Green and not heard:
The relationship between sustainably designed primary schools

and

children’s environmental attitudes and behaviours

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30th Annual International Conference of Passive Low Energy Architecture (PLEA), Ahmedabad, India, 2014- Won the **Best Paper Award**

3- Designing School Buildings with Change: Impacts on Children’s Environmental Attitude”
Izadpanahi, Parisa; Elkadi, Hisham
45th Annual Conference of the Environmental Design Research Association (EDRA), New Orleans, Louisiana, USA, 2014
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¹ The full paper and the abstract for these publications can be found in Appendix A.
4- "Impact of Sustainable School Design on Primary School Children's Environmental Attitude and Behavior"
Izadpanahi, Parisa; Elkadi, Hisham
42th Annual Conference of North American association for Environmental Education (NAAEE), Baltimore, Maryland, USA, 2013
http://convention2.allacademic.com/one/naaee/naaee13/index.php?click_key=1&cmd=Multi+Search+Load+Session&session_id=203508&PHPSESSID=sbf3m9mkabs0qbiebf969vjjm4

Other Publications:

5- "Creative Architectural Design with Children: A Collaborative Design Project Informed by Rhodes’s Theory”
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International Journal of Design Creativity and Innovation, 2015
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6- “Kids in design: Designing creative schools with children”
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7- “Kids in Design: a Case Study of Roslyn Road Primary School in Geelong Region, Children’s Engagement in Designing Schools as a Vital Part of a Healthy City”
8- “Iranian Vernacular Ice-Houses: Notable Example of a Traditional Architecture in Proportion to its Climatic Conditions”
IzadPanahi, P; Amirkhani, A; Seddigh, M; Eskandari, M; YazdanPanah, P
International Journal of Academic Research, 2010
http://web.b.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=edde6f57-1d5b-4c50-a385-bf2d4d22c657%40sessionmgr113&vid=5&hid=106

9- ”Motivational factors on citizens’ engagement in mobile sensing: Insights from a survey with non-participants”
Leao, Simone; Izadpanahi, Parisa
Journal of Urban Technology (Under review)
Statement of Authorship

This is to certify that this thesis compromises my original work, except where due acknowledgement is made, and is less than 100,000 words in length. This thesis has not been submitted for a higher degree at any other institution.

___________________
Parisa Izadpanahi
July 2015
Abstract

Associations between the designed environment, attitudes and patterns of behaviours have long been the subjects of research. There is a growing consensus that design plays an important role in alleviating undesirable behaviour, encouraging favourable attitude, and improving educational attainment. While the interrelationships between school design and children’s achievements are well established in the literature, there is less research evidencing impact on children’s environmental awareness of schools designed for sustainability. This study will address the possibility largely overlooked in research to date that the physical learning spaces of sustainably designed schools can act as pedagogic tools that influence children’s environmental attitudes and behaviours.

In order to investigate this question, 624 children, aged 10-12 years old, completed a survey adapted from the NEP (New Ecological Paradigm), and GEB (General Ecological Behaviour) scales for children; the two most widely used scales for measuring environmental attitudes and behaviours. Attempting to control for the influence of teachers and parents, NEP and GEB were also employed to assess parents’ and teachers’ environmental attitudes and behaviours. This sample, from seven primary schools in Victoria (Australia), included four conventional schools and three assessed as being designed for sustainability. Data collected from grades 4, 5, and 6 children were analysed, with results indicating that children’s environmental attitudes consisted of three factors: Children’s Environmental Attitudes towards Human Intervention, Children’s Environmental Attitudes via ESD at School, and Children’s Environmental Attitudes towards Eco-right. Children’s environmental behaviours consisted of two reliable factors: Children’s Pro-active Eco-behaviours, and Children’s Environmental Behaviours towards Resource and Energy Conservation.
Data was analysed using multiple regression analyses to evaluate the power of School-design in predicting children’s environmental attitudes and behaviours. Multiple regressions also clarified the association between parents’ and teachers’ environmental attitudes and behaviours and children’s environmental attitudes and behaviours. Multivariate analysis of variance was used to investigate differences in environmental attitudes and behaviours of children in schools designed for sustainability and conventional schools.

The outcome of the regression analyses indicated that sustainable design in schools was a powerful predictor of children’s environmental attitudes and behaviours. Multivariate analyses of variance indicated that children attending schools designed for sustainability had more pro-environmental attitudes and behaviours than children in conventional schools.

The overall results suggest that sustainable school design informs a meaningful understanding in children of the symbiotic relationship between the built environment and the wider ecological context. The results encourage designers, architects, and decision-makers to pay greater attention to school design as an efficacious factor in improving children’s environmental education.
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Chapter One

Introduction
This research has been approached from an interdisciplinary perspective, encompassing the domains of sustainable design and environmental education. The interdisciplinary perspective has contributed to the creation of novel understandings about the impacts of sustainably designed schools on different dimensions of children’s environmental attitudes and behaviours.

1.1. The need for Environmental Education

Undesirable disturbances to the ecological balance of nature, the depletion of irreplaceable natural resources, and uncontrolled growth in the man-made environment has led to a widespread consciousness about an urgent need to improve environmental education. To meet these challenges, a more integrated approach to plan, manage, achieve, and maintain pro-environmental values is needed.

Children are the focus group of this thesis for two reasons: first, children are the social group most vulnerable to environmental degradation due the constraints such degradation places on their capacity to reach their full potential (Malone & Tranter, 2003); second, research has shown that “early attitudes and knowledge shape the later thinking of adolescents and adults” (Leeming, Dwyer, & Bracken, 1995, p. 3), suggesting that in order to have a significant impact on environmental awareness, environmental education needs to be started from childhood. Schools throughout the world have been taking different direct and mediated approaches to address this need, such as developing sustainability curriculum and conducting sustainability initiatives.

This thesis will examine the potential use of school design to enhance children’s environmental attitudes and behaviours, and proposes that sustainable school design can be considered as a medium for providing environmental education. For the purposes of this thesis the term “sustainable design” will refer to both physical learning spaces, and features in schools designed for more sustainable
1.2. Background

Environmental education is seen to have a determinant role in achieving sustainable development and creating an ecologically literate society. Environmental education not only equips people with ecological awareness, but also is considered “as a key to save the world” (Schindler, 1999, p. 2). While different environmental education programs vary in their specific goals, a typical objective for most of the programs is to enhance participants’ environmental knowledge, attitudes, and behaviours (Leeming et al., 1995; Musser & Malkus, 1994; Stern, Powell, & Ardoin, 2008). These are considered to be the three prominent outcomes of environmental education since each individuals’ reaction to the environment is derived from affective (attitudes), cognitive (knowledge), and behavioural domains (Iozzi, 1989a).

Environmental education has been categorized into three different classes: education about the environment, which contributes to gaining environmental knowledge; education for the environment, which is directed towards environmental stewardship; and education in the environment, which fosters interactions and experiences in the environment (Malone & Tranter, 2003; Murdoch, 1993). Research shows that all these dimensions need to be accessible through schooling in order to create opportunities for children’s pro-environmental learning (Malone & Tranter, 2003). This thesis focuses on ‘education in the environment’ specifically, sustainable design as a “new typology that offers new spaces” (Farrelly, 2014, p. 130) for children’s environmental education, as described in Section 1.3.
1.3. Identifying the gap in the knowledge

The link between school design and students’ educational achievements has been ascertained through a growing body of research (Uline & Tschannen-Moran, 2008; Woolner, Hall, Higgins, McCaughey, & Wall, 2007). It is suggested the quality of the school environment directly influences the quality of student life and education (Sanoff, 1992) and “student’s interaction with physical settings often becomes their primary medium for learning” (Tanner, 2000, p. 6). In other words, learning is embedded in the experience of the learning environment (Mitchell & Mueller, 2011).

While the relationship between architecturally well-designed schools and children’s engagement in learning is well established, sustainable school design has rarely been considered as an avenue to transmit environmental education, with only a few studies investigating this relationship (Cole, 2013; Lyons Higgs, 2006; Nair & Fielding, 2005; Newton, Wilks, & Hes, 2009; Taylor & Enggass, 2009). As such, the relationship between sustainable design in schools and children’s environmental education is identified as a significant research gap requiring further exploration.

1.4. Significance of the study

Today’s children will be tomorrow’s leaders and their views will foreshadow the environmental orientation of future communities. As such, there is an extensive need for exploring the role of school design as a possible agent in the development of children’s environmental understanding and orientation. This therefore thesis focuses on the relationships between sustainable design, and environmental attitudes and behaviours. It is hoped that the findings will inform decision makers such as architects and other designers, building experts, educators, and policy makers.

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2 Architecturally well-designed refers to the spaces where the physical characteristics and settings of the space could meet occupants’ comfort and requirements.
1.5. Research questions

The primary focus of this study is on school design. However, secondary research questions have been developed to consider the role of other possible extraneous variables on children’s environmental education. These variables include: Parents’ Environmental Attitudes; Parents’ Environmental Behaviours; Teachers’ Environmental Attitudes; and Teachers’ Environmental Behaviours. Each of these variables will be discussed in Section 1.7.

1.5.1. Primary research question

The primary research question of this thesis is, “what is the impact of different types of school design (schools designed for sustainability compared to conventionally designed schools) on children’s environmental attitudes and behaviours?” This enquiry prompts three secondary research questions.

1.5.2. Secondary research questions

- How well are School-Design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours able to predict Children’s Environmental Attitudes and Behaviours?;
- Which out of School-Design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours is the most powerful variable in predicting Children’s Environmental Attitudes and Behaviours?;
- Do the environmental attitudes and behaviours of children in schools designed for sustainability differ from those of children in conventional schools;
1.6. Hypotheses

This study theorizes that sustainably designed schools can be used to elevate children’s environmental attitudes and behaviours. As such it was hypothesized that children who attended sustainably designed schools, compared to those who attended conventionally designed schools, would hold more pro-environmental attitudes and behaviours. This study also theorizes that parents’ and teachers’ environmental attitudes and behaviours can impact children’s environmental attitudes and behaviours as well as school design. Therefore, to control for the impact of these extraneous variables, it was also hypothesized that parents’ and teachers’ environmental attitudes and behaviours would significantly predict children’s environmental attitudes and behaviours.

1.7. Research design

A quantitative methodology was used to examine the impact of School-Design on Children’s Environmental Attitudes and Behaviours. Data was collected from children who were enrolled in grades four to six. The children were from two types of primary schools – schools designed for sustainability, and conventional schools. All of the schools were located in Victoria, Australia. Seven primary schools were selected according to criteria discussed in Section 3.2.1.

Data was also collected from the children’s teachers and parents to control, and account for the possible impacts that Teachers’ and Parents’ Environmental Attitudes and Behaviours might have on the children.

Two scales – NEP (New Environmental Paradigm), and GEB (General Ecological Behaviour) – were adapted to measure environmental attitudes and behaviours of both children and adults. The researcher modified the items, or in some cases added items, to make the instruments suitable for the
purpose of this study. As the revised instruments were being used for the first time, their reliability\textsuperscript{3} and validity\textsuperscript{4} were tested. As a result, this thesis employed the NEP (Children@School), and GEB (Children@School) to measure Children’s Environmental Attitudes and Behaviours respectively, and NEP (Parents), NEP (Teachers), GEB (Parents), and GEB (Teachers) as instruments for measuring Parents’ and Teachers’ Environmental Attitudes and Behaviours respectively.

Children’s Environmental Attitudes and Behaviours data was subjected to factor analysis to describe variability among observed, correlated variables, and as a method for data reduction. The results identified five dependent variables – (1) Children’s Environmental Attitudes towards Human Intervention, (2) Children’s Environmental Attitudes via ESD (Environmentally Sustainable Design) at School, (3) Children’s Environmental Attitudes towards Eco-rights, (4) Children’s Pro-active Eco-behaviours, and (5) Children’s Environmental Behaviours towards Resource and Energy Conservation. School-Design, Parents Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours were considered as the independent variables of this study.

The research design diagram can be found in Figure 1.1.

\textsuperscript{3} Reliability is the overall consistency of a measure. A measure is said to have a high reliability if it produces similar results under consistent conditions.

\textsuperscript{4} The validity of a measurement tool is considered to be the degree to which the tool measures what it claims to measure.
Figure 1.1: Research design
1.8. Assumptions of the study

There were three prime assumptions in this thesis. First, the potential influence of contrasting curricula between the schools was discounted because of the centralization of control over curriculum through the national curriculum in Australia (Palmer 2002). In Victoria, “AusVELS is the Foundation to Year 10 curriculum that provides a single, coherent and comprehensive set of prescribed content and common achievement standards” (AusVELS, 2014, p. 1). This study found no evidence that the curriculums of schools in the sample included anything above and beyond the AusVELS, or that teachers had added extra-curricular environmental education to the national curriculum. However, some teachers in schools designed for sustainability did state that they modified the ways the curriculum were taught by using the ‘green’ features of the school as teaching tools. Thus, because all Victorian schools taught the same curriculum with regards to sustainability, this thesis posits that the impact of curriculum variation on children’s environmental attitude and behaviours is satisfactorily controlled for.

A second assumption was that both children and adults participants answered truthfully, accurately, and honestly to the questions, and to the best of their individual abilities.

Finally, parents and teachers were requested not to communicate about environmental concepts and the content of their questionnaire with children prior to the date of the data collection. As such, it was assumed that parents and teachers adhered to this request, and there was no bias in children’s data as a result of teachers’ and parents’ advice.

5 Refer to Section 1.10 for the definition of the term ‘green’
1.9. Research objectives

The study has four prime research objectives:

- To assess the impact of sustainably designed schools on different dimensions of children’s environmental attitudes and behaviours, considering the possible impact of parents and teachers.
- To assess the power of School-design in predicting different dimensions of children’s environmental attitudes and behaviours.
- To determine which dimensions of children’s environmental attitudes and behaviours are most impacted on by School-design.
- To control for the power of Parents’ and Teachers’ Environmental Attitudes and Behaviours in predicting children’s environmental attitudes and behaviours.

1.10. Definition of terms

There are a number of terms that are central to this thesis, and have been used repeatedly throughout the text. As such, the following section will provide definitions to clarify their meaning in the context of this study.

1.10.1. Sustainable design:

Sustainable design is one of the key underpinnings of high performance design in several ways (Nair & Fielding, 2005):

- It involves a mindful approach that tries to minimize the disruption of a site’s natural features.
- It endeavours to create physical spaces, features, and settings to adapt for more sustainable resource consumption.
• It uses renewable energy sources from wind and sun to minimize the consumption of fossil fuels.

• Sustainable design minimizes the water consumption within the building, captures and utilizes the rainwater, and minimizes water runoff from the site.

The examples of sustainable design in this thesis include: outdoor classrooms, natural daylighting, solar panels, and water tanks for collecting recycled water.

1.10.2. Green architecture

Green architecture aims to awaken people’s awareness of how architecture can interact with the environment, how many resources the architecture uses, and the effect of the architecture on the environment and the occupants. Green architecture is considered to be high performance architecture that is designed to have less impact on the environment, beneficial impacts on human health, consume less water and energy, and exist in harmony with the environment. According to the report by USGBC (U.S. Green Building Council), Green architecture can save up to thirty percent in energy costs, thirty to fifty percent in water costs, and reduce up to thirty-five percent in carbon emissions, and fifty to ninety percent in construction waste and overall waste generation from building operations (Yudelson, 2008, p. 8).

