constructivist learning theory, which underpinned the study and the development of the program, as they promoted constructive social interactions amongst children. Their implementation also facilitated the participating young children's engagement with and development of positive attitudes to issues of environmental sustainability.

Research Question Three

Research question three focused on the promotion of environmental sustainability within the school context, and asked:

How can junior primary teachers promote environmental sustainability in schools?

This study had identified several methods that junior primary teachers could engage in to assist the promotion of environmental sustainability in schools, including: implementing programs supportive of environmental sustainability; communicating children's learning to the school community; engaging in dialogue with staff regarding

environmental sustainability; working collaboratively with staff on relevant programs and initiatives; and involving community members.

The first method that teachers could use to assist in the promotion of environmental sustainability in schools is leading by example. This could mean implementing programs within their class that support the learning for sustainability approach and therefore, environmental sustainability. It could lead to the promotion of environmental sustainability in schools as other staff and children see the learning that occurs as a result of participation in such programs, for example: children participating in excursions to a local environment, or children investigating a worm farm in the school gardens. It is suggested that a potential consequence of junior primary teachers implementing programs supportive of environmental sustainability themselves could be the promotion of environmental sustainability to others.

Once such programs have been implemented another method of promoting environmental sustainability in schools could include communicating children's work with staff, parents and children. Junior primary teachers could achieve this by: displaying children's work in the classroom, school administration office or in the broader community; presenting assembly items related to and supportive of environmental sustainability; inviting children's families to the classroom for children to share their learning; or children becoming 'experts' and teaching children in other classes about environmental sustainability. Each of these strategies could contribute to the celebration of children's work related to environmental sustainability, and therefore also to the promotion of environmental sustainability in schools.

Further, dialogue about environmental sustainability and about learning programs that are supportive of this, should be engaged in by staff. This could include junior primary teachers: reading about and discussing environmental sustainability; investigating examples of successful programs implemented at other schools; sharing experiences, ideas and resources; sharing successes in children's learning; seeking advice from staff; and giving constructive feedback to staff. These discussions could occur within a professional learning community, during staff meetings or collaborative planning time, or more informally as the need arises. It is suggested that these opportunities could promote meaningful dialogue and consequently environmental sustainability.

Following from constructive dialogue is the suggestion of collaboration amongst staff as a method for promoting environmental sustainability. This could include junior

primary teachers' participation in whole school initiatives (e.g., AuSSI, Waterwise or Wastewise). Further, junior primary teachers could encourage other teaching staff to become involved and administrative staff to consider establishing such initiatives. It could also include junior primary teachers: planning and implementing programs together; collaborating with teachers from other schools; or teachers from different learning areas collaborating on the integration of environmental sustainability science-programs to encourage holistic learning in children. It is suggested that junior primary teachers' involvement in such staff collaboration could promote environmental sustainability by supporting teachers to work together on common goals related to environmental sustainability.

The final method that junior primary teachers could use to promote environmental sustainability in schools is the involvement of the broader community. This could involve teachers and children working alongside community groups, for example in revegetation projects. It could also involve inviting 'expert' community members into the classroom who could share their knowledge and experience whilst working with children. Further, local AaTSI community members could be invited to participate with children and share their perspectives related to environmental sustainability. It is suggested that engaging the broader community in children's learning in meaningful ways could consequently assist in the promotion of environmental sustainability in schools.

This study suggests that the promotion of environmental sustainability in schools is something that junior primary teachers can and should engage in. Several methods have been offered to assist junior primary teachers in this process, including: implementing environmental sustainability supportive programs; sharing children's learning; engaging in dialogue with staff; collaborating with staff and involving the broader community.

Limitations

Limitations of the study

One limitation of the study is the small sample size ($n = 15$). This limits the potential for generalisations to be drawn and means that it is not possible to make comparisons between the demographics of the children.

A second limitation to this study relates to the contextualised nature of it. The sustainability science-program that was used was adapted specifically for children from

a specific small rural coastal community. It cannot be reasonably extrapolated that the implementation of this program would have the same results in all other primary schools, or in all other rural communities.

A third limitation to this study is the external influencing variables. Throughout the sustainability science-program key events were noted. It is difficult to measure the impact that these variables had on the children's development of attitudes, for example: on 10th June, 2011 the children celebrated Arbour Day. This involved discussing what Arbour day is, why we could celebrate it and the children reflecting on why trees are important. Another example of an activity that could have influenced the children is: when 'Koorliny' (Pseudonym), an AaTSI dance group, visited the school 30th June, 2011. They performed a dance about going fishing and also discussed the importance of not being greedy when you fish. Whilst the sustainability science-program was designed to promote environmentally sustainable attitudes, it must be noted that there were other possible influencing variables that could not be controlled.

A final limitation of the study related to the involvement by the teacher/researcher. The teacher/researcher role in implementing the sustainability science-program and collecting some qualitative data throughout the program meant that there was the potential for bias. There was further potential for bias given the close relationships between the teacher and children and given the power dynamics in those relationships. Despite measures being taken to reduce the influence of the researcher on the results of the study, potential bias remains an important limitation of the study.

Limitations of the survey

The most significant limitation of the study also relates to the survey, that is, the small sample size ($n = 15$). This could have been a large influencing factor on the low reliability score measured using Cronbach's alpha. It also meant that a dependent paired-samples t-test could not be applied to check for statistically significant differences between pre-program and post-program means.

A second limitation of this scale is that it was conducted in a pencil and paper way. This may not have encouraged optimal levels of engagement as some seven and eight year old children may have been disinterested and 'turned off' by such methods. Although the language used in the scale was kept simple to suit the age of the children, and bright colours and large fonts were used on the scale where possible, other methods may have been more appropriate, such as by implementing other technologies including an interactive whiteboard.

A final limitation to using a Likert scale is that the response options forced children to choose from one of four options. For coding purposes, it is assumed that the difference between each option is equal. In reality, it is unlikely that this is the case for all scale items and with all children. For this reason it cannot be claimed that a Likert scale measures the exact attitudes of children, and this is why it was used to support qualitative data.

Despite the small sample size of the survey, its pencil and paper method, and the potential for unequal numerical differences between response options, the survey contributed to this study by providing quantitative data to support the qualitative data collected. The survey enhanced understandings of the development of children's attitudes to issues of environmental sustainability as shifts in attitudes were noted in particular survey items.

Recommendations

Recommendation one

In light of the international and national recognition of the need to teach environmental sustainability with children, and given its place in the Australian Curriculum, the first recommendation is that junior primary teachers engage in the teaching of environmental sustainability with young children. This study suggests that teachers could use the learning for sustainability approach to provide guidance, or could investigate successful programs and current initiatives operating in exemplar schools. Regardless of the specifics of the program, learning not just about sustainability, but also *for* sustainability is an essential part of children's education.

Recommendation two

Secondly, the researcher recommends that educators implement learning programs for environmental sustainability that engage children. Evidence from this study indicated that children were actively involved in their learning and felt a sense of responsibility for it. This was achieved through the provision of social, meaningful and authentic learning experiences; as well as a high degree of child participation, which contributed to children's learning and to the development of positive attitudes. It is suggested that teachers ensure the implementation of other environmental sustainability science-programs also engage children at high levels.

Recommendation three

A third recommendation for teaching environmental sustainability with young children relates to the inclusion of AaTSI perspectives. Given its significance as a cross-curriculum priority within the Australian Curriculum (ACARA, 2011) and the context of the community in which it was based, this study incorporated AaTSI education, AaTSI perspectives and catered for AaTSI children within the environmental sustainability context. The researcher suggests that other environmental sustainability science-programs should also include these links as they value AaTSI cultures and promote AaTSI children's confidence and self-respect, whilst also developing children's learning for environmental sustainability.

Recommendation four

This study focused on the attitudes of Year-2/3 children in a small rural, coastal community to environmental sustainability. A recommendation to future research is the study of upper primary children's attitudes to environmental sustainability. This would be a worthwhile pursuit and may allow for some interesting comparisons of attitudinal development.

Recommendation five

A fifth recommendation relates to the use of stimulus images in the sustainability science-program. Data analysis confirmed them to be a highly effective tool in encouraging discussion and reflection, and consequently the development of positive attitudes to issues of sustainability. Given this success, and ensuring the provision of a safe, supportive class environment, the researcher recommends the use of stimulus images in other learning areas and contexts.

Recommendation six

A final recommendation sees the need to apply the survey to a much larger sample size given the limitations associated with a sample size of 15 in the present study. This would hopefully lead to the development of a valid and reliable instrument.

Implications

The completion of this study has assisted the teacher/researcher to intensely reflect upon her personal professional teaching practice. It has confirmed the significance of learning for sustainability. Both the children and the teacher thoroughly enjoyed involvement in the sustainability science-program. It was exciting to see the children actively participate in learning for sustainability and the development of such

positive attitudes to sustainability as a result. Although it is often not addressed in schools, the benefits of learning for sustainability make it a valuable inclusion in any future classroom practice.

A second implication relates to children's participation in the learning process. This study has confirmed that children's active participation and sense of ownership and responsibility assisted contributed to their learning. This suggests that teachers accommodating a higher degree of child participation and responsibility in the design of science and many other learning programs would be beneficial to children's learning.

Another important implication of this study relates to the moral development of children. It is interesting that even though the children were only seven and eight years of age, they were able to demonstrate features at the highest level of Maslow's hierarchy of needs. This suggested that if children are involved in a stimulating and engaging learning program moral development may be enhanced at a younger age. Given the significance of moral development as discussed as the development of personal and social capability in the Australian Curriculum (ACARA, 2013), it is therefore imperative that self-actualisation and moral development be considered during the development of learning programs.

Through reflection of the data analysis there is an opportunity to study the children's understandings of, and attitudes towards, real life issues and conflicts regarding environmental sustainability. The teacher/researcher did not anticipate addressing these issues, and did so incidentally. She also did not anticipate the children demonstrating such strong attitudes to these ideas. An implication of this is that these ideas be included in possible future research as it is an area of environmental sustainability that warrants its own study.

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Appendices

Appendix A

Research timeline

Time Frame	Research task completed
August, 2010	Reviewed current literature related to study
October– November, 2010	Prepared survey and stimulus images
April– May, 2011	Sought ethics approval from ECU and DoEWA
May, 2011	Conducted pilot survey with children from local area who are of a similar age but were not involved in the study
May- June, 2011	Analysed data from pilot and made changes to survey items
May, 2011	Sought permission from Principal and AIEO
May, 2011	Sent information and consent forms home with children's for children and children's parents to complete.
June 2011	Consent forms returned
June 2011	AIEO conducted pre-program survey with children
9th June– 2nd September, 2011	Implemented sustainability science-program with children
September, 2011	AIEO conducted post-program survey with children
September, 2011	AIEO interviewed children
October, 2011– July, 2012	Synthesised and analysed data
July 2012- June 2013	Wrote thesis

Appendix B(i)

Information for the Person Conducting the Survey

To complete the 'Understand the question' section:

- Leave the box blank if the student understood the questions and did not need clarification
- Put a dash (-) in the box if the student sought clarification but then understood the question
- Put a circle (o) if the students sought clarification but still did not understand the question

The 'Other comments' section could include, but it not restricted to:

- A word that was misread or misunderstood
- A statement made by the student
- The student guessing an answer without considering the response

How to administer the survey:

- Administrator writes student name on back of questionnaire and record sheet
- Student circles boy/girl and writes their year group
- Read and discuss the response choices at the top of the questionnaire (agree means like and disagree means don't like)
- Give the student a practice question (e.g. "Tell me your response to 'I like to clean my bedroom at home' or 'I enjoy going to the beach'?"")
- Explain to the student that there is no right or wrong answer and they should answer the questions honestly.
- Explain that if the student does not understand a question they should tell you
- Show the student where to mark the response sheet and to tick the box that they choose
- Read each item to the student. If they look puzzled or seem to be struggling explain what the item means. This is how to re-phrase or explain some words if it is needed:

Environment: the places around us like the bush, rivers, beaches and town

Native: plants and animals that are naturally here, they have not been brought in from other places.

Cleared: Where natural bush, plants and trees have been destroyed





- Ensure the student chooses one box to tick. They can cross it out if they make a mistake.
- Ensure the student answers on the correct line, i.e. not two ticks on one line
- Thank the student for their participation and explain that they will complete the questionnaire again at the end of the term.

Appendix B(ii) Survey

Boy/ Girl

Year: _____

Parental occupation: _____

Question	Strongly disagree	Disagree	Agree	Strongly agree
1. I always put my rubbish in the bin.				
2. I never pick up other people's rubbish.				
3. It's important for us to work together to get rid of rubbish around our school.				
4. We should walk or ride a bike and use cars less.				
5. Some animals can be bad for the environment.				
6. We don't need to care for all native animals.				
7. It is important that we care for all native plants.				
8. We don't need many types of plants growing in the bush.				
9. I think we should have lots of different types of animals in the bush.				
10. We don't need to care for the bush around our town.				
11. Its okay to get rid of bush on farms or around town.				
12. Planting trees where they have been cleared is a waste of time.				
13. We should care for our rivers and beaches.				
14. It's great to catch lots and lots of fish.				

Appendix B(iii) Recording Sheet for Survey

Question	Understand the question	Other comments (statements made, etc.)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		

Appendix C

Correspondence

Information Letter for Department of Education and Training School Principal

Ms Cara Payne
Master of Education Research Student
School of Education
Faculty of Education and Arts
Edith Cowan University
270 Joondalup Drive
Joondalup, WA, 6027

Dear Principal

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

I am writing to you on behalf of Edith Cowan University as I am conducting a research project that is looking at sustainability in primary classrooms. This research project is being undertaken as part of the requirements of a Master of Education degree at Edith Cowan University. It is specifically investigating Year-2/3 students' attitudes towards sustainability both before and after the implementation of a sustainability science-program. The program will occur in term two, 2011 and aims to increase awareness of environmental sustainability issues, impact positively on students' attitudes and equip them with the skills needed to change their actions in relation to practising principles of sustainability. I would like to invite XX School to participate in this research project because I would like to research the attitudes to sustainability of the students that I currently teach.