While the term ‘greenwash’ is commonly used within environmental discourse to describe the superficial adoption of sustainability initiatives, the term ‘green’ will be used in this thesis to reflect common usage to describe school architecture that is designed to meet the objectives of sustainable or reduced resource consumption.

1.10.3. Ecological/ Environmental attitudes and behaviours

The terms ‘Ecological’ and ‘environmental’ have been used interchangeably by researchers in literature (Krnel & Naglic, 2009, p. 7). As such, this thesis has also used these two terms with similar
meanings in different occasions. Ecological/Environmental attitudes and behaviours address those attitudes and behaviours that contribute to sustaining nature in a broad sense.

1.10.4. Dimension/ factor

On some occasions the variables involved in the analysis are not comprised of a single construct. Rather, a specific variable can be composed of two or more underlying variables. These underlying variables are referred to as dimensions or factors. Dimensions and factors are terms that will be used interchangeably with the same meaning in this thesis. To identify these dimensions or factors, factor analysis is used as a statistical technique in this study.

1.11. Outline of the chapters

The first chapter introduces the context of the research, the identified research gap, significance of the study, the research questions, hypothesis of this thesis, the research design, and the research assumptions and objectives. Chapter Two provides a comprehensive background to environmental challenges in Australia, environmental education, school design and educational outcomes, and sustainability assessment tools. Chapter Three details the methodology and describes the participants of the study, scales used for measuring children’s environmental attitudes and behaviours, and the data collection procedure. Chapter Four details the results of the analyses. A number of statistical techniques have been used in this chapter in order to answer the main hypothesis and the other research questions posed in the Introduction Chapter. Chapter Five is the discussion that looks at the possible implications of the aforementioned research findings. The thesis closes with Chapter Six, the conclusion chapter, which reviews whether the identified research gap has been addressed. Chapter six also provides an overview of the research, states the research limitations and proposes suggestions for future research.
Chapter Two

Literature review
2.1. Introduction to the literature review

This chapter opens with a literature review framework in Section 2.1. Section 2.2 then clarifies the differences between the built environment and the natural environment and the interrelationship between these two. Section 2.3 discusses the most pervasive environmental threats in Australia and summarises crucial issues of biodiversity under threat, climate change, and ozone depletion. Section 2.4 discusses the extensive need to develop children’s environmental orientation. Section 2.5 explains the implication of environmental education, its goals, and different methods for teaching environmental notions. This covers not only the practices in Australia, but also experiences around the world. Section 2.6 focuses on the use of the built environment as a teaching tool, which is the prime subject of interest for this thesis. Investigating the role of architecture, this section articulates the correlation between the school physical environment and educational achievements, which then prompts a discussion of the concept of environmental awareness in Section 2.7. This is followed by a detailed look at the different environmental attitude and behaviour scales. Section 2.8 discusses the environmental assessment tools used for identifying sustainable schools versus conventional schools. The chapter is concluded in Section 2.9 with an identification of gaps in the literature, demonstrating the need for investigating the impact of school design on children’s environmental awareness.
Figure 2.1: Literature review framework
2.2. Built environment versus natural environment

The quality of our life is affected by the quality of our environment. Environment can be categorized into two different types: natural environment and built environment. The built environment is constituted by the structures that humans have built in the natural environment; such as buildings, industry and transport (McMullan & Seeley, 2007). As such, the built environment is embedded in the natural environment. Thus, the two different types of environment are connected and relevant to each other. Indeed, built environment can be seen as a response to the natural environment. There are numerous examples of this interaction, some of which include:

- Central courtyards in hot and dry climates to trap the cool air and provide shading;
- Lightweight, flexible and timber structure for zones with frequent earthquakes;
- Buildings with sloping roofs to discard snow in regions with snowfalls.

However, the interaction between built and natural environments has gone far beyond what humans had previously predicated. According to considerable scientific evidence, global warming is largely a consequence of the built environment and the human activities it accommodates (McMullan & Seeley, 2007). Climate change is seen to cause serious problems for the natural environment, such as rising sea levels because of polar ice melting, changing patterns of rainfall, spreading deserts and changing ocean currents.

Another phenomenon created by too much interference of human beings in the natural environment is increasing greenhouse gases leading to climate change (EPA, 2014; Isah, 2012; Oreskes, 2004). Climatologists and atmospheric chemists believe that the Earth’s atmosphere acts like a greenhouse that has capacity to absorb the heat from the sun (Doll & Baranski, 2011) and radiate the heat (Doll & Baranski, 2011). When the quantity of greenhouse gases such as carbon
dioxide rises above the natural levels, the Earth cannot radiate the heat and this causes global warming (Isah, 2012).

The amounts of greenhouse gases a building generates impacts how it behaves and interacts with the environment (Brown, Southworth, & Stovall, 2005). A building can produce greenhouse gases either directly or indirectly (Brown et al., 2005; Department of Industry, 2013; Protocol, 2014). Indirect emissions are generated from purchased electricity.

2.3. Environmental challenges in Australia

Humans are altering and harming the ecosystem despite being aware that they are dependent on it. Although humanity’s welfare is dependent on the appropriate management and consumption of natural resources, these resources are being progressively overused and polluted. Society is becoming increasingly conscious of environmental hazards such as ozone depletion, loss of biodiversity, deforestation, and climate change. These hazards are no longer limited to a subject of scientific debate; people are now facing environmental hazards in everyday life from problems such as pollution from nitrogen oxide, ozone, and heavy metals. Understanding the implications of environmental threats is an essential prologue to devising the sustainable solutions for working in harmony with the environment. The following sections discuss some of Australia’s major environmental threats.

Based on the publications of the Australian government, Department of the Environment, extinction of biodiversity, climate change and ozone depletion are some of the foremost environmental challenges in Australia (Australian government, 2015). To meet these challenges, a more integrated approach to plan, manage, achieve and maintain environmental values is needed. The Australian government has made a move towards actioning these values with The Plan for
a Cleaner Environment (Australian government, 2014a). This plan, at the time of writing this thesis, outlined the government’s focus on having a cleaner Australia through “priority setting, funding and handling of policy on national issues; information gathering and sharing; and coordination of programs, guidelines and standards” (Australia. Dept. of Sustainability, 2011, p. 8).

2.3.1. Australia’s biodiversity under threat

Biodiversity is the diversity of all life that occurs in almost all environments on Earth such as land, rivers, seas, oceans, etc. (Kaennel, 1998; Swingland, 2000). It is vital to conserve biodiversity, because humans depend, directly and indirectly, on living systems for food, fibre, materials and energy (The Department of Sustainability, 2010). Although Australia is one of the world’s most biologically diverse countries, this biodiversity has drastically declined since European settlement (Australian government, 2015). Australian ecosystems are particularly vulnerable to human impact, and “more than 1700 species and ecological communities are known to be threatened and at risk of extinction” (The Department of Sustainability, 2010, p. 2). This degradation is the result of a variety of threats, one example threat is the “unsustainable use and management of natural resources, changes to the aquatic environment and water flows, and climate change” (The Department of Sustainability, 2010, p. 2).

Australia has actioned some biodiversity conservation measures. These measures include involving aboriginal people, increasing private sector investments on biodiversity and ecosystem conservation, and facilitating the cooperation between government and those sectors, improving knowledge, holding up conservation initiatives, protecting diversity, and implementing national monitoring and evaluation (The Department of Sustainability, 2010). Australia’s Biodiversity
Conservation Strategy 2010-2030 has also been developed as an informative plan for protecting Australian biodiversity in coming decades. Despite of all these efforts, there has only been limited improvement in the biodiversity of Australia. Since human dependence on ecological processes is mediated by many different elements of biodiversity, protecting other species is a definite advantage for the wellbeing of humanity. As such, it is clear that the Australian community needs to take more serious measures to protect biodiversity.

2.3.2. Climate change

Climate change is happening because of increases in using fossil fuels, deforestation and land clearing. Climate change has caused several transformations in the patterns of the natural environment, such as: increasing global air and ocean temperatures; melting the icecaps; and raising sea levels. It has also caused changes in the circulation of the atmosphere and oceans that in turn affect rainfall and wind patterns, leading to acidifying the ocean because of the incensement in atmospheric carbon dioxide, and consequently affecting marine organisms.

Australia is particularly susceptible to climate change because it is the driest inhabited continent (Botterill, 2003). Climate change is considered as a prime risk to both the Australian environment and Australian society. As such, climate change is a major item on the national agenda (Australian government, 2015). Climate change is a pervasive driver of the changing state of the environment and is less predictable compared to human agents such as population and economic growth. For example the “inertia in the atmospheric–oceanic system will drive climate change for centuries to come, even if global mitigation efforts dramatically reduce emissions” (Australian government, 2015, p. 7).
2.3.3. Ozone

At ground level, ozone forms when nitrogen oxides and volatile organic compounds, such as those emitted from motor vehicles and industrial and domestic sources, are exposed to sunlight ("Aerosols, N2O5 play key rote in ozone cycle," 2006). Because of the increase of motor vehicles etc., ozone levels are elevating during the warmer seasons when there is more sunlight. Higher ozone levels in Australia are generally short-lived. However, they are often associated with regional bushfires which contribute to ozone concentration (Australian Government, 2010). Elevated concentrations of ozone can have a negative impact on air quality and the health of people (ABS, 2007).

The ozone layer protects the Earth from the harmful Ultra Violet radiation emitted from the sun. The depletion of the ozone layer over Antarctica in the form of the seasonal ozone hole is another on-going problem due to the climate change (Newman et al., 2014; Zhou, Zhang, & Ma, 2014). This means that greater amounts of harmful UV radiation reach the lower levels of the atmosphere (Al Jeran & Khan, 2009; Daniel, Allen, & Brown, 1994).

2.3.4. Measures to limit environmental challenges

From a review of the literature regarding the present status of the environmental challenges across Australia, it can be concluded that serious measures are needed in order to deal with the hazards humanity is facing as a result of climate change. In an effort to address these hazards, environmentalists have used different approaches that can be categorized into two groups: direct approaches and mediated approaches. Direct approaches are those measures affecting the status of the environment directly. An example of this is controlling the amount of carbon emission into the atmosphere. Mediated approaches are those measures that effectively impact the status of the environment, but through the mediated role of another agent. An example of this is to enhance
people’s literacy through environmental education, which improves people’s environmental attitudes and behaviours. The focus of this thesis will be on the mediated approach, through environmental education, which will be articulated in the following three sections:

- Environmental education through curriculum (Section 2.5.2.1)
- Environmental education through environmental initiatives (Section 2.5.2.2)
- Environmental education through built environment (Section 2.5.2.3)

2.4. Children and environment

Understanding the relationship between environment, including natural and built environment, and children can inform the design (Curtis, Babb, & Olaru, 2015; McGrath, Hopkins, & Hinckson, 2015). The relationship between children and environment has been considered in different disciplines and from different perspectives (Anaby et al., 2013; Kellert, 2005b; Tanner, 2000). For instance, Freeman and colleagues found that “the environment has an appreciable effect upon the intelligence of children” (Freeman, Holzinger, & Mitchell, 1928). Research has also indicated that the natural environment can be considered as a learning arena for children (Fjørtoft & Sageie, 2000). David and Weinstein believe that the immediate environment is the primary medium for learning in young children (David & Weinstein, 2013). Environment has also shown to be related to children’s health. This, good design of the built environment can mitigate obesity by providing opportunities for children to participate in physical activities (Grafova, 2008; Oreskovic, Winickoff, Kuhlthau, Romm, & Perrin, 2009; Tester, 2009). The impact established in the literature on children of their environment provides an important foundation for the precepts underpinning this study.
2.4.1. Why children are the focus group of this thesis?

Environmental sustainability has become the major social issue (Wilson & Knopt, 2002). As environmental sustainability is largely about human choices and actions, each individual has a lot to contribute toward this change (Mayer & Frantz, 2004). While environmental problems are one of the significant concerns of governmental officials and planners, a large part of the solution rests within the hands of citizens. Citizens can influence policies and legislations by casting votes on community issues; asking informed questions at the right time, and serving as an advisor or policy maker to resolve environmental problems. To perform these tasks effectively, “it is vital that the citizenry be knowledgeable concerning their biophysical environment and associated problems, aware of how they can help solve these problems, and motivated to work toward effective solutions” (Stapp et al., 1969, p. 14). This is the point where the children’s role as future citizens becomes of special interest, and that is why assisting each individual to obtain a more comprehensive understanding of environment and the interrelationship between nature and human wellbeing becomes crucial. Children will be tomorrow’s leaders and their views foreshadow the orientation of the future community.

Many researchers, such as Leeming, Dwyer and Bracken (1995), believe that research on children’s environmental attitudes and behaviours needs to be developed because “early attitudes and knowledge shape the later thinking of adolescents and adults” (Leeming et al., 1995, p. 23), and children have shown that they gain environmental knowledge, and develop environmental attitudes as early as kindergarten (Bryant & Hungerford, 1977). Therefore, it is important to study children’s environmental development and to understand children’s environmental orientations. In this regards, many authors have discussed the adverse physical, social, and psychological effect of children’s diminishing contact with nature (Kellert, 2005a; Zaradic & Pergams, 2007). Faber and
Kuo (2009) describe how children’s concentration levels could be improved by integrating nature with indoor and outdoor environments. Some examples include providing accessible natural amenities such as trees, flowers and open lawn, or aquariums, terrariums and indoor plants, as well as providing windows with a view to nature (Faber Taylor & Kuo, 2009). Bell and Dyment (2008) also found that “green school grounds, as a school setting, can contribute to children’s physical, mental, social and spiritual well-being” (Bell & Dyment, 2008, p. 2). Thus, in order to maintain the crucial connection between environment and children, environmental education is essential. The following subsections review environmental education, including the goals of environmental education, and different perspectives on attempts for environmental education.

2.4.2. Children’s learning and development

Human development is about the biological and psychological changes a person undergoes during the life span (Shute & Slee, 2015). A major focus of developmental psychology is on the first years of life, which are recognised as the formative years in a human’s development. Some child developmental theory focuses on the growth changes that a child goes through to become an adult. Other theoretic fields focus on learning, which refers to behavioural changes as a result of environmental influences (Charlesworth, 2008, p. 13). While developmental theories usually explain change as the result of the interaction between growth and learning, behaviourist theories include change originating in the environment through learning (Charlesworth, 2008, p. 13). Since learning is part of both theories, it is important to understand how it takes place. Burger and Thompson define learning as “the relationship between stimulus and response” (Berger & Thompson, 1995, p. 49). This indicates that the learning process happens when new experiences evoke new behaviours and attitudes patterns.
Since "the developmental process can be influenced by characteristics of the physical settings" (David & Weinstein, 2013, p. 4), this thesis investigates the possible patterns of children’s attitudes and behaviours in school environments. According to learning theory, it is hypothesized that sustainability features in schools perform as stimuli, and thus evoke patterns of environmental attitudes and behaviours. The role of the built environment in children’s environmental learning will be discussed in detail in section 2.5.2. It is worth noting that what is referred to as environmental education in the following sections is considered as equivalent to environmental learning.