What does participation in the research project involve?

I will be implementing a sustainability science-program in the Year-2/3 classroom. Development of the program has been informed by: the rationale and guiding principles of ARIES; AuSSI; the Australian Curriculum; the Department of Education Western Australia's Curriculum Framework, as well as the Australian Academy of Science resource, Primary Connections. I have developed a questionnaire to be used as a tool to survey the students' attitudes to sustainability before and after participation in the 10-week sustainability science-program. The students will be invited to participate in a semi-structured interview at the end of the program to help identify changes in attitudes and any resulting changes in behaviour. The questionnaire and the interviews will need to be conducted by an Educational Assistant who currently works with the students. This will allow the students to feel more comfortable because they already know the assistant, and will discourage the students from making comments because they think they are the correct things to say. The Educational Assistant will be supported by being given information and a set of instructions that relate to how to conduct the questionnaires and the interviews. Work samples will be collected from the students, including science journal entries made throughout the 10-week program and anecdotal notes will be made and collected for analysis relating to students attitudes to sustainability. Participation in this research project will not require any financial costs to the school as these will be covered by the Edith Cowan University Faculty Grant. However, it will be necessary that other support be given to the project, including negotiated Educational Assistant time, the sending home of information letters and consent forms to students' parents and legal guardians.

In brief, this research project will involve the following activities:

- The Educational Assistant will conduct a questionnaire with participating students to ascertain current attitudes to sustainability.
- Students will participate in a 10-week sustainability science-program.
- The Educational Assistant will again conduct a questionnaire with participating students.
- The Educational Assistant will conduct structured interviews with the students which will be audio recorded for later analysis.
- Data will be collected for analysis, including the questionnaires, interview responses, work samples and anecdotal notes. All data will be held securely in either locked filing cabinets or on password protected computers. Any reports on this research project will ensure the students, staff and school remain anonymous.

To what extent is participation voluntary, and what are the implications of withdrawing that participation?

Participation in this research project is entirely voluntary and consent must be gained from all participants. Letters of information and consent will be sent home to the parents/guardians of students in the Year-2/3 class and their parents. I will further explain the project and the requirements of participating students in class. Students who choose not to participate in the project will be involved in other classroom activities and will not be approached for any data collection for the purposes of this project.

Participants may choose to withdraw from the project at any time and their data will be destroyed, unless explicitly agreed to by you. However, if a participant chooses to withdraw from the project after the project had been published their contribution cannot be removed. Withdrawal from the project will have no effect on the relationships between students and their families, the school and myself.

What will happen to the information collected, and is privacy and confidentiality assured?

All information will be reported in a way that ensures anonymity is maintained. Any identifying information will be deleted or replaced by pseudonyms. This data will be stored securely in a locked filing cabinet or on password protected computer files at my home or on the school site. This data will be kept for a minimum of five years. After this time it will be destroyed through the deletion of computer files, the shredding of paper and the erasing of audiotapes.

The identity of participants and the school will not be disclosed at any time, except in circumstances that require reporting under the Department of Education and Training *Child Protection* policy, or where I am legally required to disclose that information. Participant privacy, and the confidentiality of information disclosed by participants, is assured at all other times. Consistent with Department of Education and Training policy, a summary of the research findings will be made available to the participating school and the Department. It is anticipated that this information will be available by July 2012.

Is this research approved?

The research is being approved by Edith Cowan University Ethics Committee, and meets the policy requirements of the Department of Education and Training as indicated in the attached letter.

Who do I contact if I wish to discuss the project further?

If you have any questions or require any further information about the research project please contact myself on the number provided below. If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer
Edith Cowan University
270 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

How do I indicate my willingness for our school to be involved?

If you have had all questions about the project answered to your satisfaction, and are willing for your School to participate, please complete the **Consent Form** on the following page.

This information letter is for you to keep.

Kind regards,

Cara Payne
Master of Education Research Student
School of Education
Faculty of Education and Arts
Edith Cowan University
Ph: 0437030357
Email: cara.payne@ecu.edu.au

Research project supervisors:

Associate supervisor
Dr Karen Murcia
Associate Professor
Education and Arts
Edith Cowan University
Ph: 9304 5702
Email: k.murcia@ecu.edu.au

Principal supervisor
Dr Geoffrey Lummis
Senior Lecturer
Education and Arts
Edith Cowan University
Ph: 9370 6847
Email: g.lummis@ecu.edu.au

Consent Form for Department of Education and Training School Principals

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

Consent Form

- I have read this document and understand the aims, procedures, and risks of this project, as described within it.
- For any questions I may have had, I have taken up the invitation to ask those questions, and I am satisfied with the answers I received.
- I am aware that if I have any additional questions I may contact the research team.
- I am willing for XX School to become involved in the research project, as described.
- I understand that participation in the project is entirely voluntarily.
- I understand that XX School is free to withdraw its participation at any time, without affecting the relationship with the research team or Edith Cowan University.
- I understand that participation in this research project, as described in the information letter, is entirely voluntary. If I decide to participate and then later change my mind, I am able to withdraw my participation.
- I understand that this research may be published in an academic journal, reported at conferences or used for learning and teaching purposes. Reports of this research will not name any teachers, schools or students.
- I understand that XX School will be provided with a copy of the findings from this research upon its completion.

Name of Principal (printed):

Signature:

Date: / /

Cara Payne
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School of Education
Faculty of Education and Arts
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Ph: 0437030357
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Information Letter for Department of Education and Training School Staff Members

Ms Cara Payne
Master of Education Research Student
School of Education
Faculty of Education and Arts
Edith Cowan University
270 Joondalup Drive
Joondalup, WA, 6027

Dear Staff member

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

I am writing to you on behalf of Edith Cowan University as I am conducting a research project that is looking at sustainability in primary classrooms. This research project is being undertaken as part of the requirements of a Master of Education degree at Edith Cowan University. It is specifically investigating Year-2/3 students' attitudes towards sustainability both before and after the implementation of a sustainability science-program. The program will occur in term two, 2011 and aims to increase awareness of environmental sustainability issues, impact positively on students' attitudes and equip them with the skills needed to change their actions in relation to practising principles of sustainability. I would like to invite XX School to participate in this research project because I would like to research the attitudes to sustainability of the Year-2/3 students that I currently teach.

What does participation in the research project involve?

I will be implementing a sustainability science-program in the Year-2/3 classroom. Development of the program has been informed by: the rationale and guiding principles of ARIES; AuSSI; the Australian Curriculum; the Department of Education Western Australia's Curriculum Framework, as well as the Australian Academy of Science resource, Primary Connections. I have developed a questionnaire to be used as a tool to survey the students' attitudes to sustainability before and after participation in the 10-week sustainability science-program. The students will be invited to participate in a semi-structured interview at the end of the program to help identify changes in attitudes and any resulting changes in behaviour. The questionnaire and the interviews will need to be conducted by an Educational Assistant who currently works with the students. This will allow the students to feel more comfortable because they already know the assistant, and will discourage the students from making comments because they think they are the correct things to say. The Educational Assistant will be supported by being given information and a set of instructions that relate to how to conduct the questionnaires and the interviews. Work samples will be collected from the students, including science journal entries made throughout the 10-week program and anecdotal notes will be made and collected for analysis relating to students attitudes to sustainability. Participation in this research project will not require any financial costs to the school as these will be covered by the Edith Cowan University Faculty Grant. However, it will be necessary that other support be given to the project, including negotiated Educational Assistant time, the sending home of information letters and consent forms to students' parents and legal guardians.

In brief, this research project will involve the following activities:

- The Educational Assistant will conduct a questionnaire with participating students to ascertain current attitudes to sustainability.
- Students will participate in a 10-week sustainability science-program.
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- Data will be collected for analysis, including the questionnaires, interview responses, work samples and anecdotal notes. All data will be held securely in either locked filing cabinets or on password protected computers. Any reports on this research project will ensure the students, staff and school remain anonymous.

To what extent is participation voluntary, and what are the implications of withdrawing that participation?

Participation in this research project is entirely voluntary and consent must be gained from all participants. Letters of information and consent will be sent home to the parents/guardians of students in the Year-2/3 class and their parents. I will further explain the project and the requirements of participating students in class. Students who choose not to participate in the project will be involved in other classroom activities and will not be approached for any data collection for the purposes of this project.

Participants may choose to withdraw from the project at any time and their data will be destroyed, unless explicitly agreed to by you. However, if a participant chooses to withdraw from the project after the project had been published their contribution cannot be removed. Withdrawal from the project will have no effect on the relationships between students and their families, the school and myself.

What will happen to the information collected, and is privacy and confidentiality assured?

All information will be reported in a way that ensures anonymity is maintained. Any identifying information will be deleted or replaced by pseudonyms. This data will be stored securely in a locked filing cabinet or on password protected computer files at my home or on the school site. This data will be kept for a minimum of five years. After this time it will be destroyed through the deletion of computer files, the shredding of paper and the erasing of audiotapes.

The identity of participants and the school will not be disclosed at any time, except in circumstances that require reporting under the Department of Education and Training *Child Protection* policy, or where I am legally required to disclose that information. Participant privacy, and the confidentiality of information disclosed by participants, is assured at all other times. Consistent with Department of Education and Training policy, a summary of the research findings will be made available to the participating school and the Department. It is anticipated that this information will be available by July 2012.

Is this research approved?

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This information letter is for you to keep.

Kind regards,

Cara Payne

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Consent Form for Department of Education and Training School Staff Members

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

Consent Form

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- I am aware that if I have any additional questions I may contact the research team.
- I am willing for XX School to become involved in the research project, as described.
- I understand that participation in the project is entirely voluntarily.
- I understand that XX School is free to withdraw its participation at any time, without affecting the relationship with the research team or Edith Cowan University.
- I understand that participation in this research project, as described in the information letter, is entirely voluntary. If I decide to participate and then later change my mind, I am able to withdraw my participation.
- I understand that this research may be published in an academic journal, reported at conferences or used for learning and teaching purposes. Reports of this research will not name any teachers, schools or students.
- I understand that XX School will be provided with a copy of the findings from this research upon its completion.

Name of Principal (printed):

Signature:

Date: / /

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Principal supervisor
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Senior Lecturer
Education and Arts
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Ph: 9370 6847
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Information Letter for Parents – Student Participation

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

Dear Parent

I am currently studying towards a Masters in Education by research at Edith Cowan University. I am working on research that is investigating younger students' attitudes towards sustainability. My project also aims to increase awareness of environmental sustainability issues, positively change students' attitudes and encourage them to change their behaviours relating to sustainability. The project is fully funded by Edith Cowan University and supports collaboration with the W.A. Department of Education and Training (DET).

I would like to invite your child/children to take part in this research project because I currently teach your child/children and I am specifically studying the attitudes of Year-2/3 students in our rural community.

What does participation in the research project involve?

Your child/children will be taking part in a 10-week sustainability science-program in term two, 2011. I have developed this program based on guidelines from the Department of Education and Training, as well as current research initiatives in science education. Your child/children will complete a questionnaire at the beginning of the program that will ascertain their current attitudes to sustainability. After participation in the sustainability science-program they will again complete another questionnaire. This second questionnaire will indicate if there have been any changes in their attitudes. Your child/children will complete a short, semi-structured interview that will be audio recorded. I will then analyse the responses to further identify changes in attitudes or in behaviours. Work samples will be collected and any observations made by myself throughout the term will also be analysed. Reports on this research project will not identify: students; teachers; the school; our town, or district.

Does my child have to take part?

Your child does not have to take part. A decision for your child/children to participate must be made freely and is voluntary. If your child does not participate in the project they will have no data collected from them for the purposes of this research project and will be involved in regular classroom activities. I encourage you to talk about the project with your child/children so that they are aware of what is involved reinforcing that their participation is voluntary. I will further explain the project and the participation requirements in class.

What if either of us was to change our mind?

If you and your child/children agree to participate, you will need to complete the consent form by Monday 18th April 2011. All participants are free to change their decision and cease involvement in the research project at anytime. If this occurs your child's/children's data relating to this project will be destroyed, unless you agree otherwise. Note, if you choose to withdraw from the project after the project had been published, your child's/children's non-identifiable data cannot be removed. Withdrawal from the project will have no affect on the relationships between your child/children, the school and myself.

What will happen to the information collected, and is privacy and confidentiality assured?

All information will be reported in a way that ensures anonymity is maintained. Any identifying information will be deleted or replaced by pseudonyms. This data will be stored securely in a locked filing cabinet or on password protected computer files at my home or on the school site. This data will be kept for a minimum of five years. After this time it will be destroyed through the deletion of computer files, the shredding of paper and the erasing of audio tapes.

The identity of participants and the school will not be disclosed at any time, except in circumstances that require reporting under the Department of Education and Training *Child Protection* policy, or where I am legally required to disclose that information. Participant privacy, and the confidentiality of information disclosed by participants, is assured at all other times. Consistent with Department of Education and Training policy, a summary of the research findings will be made available to the participating school and the Department. It is anticipated that this information will be available by July 2012.

Is this research approved?

The research is being approved by Edith Cowan University Ethics Committee, and has met the policy requirements of the Department of Education and Training.

Who do I contact if I wish to discuss the project further?