2.5. Environmental education

The survival of nature’s eco-systems depends on humanity’s support and care. Humanity might not be able to solve the current environmental problems, but at least through certain behaviours it could prevent further environmental destruction. In recent decades, the concept of sustainable development has defined a balance between human’s present and future needs. Environmental education is seen as playing a key role in attaining sustainable development and in creating “an environmentally literate society- a society motivated and equipped to influence decision making” (Goldman, Yavetz, & Pe'er, 2006, p. 4). Education is a prerequisite for changing individual’s attitudes towards the environment and equipping them with the knowledge to make meaningful environmental changes (Hungerford & Volk, 1990). In sum, environmental education is pivotal in promoting environmental attitudes, achieving sustainable development, and creating an environmentally literate society. As such, environmental education is seen as the key to “save the world” (Schindler, 1999).
The recent emergence of environmental consciousness has encouraged global programs promoting environmental education (Nikel & Reid, 2006). Each of the programs, as categorized by Lucas (1972), refer to one or more of three classes: “Education about the environment - facts, concepts, principals; Education for the environment - attitude and skills directed to conservation; Education in the environment - forms of outdoor education” (Lucas, 1972, p. 136). Thus, “learning about the environment supports environmental understanding and knowledge; learning for the environment is directed toward environmental stewardship and action; learning in the environment encourages interactions and experiences in the environment” (Malone & Tranter, 2003, p. 2). Malone and Tranter (2003) posit that all three dimensions should be accessible through schooling to provide a comprehensive approach to children’s environmental learning. While “traditional approaches to Environmental Education (EE) consider students as needing to have positive experiences within the environment and learn values to appreciate and protect the environment” (Henderson & Tilbury, 2004, p. 7), a new perspective of environmental education for sustainability attempts to empower people of all ages to take responsibility for a sustainable future (UNESCO, 2002). This new perspective towards EE requires a new pedagogy that will be discussed further in Section 2.6.3 and throughout this thesis.

2.5.1. Goals of environmental education

Alan Reid (2009) believes that “the aim of environmental education is a sustainable world, both from a social and an environmental point of view” (Reid, 2009). Stone & Barlow (2005) suggest “education for sustainable living fosters both an intellectual understanding of ecology and emotional bonds with nature that make it more likely that our children will grow into responsible citizens who truly care about sustaining life” (Stone & Barlow, 2005, p. 15).
Different EE programs and initiatives vary in their specific goals, but there is a unifying objective for most EE programs and that is to enhance participants environmental knowledge, attitudes, and behaviours (Borden & Schettino, 1979; Hungerford & Volk, 1990; Leeming et al., 1995; Musser & Malkus, 1994; Stern et al., 2008). This unifying objective is particularly important because reactions toward the environment are derived from three domains of the affective, cognitive, and behavioural. Thus EE studies should address the affective (attitude) domain rather than just rely on cognition (knowledge), as this is not sufficient to produce changes in behaviour (Iozzi, 1989a, 1989b).

Following are the major EE goals as collected from the pertinent literature:

- To breed a citizenry “who is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help and solve these problems, and motivated to work towards their solution” (Stapp et al., 1969, p. 14)
- To assess environmental issues (Mangas & Martinez, 1997)
- To offer long-term solutions to environmental problems (Evans & Gill, 1996)
- To develop environmentally responsible and active citizens (Hungerford & Peyton, 1976)
- To help individuals to realize that man is an embedded part of a system comprised of humans, culture, and biophysical environment. Also that humanity has the capacity to modify the interrelationships of this system
- To obtain an extensive understanding of natural and man-made biophysical environment, and its role in present-day society
- To acquire fundamental understanding of biophysical environmental challenges that humans confront, and how these problems can be solved
• To develop attitudes of concern for the quality of the bio-physical environment that results in the citizenry participation in biophysical environmental problem-solving (Stapp et al., 1969).

2.5.2. Perspectives on attempts for environmental education

In the following section, three different approaches commonly used to achieve the goals of environmental education will be summarized: firstly, EE through curriculum; secondly, EE through environmental initiatives; and finally, EE through built environment.

2.5.2.1. Environmental education through curriculum

The most popular method for EE has been through curriculum. The schooling systems of various nations put much emphasize on the environmental curriculum (Chatzifotiou, 2006; Wolfe, 2001). Research has shown that to make the environment a public concern, environmental curriculum needs to be embedded in different schooling levels for this incorporation helps students to improve their cognition of their surroundings (Salmani, Hakimzadeh, Asgari, & Khaleghinezhad, 2015, p. 152).

In Australia, sustainability and environmental issues have been considered in AusVELS as cross-curricula. Thus, in AusVELS, teaching on the sustainable protection of the natural environment is included in the domains of Discipline-based Learning and Humanities-Geography. As noted in the Introduction chapter, because of ‘centralization of control over curriculum’ through the national curriculum in Australia (Palmer, 2002), this thesis posits that the potential influence of curriculum on children’s environmental attitude is satisfactorily controlled for.

2.5.2.2. Environmental education through environmental initiative

Some environmental education efforts, termed environmental initiatives, have focused on programs such as field trips and outdoor activities. The International Review of the Whole-school
Sustainability Programs in Australia remarks that a common characteristic of all environmental initiatives is contributing to the national curriculum (Henderson & Tilbury, 2004). The two following sections discuss examples of environmental initiatives around the world and in Australia.

- **Environmental initiatives and action plans around the world**

A series of international commitments have motivated the move toward environmental sustainability. These commitments include: the Tbilisi Declaration in 1977 (a declaration improving environmental education to assist in environmental protection and, the need for people’s engagement in solving the environmental problems) (UNESCO, 1977); Agenda 21 (which arose from the U.N. Conference on Environment and Development in Rio de Janeiro, known as the Earth Summit) (United Nations Conference, 1992); the Dakar Framework for Action in 2000 (a world education forum confirming education as a fundamental human right for effective participation in societies and economies affected by rapid globalization) (UNESCO., 2000); and the World Summit on Sustainable Development (WSSD) in Johannesburg in 2002 (Bunting, Hunt, Walker, & de Roode, 2002; Henderson & Tilbury, 2004; Kingston, 2002). All of these commitments have emphasized educational reforms that include sustainability as part of the general curriculum.

Agenda 21 had a prominent role in environmental development and was adopted by much of the international community as a fundamental action plan for the foreseeable future (United Nations Conference, 1992). Chapter 36 of Agenda 21 was dedicated to promoting and reorienting education toward increasing knowledge about sustainable development, increasing public awareness about the environment, and training people in pro-environmental behaviours (Robinson, 1993). Some of the central objectives of Chapter 36 relate to achieving environmental awareness
in all sectors of society as soon as possible, including increasing the accessibility of environmental education from primary school age through to adulthood.

As shown in Table 2.1, there have been numerous environmental initiatives around the world for school-based approaches toward sustainability.
Table 2.1: Environmental Education initiatives around the world

<table>
<thead>
<tr>
<th>EE Initiative Names</th>
<th>Country</th>
<th>Key Focus and Principals</th>
</tr>
</thead>
</table>
| **ENSI Eco Schools (1986-)** | Members from 13  | - Developing and publishing methods of environmental teaching and learning  
|                              | countries including Australia. | - Conducting comparative studies in ‘Quality Criteria Eco School Development’ (Henderson & Tilbury, 2004)                                             |
|                              |                   | - Litter and waste minimization  
|                              |                   | - Energy and water saving  
|                              |                   | - Environment and biodiversity  
|                              |                   | - Sustainable development and community knowledge  
|                              |                   | - School ground management and fieldwork  
| **FEE Eco-Schools (1994-)**  | Originally founded in Europe (England, Wales, and Scotland), then expanded to 28 countries including African, Asian and South American countries. |                                                                                                                                                  |
|                              |                   | - Whole-school environmental management and protection  
|                              |                   | - Environmental Education curriculum  
|                              |                   | - Greening school grounds  
| **Green Schools (1996-)**    | China             | - Supporting development of methods for teaching and learning about sustainable development  
|                              |                   | - Environmental Education  
|                              |                   | - Student participation at all levels  
|                              |                   | - Sustainability  
| **Green School Award (1998-)** | Sweden           | - Investigating potential of school grounds  
|                              |                   | - Transfiguring typically droughty school grounds into healthy, natural and creative outdoor classrooms  
|                              |                   | - Helping children to have a genuine interaction with natural environment and respect nature  
|                              |                   | - Providing children with safe and healthy place to learn and play (Raffan & Evergreen, 2000).  
| **Enviroschools (2002-)**   | New Zealand       | - Connecting children to natural environment  
|                              |                   | - Helping children to be more active, develop their social skills and have fun through promoting school grounds in innovative ways("LTL," 2012) |
| **Evergreen (1991-)**        | Canada            | - Incorporating built environment, physical landscape, and social environment  
|                              |                   | - Encouraging school communities to use the schools’ ground and open area learning spaces  
|                              |                   | - Encouraging school communities to look at the school grounds as opportunities for developing friendship, creative exercises, interactive play, and practical learning through getting in touch with nature  
|                              |                   | - Enhancing interaction of school communities and natural or built, interior or exterior learning environment  
|                              |                   | - Enhancing the link between curriculum and use of school ground ("ENSI," 2012)  
| **Learning through Landscapes (LtL) (1990-)** | UK               | - In Scotland known as “Grounds for Learning”  
|                              |                   | - In Wales known as “LTL Cymru”  
|                              |                   | - Connecting children to natural environment,  
|                              |                   | - Helping children to be more active, develop their social skills and have fun through promoting school grounds in innovative ways("LTL," 2012) |
| **Learnscapes**              | Originally started in NSW, and now also operating as part of ENSI | - Student participation at all levels  
|                              |                   | - Sustainability  
|                              |                   | - Investigating potential of school grounds  
|                              |                   | - Transfiguring typically droughty school grounds into healthy, natural and creative outdoor classrooms  
|                              |                   | - Helping children to have a genuine interaction with natural environment and respect nature  
|                              |                   | - Providing children with safe and healthy place to learn and play (Raffan & Evergreen, 2000).  
|                              |                   | - Connecting children to natural environment  
|                              |                   | - Helping children to be more active, develop their social skills and have fun through promoting school grounds in innovative ways("LTL," 2012) |
Environmental initiatives in Australia

There have been three important national environmental initiatives developed for Australia: the Australia National Action Plan for Environmental Education, the Australian Sustainable Schools Initiative, and the Australian Association for Environmental Education.

- The Australian National Action Plan for Environmental Education

  The first Australia National Action Plan for EE was released in 2000. This plan resulted in a range of environmental initiatives including “the establishment of the National Environmental Education Council (NEEC), National Environmental Education Network (NEEN) and Australian Research Institute in Education for Sustainability (ARIES)” (Journal, 2007, p. 1). Australia’s second national action plan, published by the Australian government, department of the Environment, Water, Heritage and the Arts, aimed to implement education about sustainability, equipping all Australians with the knowledge and skills required to live sustainably. This plan was seen to represent “a significant contribution to Australia’s participation in the United Nations Decade of Education for Sustainable Development, 2005-2014” (The Australian government Department of the Environment, 2009, p. 1). The plan consists of four strategies for sustainability education: “demonstrating Australian Government leadership, reorienting education systems to sustainability, fostering sustainability in business and industry, and harnessing community spirit to act” (Department of Sustainability, 2010b, p. 5). In accordance with the mentioned strategies, the Australian Sustainable Schools Initiative (AuSSI) was developed with the aim of achieving the national plan objectives for schools.

- Australian Sustainable Schools Initiative (AuSSI)

  The early development of AuSSI, “a partnership of the Australian Government and the states and territories that seeks to support schools and their communities to become sustainable”
was in Victoria and New South Wales in 2002 (Henderson & Tilbury, 2004). After that, enthusiasm for environmental programs grew dramatically in the other states. AuSSI not only encourages students to engage in real-life practices by managing school resources such as water, waste, energy, landscape design, biodiversity, products and materials, but also addresses social and financial themes such as engaging local communities in school activities and sustainable purchasing. Each school is able to select the themes most relevant to the school community interest.

The Department of the Environment, Water, Heritage and the Arts released a report in August 2010, called Evaluation of the Governance of the Australian Sustainable Schools Initiative (Department of the Environment, 2010b). This report declares the key achievement of the AuSSI as below:

- “30% of the Australian schools are AuSSI schools;
- Integration of sustainability based learning activities with schools management;
- Australian Government leadership in developing and implementing a collaborative and cooperative approach to information gathering;
- Active and ongoing support and participation from States and Territories” (Department of the Environment, 2010b).

While AuSSI has been described as a hugely successful initiative that has driven significant changes towards sustainability in Australian schools (The Australian government Department of the Environment, 2009, p. 24), it should be noted that to date this claim has not been tested by empirical research.

Resource Smart Australian Sustainable Schools Initiative Victoria (AuSSI Vic) is a Victorian version of the AuSSI that helps schools integrate sustainability in their everyday life,
and creates opportunities for students to learn about sustainability through tangible and realistic environment experiences. AuSSI-ACT, which is the adapted version of AuSSI for the Australian Capital Territory, is also assisting all ACT schools to become carbon-neutral by 2017 (Department of the Environment, 2010b). According to the 2010 Evaluation of Operational Effectiveness of the Australian Sustainable Schools Initiative (AuSSI), 87% of schools in Australian Capital Territory were taking part in AuSSI-ACT (Department of the Environment, 2010a). Queensland and the NSW Government have also been actively expanding the sustainability programs in their schools (Department of the Environment, 2010b). It is worth noting, however, that Western Australia is the only State in which AuSSI specifically addresses the built environment in one of their themes (Government of Western Australia, 2014).

- **Australian Association for Environmental Education**

  The AAEE is Australia’s professional Association for Environmental Education. The aim of this association is to develop environmental educators’ skills so that they are able “to stand at the forefront of the sustainability education and behaviour change” ("Australian Association for Environmental Education," 2013, p. 1). AAEE declares its three major roles as:

  - Encouraging people for the ultimate use of environmental education in order to live more sustainably;
  - Assisting the involved people through professional development;
  - Building up more active local networks to ease the environmental skill and knowledge sharing ("Australian Association for Environmental Education," 2013).

2.5.2.3. **Environmental education through built environment**

The third approach for achieving environmental education is via the built environment. This methodology uses architecture to mediate the communication of environmental concepts to the
occupants of indoor or outdoor spaces. Although there has been extensive research about the relationship between the physical environments of schools and educational outcomes (Clark, 2002; Earthman, 1998; Leiringer & Cardellino, 2011; Woolner et al., 2007), few studies have considered the impact of school design on children’s environmental awareness (Cole, 2013; Uzun, 2009). Section 2.6 will discuss the correlation between the school physical environment and educational achievement.

2.5.2.4. Examples of different methods of environmental education

Table 2.2 shows examples of research on EE through different methods:

<table>
<thead>
<tr>
<th>EE through Curriculum</th>
<th>EE through Participating in Environmental Programs and Initiatives</th>
<th>EE through Physical Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>A national survey of curriculum needs as perceived by professional environmental educators (Volk, Hungerford, &amp; Tomera, 1984)</td>
<td>What Difference Does It Make? Assessing Outcomes from Participation in a Residential Environmental Education Program (Stern et al., 2008)</td>
<td>The effect of the green class model on environmental knowledge and its retention (Uzun, 2009)</td>
</tr>
</tbody>
</table>
2.6. School design and educational outcome

To investigate the association between environmental education and the sustainable design of schools, it is essential to find out whether there is any linkage between school physical characteristics and general educational achievements. Thus, Section 2.6.1 discusses research into the relationship between school facilities, physical design characteristics, and educational achievements. Since changing attitude and behaviour is one of the goals of environmental education (Stern et al., 2008), the correlation between school built environment and general human behaviours and attitudes is also reviewed in Section 2.6.2. This topic is critical to consider because if there is a significant relationship between school design and general behaviours and attitudes, there may also be a link between environmental attitudes, behaviours, and school design. Section 2.6.3 discusses the role of sustainable school design as a pedagogical tool for environmental education and enhancing children’s ecological literacy. The two concepts of the knowing eye and financial investment on school buildings are also articulated to conclude this section.