If you have any questions or require any further information about the research project please contact myself on the number provided below. If you have any concerns or complaints about the research project and wish to talk to an independent person, you may contact:

Research Ethics Officer
Edith Cowan University
270 Joondalup Drive
JOONDALUP WA 6027
Phone: (08) 6304 2170
Email: research.ethics@ecu.edu.au

How does my child become involved?

Please ensure that you:

- discuss what it means to take part in the project with your child before you both make a decision; and
- take up my invitation to ask any questions you may have about the project.

Once all questions have been answered to your satisfaction, and you and your child are both willing for him/her to become involved, please complete the **Consent Form** on the following page.
This information letter is for you to keep.

Kind regards

Cara Payne

Cara Payne
Master of Education Research Student
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Consent Form for Parents – Child Participation

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

Consent Form

- I have read this document, or have had this document explained to me in a language I understand. I understand the aims, procedures, and any identified risks of this project, as described within it.
- I have taken up the invitation to ask any questions I may have had and am satisfied with the answers I received.
- I am aware that if I have any additional questions I may contact the research team.
- I understand that participation in the project is entirely voluntarily.
- I am willing for my child to become involved in the project, as described in the information letter.
- I have discussed with my child what it means to participate in this project. He/she has explicitly indicated a willingness to take part, as indicated by completion of this consent form.
- I understand that both my child and I are free to withdraw that participation at any time without affecting the family's relationship with my child's teacher or my child's school.
- I understand that my child's participation in this research project is entirely voluntary. If I decide my child will participate and then later change my mind, I am able to withdraw their participation at any time.
- I understand that this research may be published in an academic journal, reported at conferences or used for learning and teaching purposes. Reports of this research will not name any teachers, schools or students.
- I understand that I can request a copy of a summary of the findings from my child's school after the research has been completed.

Name of Child (printed):

Name of Parent (printed):

Signature of Parent:

Date: / /

Information Sheet for Young Children

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

Hi

My name is Miss Cara Payne and I have a project that you might like to help me with.

The project is about trying to find out what young children think about environmental issues. Would you like to help me for about 10 weeks next term, by filling out two questionnaires, answering some questions in an interview and letting me look at some of your work?

It is ok to stop helping with the project any time if you want to. If you just let me know I will give you a different science activity when we are in the classroom.

I won't tell anyone what you say while you help me with the project, unless I need to because I hear that you have been hurt by someone lately.

Your mum, dad or the person who looks after you, has talked with you about helping with the project. Now you can choose if you would like to help me.

If you do want to help with the project, please *print your name and draw a circle around the word YES, on the consent form that follows.*

If you don't want to help with the project, just circle no.

This letter is for you to keep.

Kind regards

Cara Payne

Master of Education Research Student

School of Education

Faculty of Education and Arts

Edith Cowan University

Ph: 0437030357

Email: cara.payne@ecu.edu.au

Research project supervisors:

Associate supervisor

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Senior Lecturer

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Consent Form for Young Children

Education for Sustainability: An Ethnographic study of 15 Year-2/3 Rural Western Australian children's attitudes on sustainability.

- I know that I don't have to help with the project, but I would like to.
- I know that I can stop whenever I want.
- I know that I will do a questionnaire and be interviewed.
- I know that I will be doing my normal science lessons and some pieces of my work may be looked at.
- I know that I need to write my name and circle yes before I can help with the project.

YES

I would like to help with the
project

NO

Not this time

Name of child: _____

Today's Date: / /



Ms Cara Payne

Dear Ms Payne

Thank you for your completed application received 19 May 2011 to conduct research on Department of Education sites.

The focus and outcomes of your research project, *Learning Sustainability Science: A case study of young Western Australian Regional school children's attitudes to sustainability*, are of interest to the Department. I give permission for you to approach site managers to invite their participation in the project as outlined in your application. It is a condition of approval, however, that upon conclusion the results of this study are forwarded to the Department at the email address below.

Consistent with Department policy, participation in your research project will be the decision of the schools invited to participate, individual staff members, the children in those schools and their parents. A copy of this letter must be provided to site managers when requesting their participation in the research. Researchers are required to sign a confidential declaration and provide a current Working with Children Check upon arrival at the Department of Education site.

Responsibility for quality control of ethics and methodology of the proposed research resides with the institution supervising the research. The Department notes a copy of a letter confirming that you have received ethical approval of your research protocol from the Edith Cowan University.

Any proposed changes to the research project will need to be submitted for Department approval prior to implementation.

Please contact Ms Allison McLaren, R/Evaluation Officer, on (08) 9264 5512 or researchandpolicy@det.wa.edu.au if you have further enquiries.

Very best wishes for the successful completion of your project.

Yours sincerely

ALAN DODSON
DIRECTOR
EVALUATION AND ACCOUNTABILITY

25 May 2011

151 Royal Street, East Perth Western Australia 6004

Note: The study originally planned to conduct a 'case study' and was titled '*Learning Sustainability Science: A case study of young Western Australian Regional school children's attitudes to sustainability*'. This changed after the above correspondence to an ethnographic study, and was consequently titled '*Education for Sustainability: An ethnographic study of 15 Year-2/3 rural Western Australian children's attitudes on sustainability*'.

Appendix D

Sustainability science-program

Science for Sustainability: A Sustainability science-program

Time

10 weeks

Approximately 2-3 hours per week

Links to the Australian Curriculum

Cross-curriculum priorities:

- Sustainability
- Aboriginal and Torres Strait Islander histories and cultures

Links to the curriculum (Department of Education Western Australia, n.d.).

Curriculum Framework

Values focused on include:

- Environmental responsibility
- Social and civic responsibility

K-10 Syllabus
Science:

		Year 2	
Life and Living	Interdependence of living things	<p>The environment surrounds us and contains living and non-living things</p> <ul style="list-style-type: none"> the environment surrounds us and contains things that are living similarities and differences exist between different living things such as plants <p>Living things have basic needs and these must be met for survival</p> <ul style="list-style-type: none"> in order to survive, living things need food, warmth, shelter, air and water the needs of living things may vary depending on the type of living thing, age, size and food preference people rely on certain things and other people in order to survive animals and plants live in habitats in our local environment <p>Ways to observe and care for animals and plants</p> <ul style="list-style-type: none"> animals and plants can be observed using the appropriate senses ways people care for animals and plants at home 	<p>Living things can live in different environments</p> <ul style="list-style-type: none"> different environments contain different living things an environment can change over time <p>Living things need other living things to survive</p> <ul style="list-style-type: none"> living things depend on other living things to survive a habitat may provide shelter and food for potential mates People need to care for the things they live in people need to care for the things they live in in the community, people work together to care for the things they live in
	Structure and Function	<p>Living things have structural features that help them live</p> <ul style="list-style-type: none"> living things have structures which enable them to live living things have behaviours that enable them to live different parts of living things are used for different life processes <p>Familiar living things can be grouped according to structures and features</p> <ul style="list-style-type: none"> living things are made up of parts which can be used for sorting or grouping <p>Living things survive because of essential life processes that non-living things do not have</p> <ul style="list-style-type: none"> animals must breathe and eat to survive, plants need sunlight and water to grow, while non-living things like rocks do not carry out these life processes 	<p>Living things have structural features that help them live in their environment</p> <ul style="list-style-type: none"> an adaptation is any structural feature that helps an animal survive in its environment living things have different structural features that help them live in their environment <p>Living things can be grouped according to their structural features</p> <ul style="list-style-type: none"> living things can be grouped according to their structural features <p>Living things have features that help them survive</p> <ul style="list-style-type: none"> living things have features that help them survive, such as the absorption of nutrients certain features are not found in non-living things