2.6.1. School facility and physical design characteristics, and educational attainments

A number of empirical studies have assessed the impact of a school’s environmental characteristics on its students (Clark, 2002; Colven, Organisation for Economic, & Development, 1990; Dudek, 2000; Hathaway, 1995; Higgins, Hall, Wall, Woolner, & McCaughey, 2005; Moore, Lackney, Wisconsin Univ, & Urban, 1994). These characteristics include thermal factors, lighting quality, natural ventilation, air quality, and acoustics. For example, one study compared elementary school students who were exposed to traffic noise to those students who were not exposed. This study found that students exposed to traffic noise suffered from lower concentration levels, made more errors on difficult tasks, and tired more easily compared to the students who were not exposed to the traffic noise (Moore et al., 1994). The literature also indicates a positive
relationship between thermal comfort and children’s efficacy, achievement and performance (Earthman, Lemasters, & Council of Educational Facility Planners, 1996). Likewise, it is claimed that sustainable schools positively impact educational performance (Edwards, 2006). However, some studies suggest that once the minimum standards of these environment characteristics are achieved, the benefit of improving on these minimum standards is less clear (Feilden, 2004; Higgins et al., 2005). This suggests that improving poor learning environments up to the minimum acceptable level can increase children’s motivation and educational achievement, but improving facilities to upper standard levels has a less significant effect on children’s achievements (Higgins et al., 2005; Leiringer & Cardellino, 2011).

The physical design characteristics of schools also has an educational impact, for “student’s interaction with physical settings often becomes their primary medium for learning” (Tanner, 2000, p. 313). It is believed that architecturally well-designed school settings contribute to greater level of engagement of children in learning activities (Moore et al., 1994). Schneider (2002) suggests that those involved in school planning and design should see it as an opportunity to enhance outcomes by creating better learning environments (Schneider, 2002). Different architectural approaches can therefore be seen to facilitate and accommodate different education styles by shaping children’s educational engagement. The following sections discuss the differing views about the relationship between the physical designs of school and children’s achievement.

2.6.1.1. Advocates

Some researchers state that the quality of the school buildings need to be improved if we are to raise educational achievements (Clark, 2002; Wilks, 2010). Such researchers advocate that the built environment has a significant influence on learning and teaching procedures. A study by Bowers and Burkett (1988) compared two schools in terms of the differences in student
achievement, health, and behaviour. The two schools had different physical environments. One of the schools was new and modern, while the other school was constructed fifty years prior to the date of study and had very little improvement in terms of physical structure. The results of this study show that the children in the new school significantly outperformed the children in the older school in terms of reading, listening, language, and arithmetic. There were also fewer disciplinary incidents and absentees in the school with new building. In a similar study by Edwards (1991), school building conditions were found to have a positive relationship with students’ educational achievements and behaviours after controlling for other possible extraneous variables such as student’s socio-economic status. He concluded that “students' standardized achievement scores in school buildings in poor condition were six per cent below those in schools in fair condition and eleven per cent below those in schools in excellent condition” (Edwards, 1991, p. 5).

Cash (1993) observed similar results in a study of rural high schools in Virginia. She categorized school buildings into three groups according to the state of lighting, acoustics, climate control, colour, density, science laboratory quality, and aesthetics: substandard, standard, and above standard. The results of this study indicated that achievement test scores, considering the socio-economic status, were up to five percentile points lower for students in school buildings with lower quality ratings compared to those students in buildings of higher quality ratings.

McGuffy (1982) states that old and out-dated school buildings have a harmful effect on children’s learning processes, while modern, safe, and controlled environment facilities contribute to accelerated learning processes (Earthman et al., 1996). Phillips (1997) confirms the same positive relationship between the age of the school facility and children’s arithmetic and reading scores. However, Phillips (1997) did not find any significant difference between the attendance patterns of students in the two different types of schools.
Subsequent studies by Maxwell (1999) and Lewis (2000) also corroborate significant difference for students’ performance in schools with different facilities and physical conditions. These studies found a positive relationship between upgraded school facilities and improved academic performance.

2.6.1.2. Oppositions

In contrast to the studies reviewed above, there are also researchers who have found little or no association between school physical characteristics and students’ learning or behaviour (Earthman, 1998). Rutter (1981) believes that it is “entirely possible for schools to obtain good outcomes in spite of initially rather unpromising and unprepossessing school premises” (Rutter, 1981, p. 178). Weinstein (1979) also believes that, although design features can significantly influence the general behaviour and attitude of students, it is difficult to find reliable evidence of an explicit effect of classroom environment such as seating position, classroom design, density, privacy, noise, and the presence or absence of windows on student’s achievement (Weinstein, 1979, p. 584). Earthman (2004) similarly found that although inadequate school buildings cause health problems, poor student morale and performance, he was not convinced that schools need buildings with necessarily more than adequate facilities. In confirming the issue that providing extra facilities could not add any more benefits to children’s achievements, Stricherz (2000) pointed out that “research does show that student achievement lags in shabby school buildings … but it does not show that student performance rises when facilities go from the equivalent of a Ford to a Ferrari—from decent buildings to those equipped with fancy classrooms, swimming pools, television-production studios, and the like” (Stricherz, 2000, p. 1).

In a study conducted by Wenglinsky (1997), a national sample of 14,000 students from 4th and 8th grades were compared regarding their mathematic scores against the money spent on school
building. It was found that spending more money does not increase children’s educational performance (Wenglinsky, 1997).

2.6.2. School built environment, and human behaviour and attitude change

The above literature review illustrates conflicted outcomes regarding the impact of the physical facilities, and design of school buildings on children’s educational achievements. However, because of the potential for school design to convey educational concepts, as well as the recognized importance of environmental education, this thesis investigates the possible role of architectural design in transferring environmental ideas to primary school children. This potential is informed by the theory that environmental experiences in childhood endure into adulthood, and that the design of the built environment can have both a direct and symbolic impact on children (David & Weinstein, 1987). As such, emerging impressions formed by school architecture, and thus the physical attributes of the space, is a prominent issue that should be taken into consideration. To investigate this issue further, it is necessary to determine whether school design can impact children’s environmental behaviours and attitudes, and therefore whether design can be used as a tool for the purpose of environmental education. In order to answer this question, the next section reviews the general association between built environment and human attitudes and behaviours. The following section then reviews the impact of school built environment on children’s environmental education and awareness.

2.6.2.1. Designed environment and human attitudes and behaviours

For many decades there has been research into possible connections between the built environment and human behaviours and attitudes. Many studies have found spatially informed patterns of behaviour in different places, such as: children’s psychiatric hospitals (Rivlin & Wolfe, 1972), libraries (Eastman & Harper, 1971), workplaces (Heerwagen, Kampschroer, Powell, &
Loftness, 2004; Penn, Desyllas, & Vaughan, 1999), and dormitories (Heilweil, 1973), and places with unique physical characteristics such as buildings without windows (Karmel, 1965) or places with aesthetic quality (Maslow & Mintz, 1956). Jenny Russell believes that “architecture is the formulation of sets of rules for different behaviours in a building” (Russell, 2004, p. 2).

As such, architectural design can play a significant role in deterring the occupant’s unwanted attitudes and behaviours. The corollary is that undesirable behaviours may have been produced by poor design. An example of an undesirable behaviour informed by architecture is the spatial confusion caused by the wrong placing of a partition or a wall or, environmental noise distracting occupants (Banbury & Berry, 2005). These problems can be minimized by changes in architectural design. Section 2.6.2.2, discusses the role of school design on attitudinal and behavioural changes.

2.6.2.2. School design and attitudinal and behavioural change

The designed environment has the potential to shape its occupants’ behaviour (Weinstein, 1977). There is considerable evidence supporting the relationship between school physical settings, and students’ and teachers’ behaviours and attitudes (Day, 2007; Durán-Narucki, 2008; Moore et al., 1994). The architectural symbolism of schools can also have a profound impact on children and their behaviours (Proshansky & Wolfe, 1974). While some spatial settings encourage and facilitate behaviours, others hinder and inhibit behaviours.

To test the hypothesis that spatial changes in school environments might generate desirable changes in student’s behaviour, Weinstein (1977) investigated the spatial distribution of second and third grade students’ activities in open classrooms. The study was conducted in two stages: before and then after changes in physical design. She found statistically significant differences in students’ behaviour between the two stages. Changing the spatial design of classes encouraged students to move into the spots of the class that had previously been avoided, and resulted in
altering the frequency of specific behaviours (Weinstein, 1977). Similar behavioural patterns are reported by Fisher (2001) and Wilks (2010), who declare that improved school infrastructure and building conditions results in better academic outcome (Fisher, 2001; Wilks, 2010). A study by the Carnegie foundation (1988) asserts that students’ attitudes toward education are a direct reflection of their learning environment (Carnegie Foundation for the Advancement of Teaching, 1988). Younge (2001) likewise states that school built environment is central, not marginal, to student’s behaviour and performance (Younge, 2001).

Conventional wisdom in educational facility planning and design suggests a relationship between physical environments and school occupants’ attitudes, behaviours and achievements. However, it is also understood that this “significant relationship is difficult to statistically demonstrate” (Earthman, 1998, p. 5), and thus requires further investigation.

2.6.3. Architecture as a pedagogical tool

While interventions in specific environmental issues have been effective, the magnitude of environmental problems requires broader and more innovative strategies for changing the environmental worldview. While the literature has emphasized the role of the built environment on behavioural change (Weinstein, 1977), school building design has rarely been considered as a tool for environmental education. Since it is understood that “the way education occurs is as important as its content” (Orr, 1992, p. 91), in recent decades, environmental education has evolved in significant ways. It is a question of debate whether EE should be presented in the form of a separate course at schools or whether a trans-disciplinary approach should be used. Teaching via the curriculum is the primary method for EE. However, other less directly observable and more implicit methods such as learning through participation (hands on experiences) or learning through “knowing eye” (visual literacy) have also been developed. Ann Taylor and Enngass (2009) believe
that once we start to ‘read’ an environment, we have cultivated a knowing eye (Taylor & Enggass, 2009). The visual literacy gained from a knowing eye enables the occupants of a space to read, see, deeply perceive, and critically analyse that physical environment. Thus, “developing the knowing eye means temporarily suspending the past and opening ourselves to new possibilities” (Wilks, 2010, p. 7).

2.6.3.1. Environmental learning through knowing eye (visual literacy)

Implicit in the work of Ann Taylor (2009) is the idea that knowing eye (visual literacy) can make the pedagogic link between sustainable design and environmental education. This connection between design and Environmental Education will be explored in this next section.

According to the literature, responsible environmental behaviour is believed to have a relationship with duration of exposure to encouraging incentives (Partain, 1980). These incentives can be either environmental initiatives (as discussed in Section 2.5.2.2), or the built environment of schools (as discussed in Section 2.5.2.3). As most of the environmental initiatives in schools are short-term and do not provide students a long period of exposure to environmental issues, the role of the school built environment and school design become of paramount importance. School design can provide students with valuable educational insights. School design can also offer students a semi-permanent visual exposure to education; including environmental education if the school is sustainably designed.

Designed artefacts, including buildings, are informed by an idea or concept. Occupants of a space can read these concepts and assimilate them if they are articulated. Thus, architecture can have pedagogic value, because “physical elements in the environment can act as visual cues or prompts for learning” (Wilks, 2010, p. 9). Physical environment is therefore also referred to as a ‘three dimensional textbook’ or ‘silent curriculum’ which might not be palpable, but effectively
impacts on positive or negative learning experiences of users of a space (Taylor & Enggass, 2009, p. 25). This is how architects are able to educate the public that “the design of physical spaces matters, and that they can be read and translated by our minds into ideas for better understanding of our relationship with environment” (Wilks, 2010, p. 12). Architects can be seen therefore to provide a physical design that not only generates and facilitates visual literacy, but also provide the opportunity for the design of school buildings to play a pedagogical role.

Sustainable Schools, a Brief Introduction, Department for Children, Schools and Families, UK (2008), recommends some ‘doorways’ for change for schools to become sustainable by 2020. There is a doorway category called “buildings and grounds” that encourages schools to manage and design their buildings and grounds to visibly represent sustainability to students and teachers. Such design is intended to create a connectedness to the natural world for pupils, giving them “the chance to contribute to sustainable living, and demonstrate good practices to others” (Department for Children, 2008, p. 2).

Improved visual literacy is also associated with a connectedness with nature. Faber and Kuo (2009) believe that nature can enhance children’s concentration levels. They identify different features that might be integrated with indoor and outdoor spaces to enhance children’s wellbeing, including accessible nature such as flowers, trees, open lawn, and small bushes. They also suggest incorporating windows with perspective to nature and the avoidance of the use of walls that obstruct views to nature (using sitting walls) (Faber Taylor & Kuo, 2009). Furthermore, Richard Neutra (2000) believes that good school architecture is the basis for good education (Lamprecht, Gössel, & Neutra, 2000) and that school architecture should invite the nature in, and bring the indoor out (Frith & Whitehouse, 2009). Neutra (2000) believes that each classroom should be opened to its own outdoor space via sliding glass doors (Lamprecht et al., 2000). The Department
for Children in UK (2006) also looks at the school outdoor environment as a learning space that has the capacity to be used as classrooms without walls. Evidence for improved learning through connectedness with nature was found by Carrier (2009), who investigated the relationship between outdoor learning spaces versus traditional classrooms and the environmental knowledge, attitude, behaviour, and comfort for grade four and five students in the US (Carrier, 2009). The results indicate that outdoor activities increase both boys’ and girls’ involvement in learning, and environmental lessons that take place in outdoor classrooms are more effective at providing learning opportunities for primary school children.

Having now discussed the significance of school design in environmental education, the financial implications of these connections will be discussed in the following section.

2.7. Environmental literacy

Human ecological literacy both directly and indirectly impacts the natural environment and all aspects of human life. The study of ecological literacy has thus been an issue of much debate for scholars (Mitchell & Mueller, 2011; Roth, 1992; Salmon, 2000; Wilke, 1995). However, there is not a universal definition for environmental literacy, as different researchers have found different levels and components for it. For the purposes of this thesis, environmentally literate individuals are categorised as those who possess attitudes, values, and skills that contribute to the conversion of environmental knowledge into environmental action (Goldman et al., 2006). The more a person is environmentally literate, the more it is reflected in their behaviours and actions towards the environment (Goldman et al., 2006). The suggestion is that knowledge, attitudes, and behaviours are distinguished as common components; an understanding which will be scrutinized in the following sections.
2.7.1. Ecological knowledge

Enhancing environmental knowledge of children at early ages has been discussed as one of the most important ways to overcome environmental problems (Gambro & Switzky, 1996). Reviewing the literature reveals that environmental education results in improving students’ environmental knowledge (Bradley, 1999; Farmer et al., 2007; Makki, Abd-El-Khalick, & Boujaoude, 2003; Palmberg, 2000). As environmental knowledge is essential to environmental literacy, the following questions remain:

- Is knowledge enough?
- How is this environmental knowledge conveyed?
- Do environmentally knowledgeable people necessarily have commitment to environmental friendly behaviours and possess environmental friendly attitudes?

The traditional environmental education point of view is that individuals can change behaviour through increasing their environmental knowledge (Hungerford & Volk, 1990). However, not all research in this field confirms the veracity of this traditional model. Later research has shown that environmental knowledge does not necessarily foster positive environmental attitudes (Eagly & Kulesa, 1997) and behaviours. Carrier (2009) suggests that knowledge and attitude are two agents that contribute to and determine behaviours. So, being environmentally literate is more than just having knowledge about ecology, for a completely literate person possesses knowledge with values, which leads to actions (Morrone, Manci, & Carr, 2001).

The next section will discuss environmental attitudes, which according to Hines, Hungerford and Tomera (1987), are the key to achieving responsible environmental behaviours.
2.7.2. Environmental attitudes

To understand how environmental problems are perceived, it is necessary to investigate the attitudes that inform human relationships towards their physical environments. Attitude “implies more than simply the knowledge of a body of factual information; instead, it implies a combination of factual knowledge and motivating emotional concern, which result in a tendency to act” (Stapp et al., 1969, p. 15). Attitudinal variables includes those factors that deal with “the individual’s feelings, pro or con, favourable or unfavourable, with regard to particular aspects of the environment or objects related to the environment” (Hines et al., 1987, p. 4). As such, environmental attitude research is critical for understanding what determines attitudes, and for designing environmental education programs (Newhouse, 1990).

One of the main objectives of environmental education is to modify and promote people’s environmental behaviour. Since, one of the determinants of behaviour is attitude (Kraus, 1995), it is important to evaluate environmental attitudes that facilitate modifying environmental behaviours (Pooley & O’Connor, 2000). Acknowledging attitude as one of the formative agents in environmental literacy, and given that a goal of this thesis is to find out whether environmental attitudes among school children are affected by school design, the following sections evaluate the scales previously developed to measure environmental attitudes. This evaluation will elucidate the choice of scale for this study.

2.7.2.1. Environmental attitudes scales for adults

Efforts to measure environmental attitudes have led to the development of many assessment instruments (Leeming et al., 1995). Although these instruments share a similar aim, different scales have different approaches depending on the research objectives. In a study by Werner, Turner, Shipman, Twitchell, Dickson, Bruschke, and von Bismarck (1995), attitudes
change due to participation in a free curb-side recycling program were measured using a 40-item questionnaire that tapped "general recycling attitudes, and behaviours, attitudes towards the curb-side pick-up firm, and self-concept as a recycler" (Werner et al., 1995, p. 201). In another study, Tuncer, Ertepinar, Tekkaya, and Sungur (2005) used a 45-item Likert type questionnaire to measure the effect of school type and gender on students’ environmental attitudes. The questionnaire consisted of four dimensions: “awareness of environmental problems, national environmental problems, solutions to the problems, and awareness of individual responsibility” (Tuncer et al., 2005, p. 215). Schindler (1999) created the survey of Environmental Issue Attitude in order to measure college students’ attitudes. This 20-item survey also measured demographics, ecology knowledge, and self-reported changes in behaviours toward the environment.

While there is no universal instrument to gauge environmental attitudes, there is a scale called NEP (New Ecological Paradigm), which is perhaps the most widely used instrument for measuring environmental attitudes (Dunlap, Van Liere, Mertig, & Jones, 2000; van Petegem & Blieck, 2006). Employing the NEP, a scale, which has been rigorously tested for internal consistency and validity, provides the opportunity for researchers to compare the results of different studies, and build upon knowledge about environment and attitudes in a consistent manner. Unlike previous environmental scales, which predominantly focused on attitudes towards specific problems such as energy consumption, waste disposal, and air/water pollution (Albrecht, Bultena, Hoiberg, & Nowak, 1982), the NEP relates to a more general position about environment (Noe & Snow, 1990b). Considering the scope and the limits of the environmental attitudes scales reviewed above, the NEP was chosen to assess environmental attitudes in this thesis. The following sections describe the NEP, its reliability, cross-contextual applicability, and dimensionality in detail. The details of the NEP scale as used in this thesis, and the modifications
applied to tailor it to the specific needs of this study, will be discussed in Section 3.3 of the methodology chapter.

- **New Environmental Paradigm (NEP)**

Dunlap and Van Liere (1978) developed the New Environmental Paradigm scale (as known as the NEP) as a means of investigating “whether a more general position about society and its resources existed among American public” (Noe & Snow, 1990b, p. 21). The twelve items of the New Environmental Paradigm scale “focused on beliefs about humanity’s ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity’s right to rule over the rest of nature” (Dunlap, Liere, Mertig, & Jones, 2000, p. 427).

In 2000, Riley, Dunlap, Van Liere, Mertig and Jones modified the New Environmental Paradigm. The name of the revised scale was the New Ecological Paradigm. This new scale was designed to improve upon several aspects of the original scale through covering broader range of environmental worldviews, providing better balance of pro-environmental and anti-environmental items, as well as removing out-dated terminology. The New Ecological Paradigm aimed to assess five key factors: (1) limits to growth, (2) anti-anthropocentrism, (3) fragility of nature’s balance, (4) rejection of human exemptionalism, and (5) belief in eco-crisis. All five factors were assessed using three items specifically designed for each. As such, the New Ecological Paradigm had a total of fifteen items.

- **The NEP scale reliability**

“Reliability of a scale is an indication of how accurately and repeatably it determines whatever it reports to measure” (Schindler, 1999, p. 16). The NEP scale has been subjected to a good deal of reliability testing and has been found to have reasonably strong internal consistency (Dunlap, Liere, et al., 2000). As Dunlap (2008) reports “alpha averaged .71 for all 140 samples
used in the 68 studies” (Dunlap, 2008, p. 11) that employed different versions of the NEP scales. The NEP is also reported to have stronger internal consistency in the context of more developed nations.

- **Cross-contextual and cross-cultural applicability of the NEP**

It has been found that “culture influences the structure of environmental beliefs” (Bechtel, Corral Verdugo, & de Queiroz Pinheiro, 1999, p. 123). In order to control for the impact of cultural differences on research, a scale needs to be used in a corresponding and homogeneous context to which the scale was developed. Alternatively, a scale should be tested in terms of reliability and cross-cultural applicability prior to being applied in a culture for where the scale was not originally designed. A review of the literature reveals that different versions of the NEP have been administered across thirty-six nations (Dunlap, 2008). Noe and Snow (1990) write that “the NEP scale has also been administered in ethnic and cross-cultural studies seemingly without problems in translation” (Noe & Snow, 1990a, p. 28). While the NEP was first developed for use in the United States of America, it has been utilized in Latin American countries (Bechtel et al., 1999; Vikan, Camino, Biaggio, & Nordvik, 2007), developing countries (Furman, 1998), and European countries (Gooch, 1995).

The NEP has also been used in Australia. Casey and Scott (2006) used the NEP to measure the environmental concern of 292 participants from 126 urban and rural locations across Australia. They found that “the socio-demographic bases of environmental concerns in Australia appear to be quite similar to the socio-demographic bases of such concern found in US studies” (Casey & Scott, 2006, p. 63). They reported that Cronbach alpha for the NEP scale in their study (.84) compared favourably with the corresponding reliability estimates in the US studies: .78, .82
Dimensionality of the NEP

While evidence supports the overall reliability and cross-cultural applicability of the NEP, there is a lack of consensus as to whether the NEP measures a single construct or is inherently multidimensional. While many studies have reported that the NEP is a uni-dimensional scale, thus indicating that all items were seemingly tapping a single attitudinal domain (Albrecht, Bultena, Hoiberg, & Nowak, 1982; Dunlap, Liere, et al., 2000; Edgell & Nowell, 1989; Lefcourt, 1996; Noe & Snow, 1990b; Shin, 2001; Slimak & Dietz, 2006; Steg, Dreijerink, & Abrahamse, 2005), several other studies have reported that the NEP consisted of two or more factors (Bechtel et al., 1999; Gooch, 1995; Noe & Snow, 1990a; Shetzer, Stackman, & Moore, 1991). (Albrecht et al., 1982; Corral-Verdugo, Bechtel, & Fraijo-Sing, 2003; Dunlap & Van Liere, 1978).

2.7.2.2. Environmental attitudes scales for children

Measuring environmental awareness during childhood is of interest to both researchers and environmental program educators. However, there is limited empirical research into the environmental awareness of children. While there are many environmental education programs for children, there are few studies that have used an appropriately developed scale for evaluating children’s environmental orientations. For a scale to be appropriate for use with children, apart from being reliable and valid it needs to be specifically designed for their age. Thus, “instruments that exclusively employed complex question structure to address broad attitudinal dimensions and global concepts in adult and teenage populations are less relevant for younger children” (Larson, Green, & Castleberry, 2011, p. 73). Researchers have developed some child-appropriate environmental attitude assessment instruments, such as CATES (Musser & Malkus, 1994),
CHEAKS (Leeming et al., 1995), 2-MEV (Bogner & Wilhelm, 1996), and CEP (Children’s Environmental Perceptions Scale) (Larson et al., 2011). Following are some of the most common children’s environmental attitudes scales.

- **CATES-1994**

  The Children’s Attitudes toward the Environment Scale (CATES) was developed by Musser and Malkus (1994) to measure environmental attitudes of grade-school children. The scale items reflect children’s knowledge of environmental issues. There have been different opinions about the psychometric properties of the scale. Smith-Sebasto and Semrau (2004) used CATES to evaluate an environmental education program at the New Jersey School of Conservation. Their primary goal was to assess the effect of the NJSOC program on students’ attitudes towards environment. Both Musser and Malkus (1994) and Smith-Sebasto and Semrau (2004) report that CATES has logical internal consistency reliability (Cronbach alpha = 0.70) and high test–retest reliability (0.68, p < 0.001). On the contrary, some studies have raised the issue that CATES has poor test-retest reliability (Kim, Zeman, & Kostareva, 2007). Further investigation reveals that CATES has not been commonly used due to having a bipolar answer structure (Manoli, Johnson, & Dunlap, 2007).

- **CHEAKS-1995**

  The Children’s Environmental Attitude and Knowledge Scale (CHEAKS) (Leeming et al., 1995) was derived from an adult scale developed by Maloney, Ward, and Braucht (1975), and is used to gauge ecological attitudes and knowledge. According to the developers, this scale has been shown to have acceptable levels of validity and reliability. CHEAKS is comprised of two sub-scales. One sub-scale assesses attitude and has thirty-six items (twelve items of verbal commitment, twelve items of actual commitment, twelve items of affect). The other sub-scale
assesses knowledge and has thirty items. These attitudinal items were sampled systematically from six content-dependent sub-domains (water, energy animals, recycling, pollution, and general issues). The knowledge sub-scale also systematically sampled the same six content-dependent sub-domains (Leeming et al., 1995).

Evans, Brauchle, Haq, Stecker, Wong, and Shapiro (2007) raised some criticism about CHEAKS. They stated that this scale includes difficult items for children to understand. The scale also includes items that children don’t generally have any control over. The forced choice response format of CHEAKS can also lead to children becoming disinterested with the task at hand (Johnson & Manoli, 2011). While CHEAKS has generally strong psychometric properties (Walsh-Daneshmandi & MacLachlan, 2006), “it lacks a clearly formulated theoretical basis for its structure” (Johnson & Manoli, 2011, p. 86), and is considered to be long (sixty-six items) for administering to children.

- MEV-1996

The 2-MEV scale was developed by Bogner and Wilhelm (1996) to gauge adolescents’ concern towards environment, and was used to determine the effectiveness of educational programs. The first version of the 2-MEV scale was designed for German students aged from ten to sixteen years old. The scale had sixty-nine items, and was revealed to have several subscales such as attitudes, verbal commitment, and actual behaviour. Following on from several studies that included students from Denmark, Germany, Switzerland, and Ireland, the number of scale items was reduced to twenty (Bogner, 1998a; Bogner, 1998b; Bogner, 1999; Bogner & Wiseman, 1997, 1998; Wiseman & Bogner, 1997). This scale continues to be used throughout the literature (Bogner, 2000; Bogner, 2002; Bogner, Brengelmann, & Wiseman, 2000; Bogner & Wiseman, 2002a, 2002b). Johnson and Manoli (2011) modified the scale even further to make it appropriate
for children aged between nine and twelve years old in the United States of America (USA). The revised 2-MEV scale has sixteen items and is capable of measuring statistically significant changes in participants’ environmental attitudes before and after they participate in Earth education programs (Johnson & Manoli, 2011). The revised 2-MEV scale has the potential to be used in the current study. However, the children’s version of this scale has only been used in the USA. As such, the reliability of this scale in the Australian context is uncertain.

- **CEPS-2011**

The Children’s Environmental Perceptions Scale (CEPS) was developed to measure perceptions of nature held by children aged between six to thirteen years old (Larson et al., 2011). The CEPS measures two distinct components of environmental orientation: eco-affinity and eco-awareness.

Eco-affinity items are identified as reflecting “personal interest in nature and intentions to engage in pro-environmental behaviour, and Eco-awareness items reflectes a cognitive grasp of environmental issues related to the general importance and sustainability of natural ecosystems” (Larson et al., 2011, p. 83). The CEPS was meant to help researchers to find out the ways children perceive the natural world, and “identify cognitive and affective aspects of existing environmental education programs that need improvement” (Larson et al., 2011, p. 72). The CEPS is a psychometrically sound scale and contains fewer items compared to the CHEAKS and CATES scales thus requiring less time to administer (Leeming et al., 1995; Musser & Malkus, 1994). However, the CEPS has some shortcomings in terms of its applicability to the current study. Most of the CEPS items ask about plants and animals. This study requires a more holistic measure covering a broader range of environmental issues. The scale used in this study will need to include items that assess energy consumption, waste reduction and architecture. This measure also needs
to be appropriate to use in different contexts. The CEPS has not been tested in different cultural contexts.

- **NEP for Children-2007**

  The most widely used attitude scale for adults is New Ecological Paradigm (NEP) (Manoli et al., 2007). Manoli, Johnson, and Dunlap (2007) adapted the NEP to make it an appropriate scale to use with children. This scale was called the NEP for Children. This scale includes ten items and has a five-point Likert-scale scoring system from 1 (strongly disagree) to 5 (strongly agree). NEP for Children is appropriate for use with children aged between ten to twelve years old. Manoli and colleagues (2007) reports that the NEP for Children measures the same three interrelated dimensions as the NEP: Rights of Nature, Eco-Crisis, and Human Exemptionalism (humans are exempt from the constraint of nature). However, they also found that “it is possible to treat the scale as a unidimensional measure providing one overall score on the anthropocentric to ecocentric continuum” (Manoli et al., 2007, p. 11).

- **Children’s environmental attitudes scale in this thesis**

  Considering the scope and the limits of the environmental attitudes scales reviewed above, the ten-item NEP for Children by Manoli and colleagues (2007) was adapted for use in this thesis as the environmental attitude scale for children at school (to be termed NEP (Children@School)). The reasons for and procedure of developing the NEP (Children@School) scale is described in detail in the Methodology Chapter.

2.7.3. Environmental behaviours

One of the primary goals of environmental education is to change behaviours (Pooley & O’Connor, 2000). Environmental behaviour contributes the environmental preservation and
conservation (Axelrod & Lehman, 1993). The environmental behaviours of individuals, and the impact people have on environment, have attracted public concern and motivated a wealth of research (Kaiser, 1998). The volume of research devoted to environmental behaviours has increased significantly over the last four decades. Researchers have concluded that “behaviour change is necessary to preserve environmental quality” (Leeming, Dwyer, & Porter, 1993, p. 19).