		Year 2	
Investigating	Planning: Preparing for an investigation	<ul style="list-style-type: none"> to identify class's current understandings of a topic to identify prior knowledge about a topic for investigation to ask a range of questions to make simple predictions about what may occur in an investigation simple steps for planning and discussing what needs to be done and what to use to identify possible sources of information 	<ul style="list-style-type: none"> to individually reflect on to identify and cluster id to pose focus questions t happened and to develop to make simple predictio knowledge/experiences simple steps for planning controlling variables and comparisons fair to utilise teacher-directe to gather information or to suggest how ICT can
	Conducting: Collect and record information relevant to the investigation	<ul style="list-style-type: none"> to observe, describe and measure using non-standard units during hands-on experiences use a variety of ways to record findings in simple terms to record and label information 	<ul style="list-style-type: none"> to observe, describe and experiences use appropriate equipme the need for careful obse utilise a variety of ways to identify information th to record and present sel
	Processing Data: Processing and translating information to find patterns and draw conclusions	<ul style="list-style-type: none"> to sort by translating information into different forms classify objects or events based on their common characteristics to tabulate information and use tables to construct simple graphs to interpret data presented in graphs to use teacher-directed formats for recording informing others about what has been observed and suggest reasonable explanations to communicate findings in a variety of forms 	<ul style="list-style-type: none"> strategies for organising to sort and arrange event to construct graphs to re to extract and interpret d to describe events, featur suggest reasonable expla to use teacher-directed f to inform others about w explanations, to represen and tasks using ICT to communicate findings to respect the views of o
	Evaluating: Reflecting on an investigation, evaluating the process and	<ul style="list-style-type: none"> to comment on results of an investigation and offer simple explanations to explain any difficulties and successes experienced to reflect on personal learning 	<ul style="list-style-type: none"> To comment on results c to explain any difficultie ways to reflect on person

Australian Curriculum

K-3: Focus on awareness of self and the local world

Science understanding

- Comparing, sorting and classifying objects and materials
- Living and non-living things
- Needs, structures and growth of organisms
- Changes on earth and the effects on living things

Science inquiry skills

- Explore, be curious and wonder
- Ask questions and begin to investigate
- Describe what has happened
- Make and share observations
- Use evidence to support ideas

Science as a human endeavour

- Recognise aspects of science in everyday life
- Identify work associated with science in the community
- Care for the environment.

Make use of the following strategies:

- Exploration: *Investigation* of objects and things around them.
- Observation: Using the senses to *observe and gather information* about the environment, looking for what is the same and what is different.
- Order: Observing similarities and differences and comparing, *sorting and classifying* to create an order that is more meaningful.
- Change: There are *many changes* that occur in the world. Changes occur in materials, the position of objects, and the growth cycles of plants and animals. Some of these changes are reversible, but many are not. These changes vary in their rate and their scale.
- Questioning and speculating: Questions and ideas about the world become increasingly *purposeful*; explanatory *ideas are developed and tested* through further exploration.

General capabilities addressed in program (Australian Curriculum Assessment and Reporting Authority, 2013):

- Critical and creative thinking
- Personal and social capability
- Ethical understanding
- Intercultural understanding

This program addresses:

Acting Responsibly

Children make decisions that include ethical consideration of the impact of the processes and likely products of science on people and the environment.

Communicating Scientifically

Children communicate scientific understandings to different audiences for a range of purposes.

Science in Society

Children understand that science is a human activity which influences all people as part of their everyday lives.

Science in Daily Life

Children apply and evaluate scientific knowledge, skills and understandings across a range of contexts.

Other Science Outcomes:

Earth and Beyond

Sustainability of life and wise resource use:

- Natural resources used at home or in school
- Wise resource use at home/school and in the community

Earth forces and materials:

- Unique features of the local environment

Links to other learning areas:

Mathematics

Chance and data (graphs)

Measurement (use of standard and non standard units)

English

Reading (Use of a word wall, science journals and guided reading)

Writing (writing observations; writing labels; and reflecting on science understandings, attitudes and behaviours in science journals)

Listening and Speaking (during group activities and when sharing and listening to ideas)

Society and Environment

Place and Space

ICP

Resources

Natural and Social Systems

Active citizenship

ICT

Use of interactive whiteboard to demonstrate the graph making in investigation

Use of digital cameras

Children use computers to design and publish a record sheet for investigation

Show related You-tube videos

Learning Outcomes

Children will work towards achieving the following outcomes:

- Sort living and non-living things
- Investigate the needs, structures and growth of organisms
- Define the term biodiversity
- Identify a local environmental issue related to biodiversity
- Work collaboratively to prepare and plan an investigation that addresses the problem
- Conduct the investigation
- Communicate the investigation to others
- Reflect on the investigation and consider possible future developments

Sustainability science-program outline

Week	5E's Model	Skills, Understandings and Activities
Before sustainability science-program		Survey regarding children's current attitudes towards sustainability
1	Engage	<p><i>Inquiry skills: Explore, be curious and wonder</i> <i>Science understandings: Living and non-living things</i> <i>Science as human endeavour:</i> <i>Recognise aspects of science in everyday life</i> <i>Care for the environment</i></p> <p>Before Session-1: Start a word wall on large sheet of card. Display at front of the class, explain its purpose and st words can be added throughout term.</p> <p>Session-1: School walk</p> <ul style="list-style-type: none">• Use RallyRobin (Kagan, 2009, p. 6.33) structure to discuss what makes things living or not. Discuss acting respo• observations and collecting specimens.• Take children on a walk around the school. Collect and record as many living things, including insects, as possibl• of Science, 2008, Lesson 1). Use digital cameras.• <u>Science journals</u>: reflect on experiences, what acting responsibly is and share reflections.
2	Explore	<p><i>Inquiry skill: Comparing, sorting and classifying objects and materials</i> <i>Make and share observations</i> <i>Use evidence to support ideas</i> <i>Science Understandings: Comparing, sorting and classifying objects and materials</i></p> <p>Session-2: Classify</p> <ul style="list-style-type: none">• Discuss how things can be classified. Model this with the class on the whiteboard (photos from school yard walk• onto the whiteboard so they can be moved). Look for similarities and differences to sort and order the specimens• Children use own language to share and describe their ideas. They can use the specimens as evidence to support t• Use RallyTable (Kagan, 2009, p. 6.34) so children take turns to classify items.• Pairs Compare (Kagan, 2009, p. 6.31) and explain their classification to another pair.• <u>Science journals</u>: children reflect on how they sorted the specimens. Draw simple diagrams to support ideas and s <p><i>Inquiry skills: Make and share observations</i> <i>Science understandings: Interdependence of living things</i> <i>Changes on earth and the effects on living things</i></p>