There have been multiple studies focused on evaluating different determinants of ecological behaviour (Hines et al., 1987). Some of the variables found to influence environmental behaviours are: “knowledge of issues, knowledge of action strategies, attitudes, verbal commitment, and an individual's sense of responsibility” (Hines et al., 1987). However, there is no substantive consensus on which are the most influential incentives that encourage environmental behaviours. This might be due to the complex nature of behaviour itself. It may also be due to inconsistencies in research outcomes. Regardless, the need for a scale that accurately assesses environmental behaviour still exists.

2.7.3.1. Environmental behaviours scales for adults

A review of the literature reveals that assessing environmental behaviours across different domains is a complex issue (Heimlich & Ardoin, 2008). There is a lack of consensus regarding how to accurately measure environmental behaviours. Environmental behaviours can be measured through self-reported measures (e.g. interviews and/or questionnaires), or via rating scales and observations (Erdogan, Ok, & Marcinkowski, 2012). Whether the goal of environmental behaviour research is behaviour change (Leeming & et al., 1993), or assessment and identification of the determinants of environmental behaviour (Hines et al., 1987), accurate measurement of environmental behaviours is pivotal.
Some researchers assume that environmental behaviour cannot be generalized across different research contexts and therefore they have used more specific types of environmental behaviours scales (Berger & Corbin, 1992; Granzin & Olsen, 1991; Liere & Dunlap, 1978; McGuinness, Jones, & Cole, 1977; Schahn & Bohner, 1993; Schahn & Holzer, 1990; Vining & Ebreo, 1992). Conversely, other researchers include different types of behaviours from different domains in a single measure (Levenson, 1974; Smith, Haugtvedt, & Petty, 1994), and thus have developed more general environmental scales (Maloney & Ward, 1973; Maloney et al., 1975; Pickett, Kangun, & Grove, 1993; Ramsey, 1993; Sia, Hungerford, & Tomera, 1985; Smith-Sebasto & Fortner, 1994).

Maloney and Ward (1973) developed the first measure of general environmental behaviour. This measure included thirty-six different items and was presented in a true/false format. The reported internal consistency of this scale was high ($\alpha=.92$). Two years later the measure was revised and condensed down to a ten-item scale (Maloney et al., 1975). This version of the measure had lower internal consistency ($\alpha=.89$) compared to the previous version.

A second general environmental behaviour measure was developed by Hungerford and colleagues (Sia et al., 1985). This measure contained five subscales of eco-management, persuasion, consumerism, political action, and legal action. However, there were concerns regarding the unidimensionality of this measure, and how susceptible it was to issues such as participant’s response style, social pressure, moral norms, and social desirability (Kaiser, 1998).

A less established measure for general environmental behaviour was developed by Fejer and Stroschein (1991). The specification of this measure was to consider different behaviour difficulties of performing (Fejer & Stroschein, 1991). This scale had a yes/no response format and had seven subscales. These subscales were ordered according to their difficulty to conduct.
Another specification of this measure was the “integration of prosocial behaviour items that allow a check on the assumption that ecological behaviour is one branch of prosocial behaviour in general” (Kaiser, 1998).

Preferring general behaviour measures, Kaiser (1998) believes that “specifying behaviour in more and more precise terms is no real solution because measurement gains meaning by allowing generalization” (Kaiser, 1998, p. 398). In other words, when a scale is too specific the outcome of the study that used that scale cannot be readily compared to other studies. As a result, Kaiser (1998) developed the General Ecological Behaviour (GEB) measure. The GEB is assumed to be the most generalizable and all-encompassing environmental behaviour measure compared to the other environmental behavioural measures (Kaiser, 1998). The above literature review suggests that GEB is the most appropriate scale for measuring environmental behaviours in this study.

- **General Ecological Behaviour**

In the absence of a reliable ecological behaviours scale, the General Ecological Behaviour (GEB) scale was developed by Kaiser in 1998 (Kaiser, 1998) as a scientifically grounded measure. He developed this scale in a study of 445 members of two Swiss transportation associations. This initial measure consisted of 40 items with a dichotomous yes/no response format including seven subscales of: 1-pro-social behaviours; 2-ecological garbage removal; 3-water and power conservation; 4-ecologically aware consumer behaviours; 5-garbage inhibition; 6-volunteering in nature protection activities; 7-and ecological automobile use.

In a 2000 study of 686 California students, Kaiser and Wilson employed a 51-item measure in which items 1 to 38 were adopted from the original GEB, and items 39 to 51 were additions. Here, to give a broader variety of responses, they transformed the GEB from a Rasch dichotomous response format to a 5-point Likert format ranging from 1 (strongly disagree) to 5 (strongly agree).
Kaiser and Wilson expected that “not forcing people to decide by allowing them to choose a neutral midpoint may allow them to experience the survey with greater comfort” (2000b). However, the Likert response format did not enhance the reliability of the GEB.

In the same year, Kaiser and Biel (Kaiser & Biel, 2000a) compared ecological behaviours in Sweden and Switzerland. A 30-item questionnaire was adapted from Kaiser (1998) that considered given difficulties for each item as an estimation of the situational constraints affecting that behaviour. They found that the GEB was applicable to both Swedish and Swiss samples.

In 2003, Kaiser et al. explored the ecological validity of a 65-item GEB. They used the yes/no format for 30 items and the polytomous response format for the remaining 35. The polytomous responses were later recoded to dichotomous responses for further analysis. 13 items were omitted from the scale in the process and, at the end, Kaiser et al. were able to validate 46 out of 52 ecological behaviours items (Kaiser, Doka, Hofstetter, & Ranney, 2003).

In 2005 Scheuthle et al. used the 65-item GEB scale to assess different types of conservation behaviours among 660 Swiss and Spanish pupils who self-reported their responses (Scheuthle, Carabias-Hütter, & Kaiser, 2005). They used the GEB to determine the impact of context, such as a pupil’s country and major. The GEB in this study had the reasonable reliability of .88.

- **The GEB scale reliability**

The GEB has been shown to have good reliability. The internal consistency of the scale with Cronbach’s $\alpha$ has ranged from 0.72 (Kaiser & Wilson, 2000b) to 0.81 (Kaiser & Gutscher, 2003).

- **Cross-cultural applicability of GEB**

The GEB is appropriate for cross-cultural applications (Kaiser & Biel, 2000a), because it “neither bounds to a particular set of ecological behaviours nor to a particular questionnaire response format” (Kaiser & Wilson, 2000a, p. 952).
2.7.3.2. Environmental behaviour scales for children

One of the primary goals of environmental education is to motivate ecological behaviours and actions. A common way of evaluating the efficiency of environmental education is to measure its impacts on individuals’ behaviours. As such, assessing environmental behaviours is of critical importance. However, very few scales have been developed to assess children’s environmental behaviour. Following are some of the most common children’s environmental behaviours scales.

- **CREBS**

   Erdogan, Ok, and Marcinkowski (2012) developed the Children’s Responsible Environmental Behaviour Scale (CREBS). This scale was designed for Turkish students in grade four through to grade eight. This scale had twenty-three items, a seven-point Likert type response format, and consists of four subscales: political action; eco-management; consumer and economic action; and individual and public persuasion. Political action refers to the actions individuals take to prevent or resolve environmental problems through political discussions with government or government agencies. The second sub-scale, eco-management, is about direct environmental physical actions of individuals to resolve, restore, and improve environmental systems. The third subscale, consumer and economic action, refers to actions “in which individual use monetary support or financial pressure to help prevent and resolve environmental problems” (Erdogan et al., 2012, p. 507). The fourth subscale, individual and public persuasion, is about the ecological actions undertaken by individuals to persuade others to help resolve environmental problems. CREBS only assesses the most common environmental behaviours, and thus does not include all possible environmental behaviours that children could engage in.

   The CREBS is limited in a number of ways. One limitation relates to the items in the “Political Action” factor. This factor entails questions about communication with government
officials, which it might be argued is rarely applicable to children. For instance, “talking to government officials in order to enforce environmental laws or punish people who violate these laws”, and “encouraging government officials to create a newspaper in order to increase public support for environmental protection” seem out-reach of children in that age. Another limitation relates to its applicability across different cultural and educational contexts. Since this scale is only newly developed in Turkey, it is yet to be tested in contexts with similar cultural, environmental, and educational systems “to explore and extend its external validity and therefore its international usability” (Erdogan et al., 2012, p. 534).

• **CHEAKS**

CHEAKS aims to measure environmental attitudes and behaviours through assessing people’s verbal commitments and actual commitments (Leeming et al., 1995). Although this scale is widely used, it has some limitations for being used in this study. All attitudes, behaviours and knowledge items are mixed in one scale, and there is a lack of distinct orientation to the behavioural issues. More comprehensive information about the characteristics of CHEAKS can be found in Section 2.7.2.2.

• **GEB**

The General Ecological Behaviour scale (GEB) was developed by Kaiser (1998). It measures a variety of environmental behaviours; from simple behaviours through to behaviours that require greater commitment and sacrifice. The GEB is unlike other behaviour scales in that it does not assume an individual’s level of engagement will be uniform across different environmental behaviours (Bond & Fox, 2007).

Evans and colleagues (2007) adapted the GEB to develop an environmental behaviour scale for children. One of the pivotal strengths of this GEB for Children scale by Evans (2007) is
that the questions contained are designed to assess the daily experiences of children. For example, there are no items about phosphate-free detergents, prewashing clothes, or chemical toilet cleaners, because these kinds of questions relate to the environmental behaviours and daily experiences of adults.

- *Children's environmental behaviours scale in this thesis*

Considering the characteristics of the environmental behaviours scales reviewed above, the GEB for Children scale (Evans et al., 2007) was adapted for this thesis as the GEB (Children@School). The reasons for and procedure of developing the GEB (Children@School) scale is described in detail in the Methodology Chapter.

2.8. *Sustainability assessment tools*

A number of tools have been developed to identify whether a building is sustainable or not. While these tools all share similar, underlying concepts, many of the tools are context–specific in that they are informed by the country and cultures they are from. Following is a review of some of the more common tools for assessing building sustainability.

2.8.1. *Internationally*

The BRE Environmental Assessment Method (BREEAM) is one of the most comprehensive and widely recognized measures of a building's environmental performance. This methodology was launched in 1990 and has been regularly updated in order to adhere to current building codes, regulations, and standards in United Kingdom. The BREEAM is the world's leading method for assessing the environmental impact of a building in terms of: energy, health and well-being, transport, material, water, waste, pollution, land use and site ecology, and management (BREGlobal, 2008).
BREEAM is described as setting “the standard for best practice in sustainable building design, construction and operation and has become one of the most comprehensive and widely recognized measures of a building's environmental performance” (“BREEAM," 2014, p. 1). The international version of the BREEAM is called the BREEAM International. BREEAM International has been designed so that it can be easily tailored to match the varying contexts and needs of different countries.

In 1998 the US Green Building Council (USGBC) developed Leadership in Energy and Environmental Design (LEED) based on the BREEAM method. The LEED was tailored to meet United States of America’s construction industry requirements and to help promote sustainability in building construction. The LEED is a recognized standard for assessing American buildings and is a tool that addresses the entire building lifecycle. The goals of the LEED are to elevate design and construction practices while reducing the negative environmental impacts of the built environment and improve the health and wellbeing of building occupants. Different versions of LEED have been developed for different project types ranging from homes, schools to commercial constructions.

2.8.2. Australia

2.8.2.1. Green Star

The Green Building Council of Australia developed Green Star in 2003 with the aim of encouraging the sustainable design and construction of buildings whilst also considering the occupants’ health, and operational costs of the building. Green Star was derived from BREEAM. As such, the two methodologies are very similar except that Green Star has been adapted for the Australian context. This comprehensive rating system is used throughout Australia for a wide variety of building types from houses, schools, shopping centres, and industrial buildings. Even
though Green Star is a voluntary environmental rating method, there are 7.2 million square meters of Green Star certified space around Australia.

Green Star evaluates the environmental performance of the buildings in terms of: management, energy, water, materials, indoor environment quality, emissions, transport, and land use and ecology innovation. Buildings gain green points for each of the aforementioned categories. The total points will determine the overall Green Star rating. The aims of developing Green Star rating system is to establish a common language; set a standard of measurement for built environment sustainability; promote integrated, holistic design; recognize environmental leadership; identify and improve life-cycle impacts; and raise awareness of the benefits of sustainable design, construction and urban planning (Green Building Council, 2014). There are three Green Star certified ratings including: a Four Star rating that indicates ‘best practice’; a Five Star rating that indicates ‘Australian excellence’; and Six Star rating that denotes ‘world leadership’.

The Green Star rating system covers different versions including: Green Star-Office Design V3; Green Star-Office as Built V3; Green Star-Office Design V2; Green Star-Office as Built V2; Green Star-Office Interiors V1.1; Green Star-Retail centre V1; Green Star-Education V1. Although Green Star-Education V1 covers a comprehensive range of efficacious factors, it does not focus specifically on schools. The Green Star rating system did not provide enough information about the schools that achieved a Green Star rating to be considered a useful method of selecting schools for inclusion in this study. Being able to identify sustainably designed schools from conventionally designed school buildings is central to this thesis. As such, it was important to find an environmental rating system that was frequently used by schools.
2.8.2.2. The Australian Institute of Architect’s Awards


Category number 10 (Sustainable architecture), which is the category of interest for this thesis, identifies the projects demonstrating innovative approaches to and superiority in environmental sustainability. Environmental performance of projects are evaluated based on the Australian Institute of Architects Environment Policy (Supplement: Sustainable Design Strategies for Architects) (2001). Eight design strategies have been recommended by the awards program that encompass all stages of pre-design, site and planning issues, concept design, material selection, energy, water, construction management, and building operation and management in ecologically sustainable development of buildings (The Royal Australian Institute of Architects, 2001). The award winners of the sustainable architecture category of Australian Institute of Architects’ Award are considered exemplars of sustainable design.
2.8.2.3. Australian Sustainable Schools Initiative

The Australian Sustainable Schools Initiative (AuSSI) is an initiative that advocates a whole-school approach to sustainability. As such, AuSSI’s goals are not dissimilar to Green Star’s. AuSSI makes it possible for this study to easily discriminate between schools involved in sustainability programs and those schools that are not sustainable.

The Australian Sustainable Schools Initiative (AuSSI) is a partnership of the Australian Government, Australian states and territories, and the Catholic and Independent School sectors. AuSSI supports schools and their communities to live and work more sustainably. AuSSI pilot projects were launched in New South Wales and Victoria in 2003 (Australian government, 2014b). Following the achievements of these pilot programs, Queensland, West Australia, and South Australia received funding to develop sustainable schools. Following on from the success of these programs, in 2004 the Australian government declared the commencement of the Australian Sustainable Schools Initiative (AuSSI).

AuSSI aims to provide an integrated approach to education for sustainability activities across Australian schools, and encourages schools to improve their management of resources and facilities including: water, waste, energy, biodiversity, landscapes, products and materials. AuSSI also aims to encourage students, staff, and community members to engage in sustainability orientated activities. AuSSI promotes sustainability not only through curriculum, but also encourages learning via engagement with sustainable activities (Australian government, 2014b). AuSSI assists schools through providing them with necessary information, resources, high quality tools and facilitators.
ResourceSmart AuSSI Vic- 5 star certificate

ResourceSmart AuSSI Vic is a version of AuSSI contextualized for Victorian schools that aims to support schools and their communities to live sustainably, with an emphasis on environmental management and community engagement. While the initiative does not directly focus on design, it helps schools embed sustainable resource consumption through a consideration of school performance in terms of water, energy, biodiversity and management; qualities that can be improved through design.