Week	5E's Model	Skills, Understandings and Activities
		<p><i>Science understandings: Needs, structures and growth of organisms</i> <i>AaTSI perspectives in Science</i> <i>Life cycles of organisms</i></p> <p>Session-4: Worm Farm</p> <ul style="list-style-type: none"> Carefully observe worms in a worm farm. Discuss and record information about its features, habitat, behaviour and life cycle. Read a big book as a class “ Earth worms” (Smith, 2002) <u>Science Journals</u>: Discuss, draw and label the earth worm in. <p>Session-5: Witchetty Grub</p> <ul style="list-style-type: none"> Read poem “Honey Ant” (Mc Dougall, 2000, p. 28). Children act this out as they read it in groups. Show photos of witchetty grubs and honey ants. Discuss how they are collected; their diet, habitat and structure; AaTSI cultures. AIEO to assist with discussion. Watch You Tube Videos of collecting witchetty grubs (McLeay, 2006) and honey ants (BBC Worldwide, 2008) (Adapted from Australian Academy of Science, 2008, Lesson 4) Summary: Reflect on lesson. AIEO suggested AaTSI words that she knows related to bush tucker. These are added to the class list. (Adapted from Australian Academy of Science, 2008, Lesson 5) <p>Session-6: Witchetty Grub cont.</p> <ul style="list-style-type: none"> Children make a clay witchetty grub for display around the classroom. Pay attention to the structures of the grub. (Adapted from Australian Academy of Science, 2008, Lesson 2) Draw and label a diagram of the witchetty grub. Share their model and their knowledge with children from the Year-1 class. <u>Science journals</u>: discuss and reflect on littering and working together stimulus images (1-4)
4		<p>Session-7: Excursion to Clearwater Creek: Tadpoles</p> <ul style="list-style-type: none"> Children carefully observe the habitat of tadpoles and some that have been caught. Discuss their behaviour and life cycle. Show children a model of the life cycle of tadpoles. Record information regarding their diet, habitat, and life cycle. ‘Expert’ from local Oceanside Environmental Group to assist
5		<ul style="list-style-type: none"> <u>Science journals</u>: discuss and reflect on water and air pollution stimulus images (5-8). Relate to tadpole experience. <p><i>Inquiry skills: Identify possible information sources</i> <i>Children find information from a range of sources</i></p>

Week	5E's Model	Skills, Understandings and Activities
		<ul style="list-style-type: none"> <u>Science journals</u>: discuss and reflect on animal biodiversity stimulus images (9-13)
6	Elaborate	<p><i>Inquiry skills: Prepare for an investigation</i> <i>Explore, be curious and wonder</i> <i>Ask question and begin to investigate</i> <i>Plan and conduct a simple investigation</i></p>
7		<p>Session-10: Plan investigation</p> <ul style="list-style-type: none"> Discuss habitats and elicit child knowledge/ideas of this. With teacher guidance children plan for a group investigation of plants as habitats. Discuss plants as habitats and (2009, p. 6.33) to list the plants at Clearwater that could be investigated (e.g. dead tree, river gum, reeds, acacia, e Put children in teams, discuss types of questions that could be investigated as a class and teams choose questions Teams fill out teacher made investigation planner, including predicting the types of animals that might be found. Design on the computer a recording sheet for the investigation observations and results. (Adapted from Australian Academy of Science, 2008, Lesson 6) <u>Science journals</u>: discuss and reflect on fishing responsibly stimulus images (23-24)
8		<p><i>Inquiry skills: Collect and record information</i> <i>Science understandings: Interdependence of living things</i></p> <p>Session-11: Conduct investigation at Clearwater Creek</p> <ul style="list-style-type: none"> Excursion to Clearwater. Children work collaboratively in investigation teams to observe and record information living in and around different plants at Clearwater. Use child made recording sheets. Group swap to share findings. <u>Science journals</u>: discuss and reflect on plant biodiversity stimulus images (14-16) <p><i>Inquiry skills: Process and translate information</i> <i>Find patterns and draw conclusions</i> <i>Describe what happened</i> <i>Use evidence to support ideas</i> <i>Science understandings: Interdependence of living things</i></p> <p>Session-12: Process data</p>
	Evaluate	

Week	5E's Model	Skills, Understandings and Activities
9		<p><i>Inquiry skills: Reflect on investigation</i> <i>Describe what happened</i> <i>Evaluate process</i> <i>Generate further ideas</i> <i>Use evidence to support ideas</i></p> <p><i>Science understandings: Interdependence of living things</i> <i>Science as human endeavour:</i> <i>Care for the environment</i></p> <p>Session-13: Evaluate investigation</p> <ul style="list-style-type: none"> As a class give simple explanations for results Children help each other in their groups to complete teacher made evaluation sheet; including reflect on difficulties in learning and on where to go from here. Discuss as a class the ways children could help support biodiversity at Clearwater Creek, e.g. plant trees and shrubs and native vegetation.
10		<p><i>Science understandings:</i> <i>Changes on earth and the effects on living things</i> <i>Acting responsibly</i> <i>Science as a human endeavour:</i> <i>Identify work associated with science in the community</i></p> <p>Session-14: Tree planting</p> <ul style="list-style-type: none"> Children work with the Oceanside Environmental Group to plant native tree and shrub species around the Clearwater Creek <u>Science journals</u>: children discuss science experiences this term and write about what they have learnt.
After sustainability science-program		<p>Survey regarding children's attitudes towards sustainability.</p> <p>Interview children</p>

Appendix E

Teacher Made Resources

School walk observations

Date: _____

Living and non-living things at Clearwater Creek

Date: _____

Living things	Non-living things

Earthworms

Date: _____

Features

Habitat

Diet

Behaviour

Tadpoles at Clearwater Creek

Name: _____ Date: _____

Habitat

Diet

Behaviour

Life cycle

Diagram

Science investigation plan

Date: _____

Names in group: _____

Plant habitat: _____

Question/s to investigate:

Predict which animals might be found in and around
your chosen plant:

Clearwater Investigation

Date: _____

Habitat: _____

Put the information you collected at Clearwater into a neat table.

Animal/ plant	Number

Science Investigation: Evaluation

Date: _____

- 1) Which species did you find living in and around your habitat?

- 2) Why do you think this is?

- 3) How do you think one of the species used the habitat?

- 4) List 3 things that you found difficult in this investigation:

5) List 3 things that you learnt from your investigation?

6) What did you enjoy about this investigation?

7) What would you like to investigate from here?

8) List some ways that you could help care for the biodiversity at Clearwater Creek.