Resource Smart AuSSI Vic is managed by Sustainability Victoria in partnership with the Department of Education and Early Childhood Development (DEECD). Resource Smart AuSSI Vic defines the highest level of sustainability as 5 stars and provides a 5 star certificate for those schools that qualify. The stars comprise Awakening, Discovering, Transforming, Sustaining and Leadership, and schools are required to complete the first four levels in order to have the chance to apply for the 5th star (leadership) (Figure 2.2). 5 star is a modular approach comprising Core, Biodiversity, Energy, Waste, and Water (Table 2.5). To progress up through the stars, the schools need to set their benchmarks within the modules and complete the criteria for each star (Sustainability Victoria, 2014). 5 star gives schools the opportunity to show continuous improvement in their environmental performance through the five levels.
Table 2.3: Modules of the 5 Star Certificates

<table>
<thead>
<tr>
<th>Module</th>
<th>Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core</td>
<td>Whole-school approach, environmental management planning, environmental policy plus setting and entering baseline data, evidence and resource use into Schools Environment Tracking System</td>
</tr>
<tr>
<td>Biodiversity</td>
<td>Land care, habitat, ecology and school grounds</td>
</tr>
<tr>
<td>Energy</td>
<td>Land care, habitat, ecology and school grounds</td>
</tr>
<tr>
<td>Waste</td>
<td>Zero waste (reduce reuse and recycle), green purchasing and litter control</td>
</tr>
<tr>
<td>Water</td>
<td>Conservation, storm water management and quality, river health, water way protection and coast care</td>
</tr>
</tbody>
</table>

2.9. Summary of the literature review

This chapter opened with a brief overview of the environmental challenges Australia is facing that underscore the importance of preventing further damage to the environment as a result of human activities. A number of studies have indicated that the environmental orientations of adults are shaped by their childhood experiences. The interrelationship between children and environment was also reviewed. Environmental education (EE) for children was explored as a
possible solution to environmental problems. However, a review of the EE literature indicated a
notable gap in knowledge about the role of the sustainable built environment in environmental
education. While there is a wealth of research on the link between students’ learning outcomes and
the physical characteristics of buildings, there is only limited empirical research addressing the
impact of sustainable school design on children’s educational achievements. In a move towards
addressing this knowledge gap, the correlation between school physical characteristics and
educational attainment was explored; as was the relationship between the school built environment
and children’s behaviours and attitudes. The findings of this review argued for sustainable school
design as an important teaching tool for informing children’s environmental attitudes and
behaviours. This review was concluded by a discussion identifying the assessment tools used for
addressing the research question of this thesis. These assessment tools will be used to measure
children’s environmental attitudes and behaviours and identify sustainable school buildings and
facilities.
Chapter Three

Methodology
3.1. Introduction

This chapter presents the methodology used to answer the research questions on the effects of sustainable design on children’s environmental awareness. First, this chapter will introduce the participants, including the rationale for how schools designed for sustainability were differentiated from conventional schools. Second, the materials used, namely the scales measuring environmental attitudes (NEP) and behaviours (GEB), are outlined. Finally, the procedure of survey implementation and data collection is described and followed by some concluding remarks.

3.2. Participants

This section will describe the rationale for selecting the case study schools of this thesis, and the three groups of participants; children, parents, and teachers.

3.2.1. Rationale for selecting sustainable versus conventional primary schools

As discussed in the literature review, Section 2.8.2, two different tools and one awards program have been discussed to evaluate sustainability in Australia. As each of these assessment methods has been developed to address specific goals, there are some similarities and some differences between them. To find out which of these approaches could be the best for the purpose of this study, the characteristics, advantages and disadvantages of each are indicated in Table 3-1 and Table 3-2.
Table 3-1: Different sustainability assessment methods in Victoria and their characteristics

<table>
<thead>
<tr>
<th></th>
<th>Pre-design sustainable Strategies &amp; Concept Design</th>
<th>Siting &amp; Planning Issues</th>
<th>Management/Construction Management</th>
<th>Energy</th>
<th>Water</th>
<th>Land Use &amp; Ecology</th>
<th>Innovation</th>
<th>IEQ</th>
<th>Transport</th>
<th>Materials/Waste</th>
<th>Emissions</th>
<th>Indication</th>
<th>Number of the Vic primary schools which have been granted this certificate prior to 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green Star</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Certified by Green Star</td>
<td>1- Wyndham Vale Select Entry School</td>
</tr>
<tr>
<td>Victorian Architecture Awards</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>Victorian Architecture Awards</td>
<td>1- North Melbourne Primary School 2, 2- Epping Views Primary School</td>
</tr>
<tr>
<td>ResourceSmart AuSSI-Vic</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>●</td>
<td>5star certificate</td>
<td>26 schools in Victoria</td>
</tr>
</tbody>
</table>

1. Through management category: Adoption of sustainable development principles from project conception step (Green Building Council, 2014).
2. Through Building Operation & Management category: Ensuring that Environmental Sustainable Design initiatives of the design and construction stages are well understood and utilized by building occupants during the building lifetime (The Royal Australian Institute of Architects, 2001).
3. These two schools are winners of public architecture award not sustainable architecture award (Architects, 2013).
4. Through Biodiversity module: protecting the school site, grounds, and surroundings, preserving local ecosystem, plants, and animals (Sustainability Victoria, 2014).
5. Through Core module: Evaluating the existing situation in terms of sustainability, where you want to go, and you want to get there (Sustainability Victoria, 2014).
Table 3-2: Strengths and weaknesses of the three sustainability assessment methods in Victoria

<table>
<thead>
<tr>
<th>Method</th>
<th>Strengths</th>
<th>Weaknesses</th>
<th>Overall assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Green Star- By Green Building Council Australia</strong></td>
<td>- Encompassing essential criteria for sustainability</td>
<td>- Only a few certified Buildings were found in Victoria;</td>
<td>Not appropriate for this study because of not having enough cases in Victoria State.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Not very popular among primary schools;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Only one certified primary school were found;</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Not evaluating the environmental performance - Because that school building is recently certified</td>
<td></td>
</tr>
<tr>
<td><strong>Victorian Architecture Awards</strong></td>
<td>- Well-recognized</td>
<td>- Only 2 primary schools in Victoria won the award (refer to table 2-8)</td>
<td>Not appropriate for this thesis because only two primary schools that had sustainability features won the award so far. So this does not provide an appropriate pool of primary schools for the researcher to select the case studies from.</td>
</tr>
<tr>
<td></td>
<td>- Launched in 1929</td>
<td>- Those two primary schools were not the winners of sustainable architecture award</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Including different awards category including sustainable architecture</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ResourceSmart AuSSI-Vic</strong></td>
<td>- Large number of schools involved</td>
<td>- Not specifically addressing the architecture of schools</td>
<td>Appropriate for this study - This initiative has a lot of common criteria with other evaluating tools which are more architectural; and also there are large numbers of schools which have been awarded the sustainability 5star certificate.</td>
</tr>
<tr>
<td></td>
<td>- More feasible for schools to take part</td>
<td>- Emphasize on environmental management and community engagement more than actual built environment</td>
<td></td>
</tr>
</tbody>
</table>
Although Victoria has the largest number of Green Star certified projects in Australia, and although the educational category of the Green Star rating system covers a variety of educational buildings, including Education as Built v1, Education Design v1, Education PILOT, there have only been a few educational buildings in Victoria that have been Green Star certified (green building council Australia, 2014). Overall, despite the comprehensiveness and popularity of Green Star, it is not a tool commonly used for assessing the sustainability of primary schools.

The second choice for selecting sustainable schools in Victoria was the Australian Institute of Architects Award. According to the Australian Institute of Architects website, none of the award winning primary schools claimed the Sustainable Architecture Award, and thus can not be used as case studies for this thesis.

The ResourceSmart AuSSI Vic was investigated as the third choice for identifying sustainable schools in Victoria. ResourceSmart AuSSI Vic has common criteria with both Green Star and the Australian Institute of Architects Award. After careful investigation, ResourceSmart AuSSI VIC was found to be the most frequently used method for determining the sustainability credentials of Victorian primary schools.

Although ResourceSmart AuSSI VIC does not focus on design credentials, it does consider school performance in terms of water, energy, biodiversity and management; qualities that are very closely connected to design. This connection has been discussed in the Building Operation and Management strategy contained in the Sustainable Design Strategies of the Royal Australian Institute of Architects (The Royal Australian Institute of Architects, 2001). Sustainability Victoria’s justification for not focusing on the design of school buildings in 5 star certification is that most schools are not built from scratch. As such, ResourceSmart AuSSI Vic works with the school’s existing facilities to improve resource efficiency as well as infrastructure changes. While
having a school building designed for sustainability might be considered a latent advantage for better performance, Sustainability Victoria evaluates schools on resource-consumption performance rather than other design quality indicators.

There were twenty-six 5 star schools in Victoria by 2013 (AuSSIVic, 2013). This pool of sustainable schools provided practical access to information on schools actively involved in sustainability. This information was reported in the annual ResourceSmart Schools Award, which assesses schools on sustainability criteria for different categories of award, such as: ResourceSmart School of the Year, Energy School of the Year, Water School of the Year, Waste School of the Year, Biodiversity Smart School of the Year, etc. Only three out of twenty-six sustainable primary schools made themselves available for the data collection of this study – St Macartans, Epping Views, and Gembrook Primary School. The sustainability characteristics of these schools are detailed below.

In 2012, Epping Views Primary School was the finalist for Biodiversity Smart School of the Year and winner for: ResourceSmart School of the Year (the top award), Waste School of the Year, Water School of the Year, and Teacher of the Year. It continued to be Waste Primary School of the Year in 2013 (Victoria, 2014). This school has large areas of solar panels and water tanks for harvesting rainwater designed to be highly visible from the children’s playground. There are ten large water tanks in total, with messages printed on them such as: every drop counts; be water wise; learn water-live water; save water-save life; our water-our future. There is also a rainwater calculator for children to gauge how much water is saved in the tanks. There are also outdoor learning spaces, playgrounds constructed of natural material, and a hen house.

St Macartan’s Primary School was winner of Energy School of the Year in 2012, and also the finalist for: Biodiversity Smart School of the Year, Water School of the Year, and Student
Action Team of the Year. It continued to be Community Leadership Primary School of the Year and student Action Team Primary School of the Year in 2013 (Victoria, 2014). This school has developed a sustainability centre where students can experience animal husbandry, growing plants and vegetables, propagating plants, planting, composting, and associated scientific concepts. It utilises solar panels, water tanks, and numerous outdoor learning spaces. This school did not use air conditionaires for cooling the classrooms, rather the school building is designed for natural ventilation and in some cases ventilation fans are used.

Gembrook Primary School was selected as another sustainable school as it was awarded a 5star certificate. This school had energy and water audit equipments for maintaining the records of resource consumption that can be accessed easily by both students and staffs. The trees used in design of the outdoor environment were selected for their low water use, and natural material was used in play areas to reduce the impact on the environment. The addition of compost and outdoor eating areas, and adoption of a biodiversity module to inform ideas for developing the school grounds were among other measures taken in Gembrook primary school.

It should be noted that the three selected sustainable schools have greater access to resource-conservation facilities. Equipment such as energy meters and water meters, as explicit examples of facilities in these schools, allow children to control and monitor resource consumption. These schools also use clean, non-polluting and renewable energy sources, such as solar energy. Sustainable schools also have gardens that allow children to grow their food locally. Although, growing food might be a symbolic action at these schools, but encourages children to practice this behaviour to avoid carbon emission.
Table 3-3 summarizes the sustainable schools identified in this thesis versus conventional schools. The difference in the number of schools selected from each category can be explained by the desire to have a near equal sample size of children in each type of school.

Table 3-3: Selected sustainable and conventional schools

<table>
<thead>
<tr>
<th>Type of the School</th>
<th>Primary Schools</th>
<th>Suburb in Victoria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable schools (5 Star)</td>
<td>St Macartans</td>
<td>Mornington</td>
</tr>
<tr>
<td></td>
<td>Epping View</td>
<td>Epping</td>
</tr>
<tr>
<td></td>
<td>Gembrook</td>
<td>Gembrook</td>
</tr>
<tr>
<td>Conventional schools</td>
<td>Geelong East</td>
<td>Geelong East</td>
</tr>
<tr>
<td></td>
<td>Rollin’s</td>
<td>Bell Post Hill</td>
</tr>
<tr>
<td></td>
<td>Belmont</td>
<td>Belmont</td>
</tr>
<tr>
<td></td>
<td>St Partick’s</td>
<td>Geelong West</td>
</tr>
</tbody>
</table>

3.2.2. Children

The children participants included students in the fourth, fifth, and sixth grades with an age range of ten years old to twelve years old. The children participants were 42% male and 58% female. The schools made all their children available for data collection. The children selected for participation were thus simply those students who were present on the day of survey who had brought their parents’ questionnaires. Parents’ questionnaires were needed on the day of data collection because children’s and parent’s data had to be paired and the surveys had no identifying information. Thus, while 624 children completed the survey, data from only 275 could be used in the analyses (Table 3-4). The grade level composition of the participants was: 101 children from grade four (ages nine to ten), ninety-one from grade five (ages ten to eleven), and eighty-three from grade six (ages eleven to twelve). Grade level composition distributions were not equally spread across the two categories of schools. Of the 275 usable surveys, 132 were from students enrolled at schools designed for sustainability. The other 143 surveys were from students enrolled at conventional schools. There were fifteen children from Geelong East, thirty-one children from
Rollin’s, thirty-one children from Belmont, sixty-nine children from St Macartan’s, forty-nine children from Epping View, fourteen children from Gembrook and sixty-six children from St Patrick’s primary school.

3.2.3. Teachers and Parents

Adult influence is one of the external environment factors that “has a critical role in children’s learning. The adult role has two basic aspects: interaction with children in their daily lives and provision of the physical environment in which children operate” (Charlesworth, 2011, p. 68). Due to the potential impact teachers and parent might have in shaping children’s environmental attitudes and behaviours, both teachers and parents were included as part of this thesis.

Teachers who taught the students who were included in the study were also surveyed. The teachers were invited to complete the adult version of the same scales used for children (NEP and GEB). Forty-two teachers aged from twenty-three to fifty-one years old responded to the survey: three teachers from Geelong East, five teachers from Rollin’s, six from Belmont, ten from St Macartan’s, seven from Epping View, four from Gembrook, and seven teachers from St Patrick’s primary school (Table 3-4). The teacher participants were 27% male and 73% female.

Parents whose children were included in the survey were also invited to participate in the survey6. Although the parent questionnaires were sent to almost all surveyed students’ homes, not all of the parent surveys were included in the analysis. This was because either some children did not return their parents’ questionnaire or the child did not show up on the date of the data collection. In the second situation, the specific parent’s data was taken out of the analysis. In a few

6 Children were coupled with only one parent. It was not deemed necessary to collect information on the marital status of parents because such sensitive data would be seen as unnecessary given the focus of the thesis.
cases children returned their parent’s questionnaire after the date of the data collection. As those surveys could not be matched with the corresponding child’s data, that parent’s data was excluded from the analysis\textsuperscript{7}. Overall, fifteen parents from Geelong East, thirty-one parents from Rollin’s, thirty-one parents from Belmont, sixty-nine parents from St Macartan’s, fourty-nine parents from Epping View, fourteen parents from Gembrook, and sixty-six parents from St Patrick’s primary school completed the questionnaires (Table 3-4). Parents’ ages ranged from twenty-four to seventy years old. While 79% of the parents were female, 21% were male. These age and gender variances did not bias results, as the age and gender distribution was similar between the two types of schools.