Appendix F





Pilot survey





Questionnaire

Boy/ Girl

Year: _____

Parental occupation: _____

Question	Strongly disagree	Disagree	Agree	Strongly agree
				
1. I always put my rubbish in the bin.				
2. I never pick up other people's rubbish.				
3. It's important for us to work together to reduce litter around our school.				
4. Pouring things down the sink or a drain is a good way to get rid of them.				
5. We should walk or ride a bike and use cars less.				
6. Some animals in the environment can be pests.				
7. All plants are good for the environment.				
8. We don't need to care for all native animals.				
9. It is important that we care for all native plants.				
10. We don't need many types of plants growing in the bush.				

	Strongly disagree	Disagree	Agree	Strongly agree
				
11. I think we should have lots of different types of animals in the bush.				
12. It is my job to help look after the environment.				
13. We don't need to care for the bush around our town.				
14. It's okay to clear bush on farms or around town.				
15. Planting trees where they have been cleared is a waste of time.				
16. We should care for our rivers and beaches.				
17. We shouldn't limit the number of fish we catch.				
18. It's okay to catch fish if they are too small or young.				

Appendix G

Interview

The interviews will be recorded and conducted by the AIEO.

Interview questions to guide discussion

1. Can you tell me what biodiversity is?
2. Can you think of anything you have done to help look after the biodiversity at Clearwater Creek?
3. What could we do in other places to look after the biodiversity?

Appendix H

Stimulus Images

(These images were printed individually, on A4 paper and in colour when used with the children. Colour has been removed from the images showing students from this school to ensure anonymity.)

Stimulus Image-1



Stimulus Image-2



Stimulus Image-3



Stimulus Image-4



Stimulus Image-5



Stimulus Image-6



Stimulus Image-7



Stimulus Image-8



Stimulus Image-9



Stimulus Image-10



Stimulus Image-11



Stimulus Image-12



Stimulus Image-13



Stimulus Image-14



Stimulus Image-15



Stimulus Image-16



Stimulus Image-17



Stimulus Image-18



Stimulus Image-19



Stimulus Image-20



Stimulus Image-21



Stimulus Image-22



Stimulus Image-23



Stimulus Image-24



Appendix I

Diary of Events

2010 (Year-3's only)	<p>Clearwater Creek Revegetation Project</p> <p>Children were actively involved with Clearwater Creek Environmental Group (CCEG) and shire in revegetating area. Identified a problem, researched it, came up with a plan and implemented plan. Also got a plaque made, made a path, fundraised (sausage sizzle and sold Christmas cards).</p>
05/04/11	<p>Submission of Environmental Community Grant</p> <p>I explained to the children that CCEG, the shire and I had applied for a grant for an 'outdoor classroom' at Clearwater.</p>
10/06/11	<p>Arbour Day</p> <p>Discussed what it is, how we celebrate it (save, plant, play with, etc.) and why trees are important (shelter, homes, erosion, oxygen and carbon dioxide, part of environment, special). Children wrote about their ideas.</p>
30/06/11	<p>Tree planting at Clearwater Creek with CCEG</p>
30/06/11	<p>'Koorliny' AaTSI Dance Group (Pseudonym)</p> <p>Performed a dance for whole school that was about going fishing and addressed the fishing responsibly theme. They said that sharing fish was good and not to be greedy. They also danced/acted out and talked about throwing back the small fish and only keeping the big fish.</p>
Around June	<p>Carbon Tax</p> <p>This issue was in the media (news, TV, radio, etc.). Parents may have discussed this with children, or children overheard it.</p>
07/07/11	<p>Design a grub to eat</p> <p>Children did a timed rally robin to discuss ideas. Used the teacher planning sheet to 'design' the edible grub and consider which ingredients to use. Cooked these on 08/08/11 (the last day of term).</p>
02/08/11	<p>Read text "Fisherman and the Theefyspray"</p> <p>Strong sustainability and fishing responsibly themes. Images appeal emotionally to children. Children discussed how it didn't matter that the fisherman left without any fish. They empathised with the mother. "She felt sad".</p>

- 04/08/11 Birds Australia Visit
Guests talked to all children at school and showed images on interactive whiteboard. Discussed the types of birds found in this area and how to identify them.
- 05/08/11 Birds Australia bush walk
Children walked with guests and CCEG members around Clearwater Creek. They each used binoculars to try and spot and identify birds at the creek.
- 23/08/11 Assembly Item
The class wrote a song called 'Biodiversity' for performance as an assembly item This is also being practiced for the end of year concert item. It explains what biodiversity is (in the chorus) and each verse describes different plant and animal species.
- October 2011 Application for community grant successful
Explained to the children that CCEG, the shire and the school will be working together to put up an 'outdoor classroom' with information etc at Clearwater Creek. Children were very excited about this.

Appendix J Results

Table 18a: Pre-program Cronbach's alpha with items deleted

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
I always put my rubbish in the bin	41.1333	16.267	-.085	.304
I never pick up other people's rubbish	42.2000	12.314	.296	.156
It's important for us to work together to get rid of rubbish around the school	41.1333	16.267	-.085	.304
We should walk or ride a bike and use cars less	41.6667	15.667	-.046	.315
Some animals can be bad for the environment	42.4000	18.829	-.412	.460
We don't need to care for native animals	41.6667	11.952	.379	.116
It is important that we care for all native plants	41.0000	16.429	-.128	.307
We don't need many types of plants growing in the bush	41.6000	12.400	.435	.117
I think we should have lots of different types of animals in the bush	41.0667	16.924	-.212	.360
We don't need to care for the bush around our town	41.6667	13.381	.159	.231
It's okay to get rid of bush on farms or around town	41.6667	13.524	.318	.182
Planting trees where they have been cleared is a waste of time	41.8000	10.029	.623	-.052 ^a
We should care for our rivers and beaches	41.0667	15.067	.252	.240
It's great to catch lots and lots of fish	42.3333	16.952	-.224	.410

Table 18b: Post-program Cronbach's alpha with items deleted

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
I always put my rubbish in the bin	43.6667	19.238	.161	.570
I never pick up other people's rubbish	44.2000	13.886	.624	.447
It's important for us to work together to get rid of rubbish around the school	43.4667	19.838	.054	.581
We should walk or ride a bike and use cars less	44.1333	17.124	.224	.562
Some animals can be bad for the environment	45.3333	19.810	-.073	.629
We don't need to care for native animals	43.5333	17.124	.370	.531
It is important that we care for all native plants	43.3333	19.238	.399	.559
We don't need many types of plants growing in the bush	43.8000	20.029	-.080	.622
I think we should have lots of different types of animals in the bush	43.4000	19.400	.221	.567
We don't need to care for the bush around our town	43.5333	15.838	.587	.486
It's okay to get rid of bush on farms or around town	44.5333	15.695	.379	.520
Planting trees where they have been cleared is a waste of time	44.3333	16.238	.349	.529
We should care for our rivers and beaches	43.4000	19.686	.128	.574
It's great to catch lots and lots of fish	43.8000	18.743	.079	.590