Inviting parents and teachers to fill in the same scales as those used for the children (NEP and GEB) allowed for the comparison of common concepts between adult and children participants. Analysing data from teachers and parents also meant that the influence of school building design on children’s behaviours and attitudes could be isolated from the influence of parents and teachers.

Table 3-4: Participants of this study

<table>
<thead>
<tr>
<th>Type of school design</th>
<th>Number of children participants</th>
<th>Number of parents participants</th>
<th>Number of teachers participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geelong East</td>
<td>Conventional</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Rollin’s</td>
<td>Conventional</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>Belmont</td>
<td>Conventional</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>St Macartan’s</td>
<td>Sustainable</td>
<td>69</td>
<td>69</td>
</tr>
<tr>
<td>Epping View</td>
<td>Sustainable</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Gembrook</td>
<td>Sustainable</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>St Patrick’s</td>
<td>Conventional</td>
<td>66</td>
<td>66</td>
</tr>
<tr>
<td>Total</td>
<td>Both</td>
<td>275</td>
<td>275</td>
</tr>
</tbody>
</table>

\textsuperscript{7} In preparation for the different analyses, teachers’ and parents’ data needed to be matched to individual children.
3.3. Materials

Different environmental attitudes and behaviours scale were reviewed in Literature Review Chapter. NEP (Dunlap et al. 2000) and GEB (Kaiser & Biel, 2000) were selected to be adapted as the suitable attitudes and behaviours scale for this study. Different characteristics of these scales, such as the evolution process of NEP, reliability, cross-cultural applicability, and dimensionality were discussed in detail in the literature review Chapter. This section describes how the NEP and GEB scale were used and in some cases adapted to develop the environmental attitudes and behaviours scales of this study for adults and children.

3.3.1. NEP (Parents)

In order to assess the environmental attitudes of parents, the 15-item NEP scale (Dunlap et al. 2000) was administered without any modification. Expert advice supported the face validity of the NEP, and ensured that the NEP was indeed suitable for the contextual and cultural characteristics of Australia. The NEP used for parents in this study will be referred to as NEP (Parents). The NEP (Parents) scale can be found in Appendix B, Table 1.

3.3.2. NEP (Teachers)

In order to assess the environmental attitudes of teachers, six extra items were added to the NEP 15-item scale (Riley & Dunlap, 2000). These six items, which pertained to school environmental attitudes, are listed below:

- I would be willing to teach in a school which is part of nature.
- I believe that the light in classroom should be generated by solar panels.
- I feel uncomfortable to use recycled water for irrigating the school garden or flushing the toilets in the school.
- I’d be willing to grow food in the school garden.
- I feel more connected with nature when I hold my classes in outdoor space.

- It makes me feel better when we have daylight rather than artificial light all day in classroom.

The NEP scale used for measuring teachers’ environmental attitudes in this study will be referred to as NEP (teachers). The NEP (teachers) scale can be found in Appendix B, Table 2.

3.3.3. NEP (Children@School)

The literature reviewed in Chapter Two indicated that the NEP would be the most appropriate attitude scale to assess the environmental attitudes of children. This conclusion was based on the work of Manoli and colleagues (2007) who adapted the original NEP scale to make it appropriate to use with children. This scale was called NEP for Children, and was appropriate for use with children aged between ten to twelve years. The NEP for Children includes ten items and has a five-point Likert-type scoring system from 1 (strongly disagree) to 5 (strongly agree). Manoli and colleagues (2007) found the instrument measures three interrelated factors of the New Ecological Paradigm: Rights of Nature, Eco-crisis, and Human Exemptionalism. They also found that “it is possible to treat the scale as a uni-dimensional measure providing one overall score on the anthropocentric to ecocentric continuum” (Manoli et al., 2007, p. 11).

In order to adapt the NEP for Children scale to the purposes of this study, six items were added to the scale that related to ecologically sustainable design of schools:

- I would be willing to go to a school which is part of the nature.

- I believe that artificial light in classrooms should be generated by solar panels.

- It makes me feel bad to use recycled water for watering the garden or flushing school toilets.

- I would be willing to grow food in the school garden.

- I feel more connected with nature when classes are held in outdoor spaces.
- It makes me feel better when we have natural daylight rather than artificial light all day in classrooms.

The modified NEP will be referred to as NEP (Children@school). Experts from different areas of specialization, including primary school teachers, science educators, ecology university lecturers, sustainability teachers, and environmental educators, examined the NEP (Children@school) questionnaire for both content and face validity. They checked the content, comprehensibility and clarity of the items (as recommended by Erdogan, Ok, & Marcinkowski, 2012). Consequently, some sentences were re-worded and shortened, and some technical terms were replaced by terms more familiar to children. The NEP (Children@school) scale can be found in Appendix B, Table 3.

3.3.4. GEB (Parents)

As mentioned in Section 3.3, the 30-item GEB (Kaiser & Biel, 2000) was the parents’ environmental behaviours scale selected for use in this study. Minor modifications were made to the GEB (Kaiser & Biel, 2000) in order to tailor it to the requirements of this study. Four items were deleted as the result of expert advice received from primary school teachers, science educators, ecology university lecturers, sustainability teachers, and environmental educators, or because they were not applicable to the context of Australia, or because they weakened the scale reliability. The modified GEB for parents with 26-items will be referred to as GEB (Parents) in this study. The GEB (Parents) scale can be found in Appendix B, Table 4.

3.3.5. GEB (Teachers)

The GEB scale used for measuring teachers’ environmental behaviours was the same as the GEB (Parents), and was called GEB (Teachers). The GEB (Teachers) scale can be found in Appendix B, Table 5.
3.3.6. GEB (Children@School)

The literature reviewed in Chapter Two indicated that the GEB scale was an appropriate measure for assessing children’s ecological behaviours. The environmental behaviour scale for children in this study, referred to as the GEB (Children@School), was adapted from the 8-item Evans and colleagues (2007) jumping game. Evans and colleagues (2007) assessed children’s environmental behaviours through a jumping game based on Kaiser’s GEB (Kaiser & Biel, 2000). The participants in Evans and colleagues (2007) study were first-grade and second-grade students. These children were “instructed to jump to the appropriate line to indicate how frequently (never, sometimes, most of the time) he or she engaged in the behaviour” (Evans et al., 2007, p. 643).

Although the content of the GEB (Children@School) was adapted from Evans and colleagues (2007), this study used a 5-point Likert questionnaire (Never, Seldom, Sometimes, Usually Always) as opposed to the jumping game response format used by Evans and colleagues (2007). While jumping games might be more alluring for younger children, the same games may not have engaged older children. Moreover, the large number of participants, and the time consuming nature of the jumping game, made this format impractical for the purposes of this study.

In order to modify Evans and colleagues (2007) scale, the items had to be re-phrased to target school-related ecological behaviours. As part of this modification two extra items were added:

-I turn on the air conditioner rather than opening the glass window when it is warm inside.
-I don’t turn on the classroom lights because there is always enough light in my classroom.

The GEB (Children@School) asks students about their daily school behaviours in which environmental considerations could be an issue. The GEB (Children@School) scale can be found in Appendix B, Table 6.
3.4. Procedure

This section will describe the ethics approval and explain how the pilot study and the main study was carried out.

3.4.1. Ethics Approval

Ethics approval was obtained to collect information from primary school children, teachers, and parents. Obtaining the ethics approval to gather information from children had two stages. The first step was to obtain DEECD (Department of Education and Early Childhood Development) approval (No.2012-001422). This approval was prerequisite to Deakin University Human Research Ethics Committee (DUHREC) approval. DUHREC ethics approval was received on the 2nd of March 2012 (No.2012-016).

According to the ethics approval, the following commitments needed to be observed:

- All the data was collected anonymously, and plain language statement and the consent form were given to all participants prior to data collection.

- According to the requirements of Deakin ethics approval, all the data collected through hardcopies (parents and teachers questionnaires) was to be kept in a locked file cabinet to maintain confidentiality and information safety. All other digital data collected through clickers\(^8\) was to be stored in a safe personal drive of the researcher with a password for accessing.

- Any participants of the project could withdraw from attending the survey without any adverse consequences. Children were asked to freely leave the survey responding if they

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\(^8\) Clicker is an interactive voting system used for the data collection of this thesis. Detailed description can be found in Section 3.4.2.
didn’t feel comfortable in any way. Children did not require the researcher’s permission to quit the attendance. They were only required to return the clickers.

The ethics approvals granted by DEECD and DUHREC, and examples of the Plain Language statement and the consent forms are presented in the Appendix D.

3.4.2. Pilot-testing the NEP (Children@School) and GEB (Children@School)

The initial draft of the NEP (Children@School) and GEB (Children@School) scales were administered at Geelong East primary school for pilot testing to investigate the appropriateness of the scale for children in grades four to six. The aim of the pilot testing was to identify any difficult terms or ambiguous questions, and also determine the effectiveness of the clicker survey method.

Clickers (keypads) were used to collect the data because it was believed that clickers would interest and engage children in the activity of answering the survey. A clicker resembles a television remote control. It uses infrared or radio frequency technology to transmit and record responses to questions that are presented to children through a video projector. The clicker not only collects data, but also makes the data immediately available via a graph generated by the KP1 software. Clickers maintained the children’s attention and therefore proved to be a useful data collection device.

The following stages show how clickers were employed in this study:

1- A video projector was used to demonstrate some five-point Likert type items through PowerPoint slides.

2- Children clicked their desired answer using remote transmitters (each clicker was registered to one child and it could generate unique and identifiable responses).

3- A USB was used to collect and record students’ responses.
4- The collected information was tabulated instantly and could be presented to participants in the shape of the bar chart, histogram, pie chart etc.

5- A spread sheet of responses was also generated by the program for subsequent analysis.

Using Clickers also ensured the accuracy of the data transferred. Visual inspection of the response graph, immediately generated after asking each question, also helped the researcher to monitor problems and identify areas that required any improvement (ELI, 2005). However, the clickers also presented some challenges. Some children started to play with clickers and sometimes clicked without reading the items. Children were reminded that a sentence should be read and answered accurately. The problem was solved to a large extent after children found that there is no possibility to edit their responses once they have clicked.

Figure 3-1: Clicker for data collection

The pilot test indicated there were no problematic items on the scale, and that the children could answer the questionnaire without any confusion. Clickers were also shown to be a successful means of data collection. As such, the Geelong East primary school sample was also used in the final analysis of the thesis data alongside the main study.
3.4.3. Main study

The 16-item NEP (Children@School) and 10-item GEB (Children@School) questionnaires were then administered in three schools considered as designed for sustainability – St Macartan’s, Epping View, and Gembrook Primary School – and three conventional schools - Rollin’s, Belmont, and St Patrick’s Primary schools. The criteria used to select sustainable versus conventional schools were comprehensively explained in Section 3.2.1. Prior to data collection, a number of tasks were undertaken. These tasks are listed below:

- Parents’ plain language statement, consent forms, and questionnaire were sent to children’s homes two-three weeks before going to schools for the data collection.
- Parents were asked to study the plain language statement, which was a brief description of the project, and sign the consent form if they are happy for their children to participate.
- Parents were also asked not to talk about the content and concept of the study with their children prior to the date of the data collection from children in an effort to minimise any impact on the data from possible short-term parents’ or teachers’ environmental attitudes and behaviours.
- Children were encouraged to return the parents’ questionnaire on the day they were to be surveyed. The reason was that the collected data from children needed to be anonymous and at the same time needed to be matched with their corresponding parents.

On the day of testing forty-five minutes was allocated for data collection. Due to limited resources, it was only possible to collect the data from a maximum of fifty children at a time. In each school, at least one of the teachers assisted handing out the children’s consent forms and clickers, and supervised the children by encouraging them to answer carefully. Before launching the PowerPoint slides that contained the questions, the researcher ensured that all children
understood that the data was anonymous and that the child could terminate the survey at any time without any consequences. There were six steps to the survey process:

1. Allocate a clicker to each student. Each clicker was registered to a student and generated a unique and identifiable signal.

2. Since each clicker had a number on it, the researcher asked the children to write the number of the clicker at the top of the parent’s questionnaire that the students had brought on the same day. This number was used to anonymously match the data from the child with the corresponding parent.

3. The parent’s consent forms and questionnaires were collected.

4. It was then emphasized that once the children selected an answer via the clicker, they could not clear or revise it. While it was practically possible to edit the answers, this function was disabled as it was found that most children liked to play with the clickers. This ‘play’ could affect the precision and the accuracy of the answers if it led to an accidental edit.

5. Each item of the questionnaire was read aloud from a PowerPoint slide shown on a big screen. This was because the children in the pilot appeared to better comprehend the items when somebody else read them. Each word of the sentences was read uniformly and with the same intonation to avoid indicating degree of approval toward any answers.9 Children were invited to ask questions and request further explanation if any question was not clear. These measures facilitated a constructive, helpful and friendly ambience. Nobody requested to terminate the procedure in the middle of the data collection.

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9 During the data collection, but only in some schools, it was identified that some items were still unclear. These uncertainties were related to the items that tapped behaviours that children had no discretion over (e.g. forgetting to turn off water after washing hands in the school toilets, because their school had automatic taps, or turning on and off the air conditioner when teachers adjusted the class temperature when necessary). As the main concern of the researcher was to track children’s behaviours, in such cases children were asked to think about the same behaviours at home (e.g. forgetting to turn off water after washing hands at their house toilet).
6. As students entered their selection, a running tally of students’ responses was projected on the screen, and the number of the respondents to each question could be monitored with the clicker software. As such, it was possible to track how many students replied and how many were still thinking or who had difficulties in answering. This also provided a good indication when it was appropriate to move to the next slide. However, this issue was sometimes problematic. For example, some of the students didn’t answer till the last second when they were warned that the presenting slide was going to be changed to the next one. A few students also tried to avoid answering some of the items. In these cases, a countdown clock was activated on the slide and children were encouraged to answer within the time frame. If they still did not answer, the next slide was presented. Some missing data was deemed as acceptable.

3.5. Concluding Remarks

This chapter explained the selection of the sustainable and conventional schools used as the case studies of this study, as informed by the ResourceSmart AuSSI VIC 5 star certificate. ResourceSmart AuSSI VIC was the selected sustainability assessment tool of this study based on the thorough review conducted in Section 2.8.2. Next, the three groups of participants of this study were explained. The chapter then continued with describing the environmental attitudes and behaviours scales used for the three groups of participants. This chapter concluded by discussing the procedures involved, including the ethics approval framework, pilot testing the adapted scales, and the survey implementation in the main study.
Chapter Four

Results
4.1. Introduction to analysis

This chapter outlines the statistical analyses conducted to explore the relationships between School-design and Children’s Environmental Attitudes and Behaviours. Apart from School-design, the Environmental Attitudes and Environmental Behaviours of both Teachers and Parents were identified as factors that could also influence children’s environmental awareness. As such, this chapter aims to examine the impact of School-design on Children’s Environmental Attitudes and Behaviours while also differentiating this impact from the influence of teachers and parents.

The chapter proceeds from a review, in Section 4.2, of the environmental measures used for evaluating the attitudes and behaviours of the participants of this study. Next, Section 4.3 describes the strategies for calculating the variables used for analyses. In Section 4.4, a series of multiple regression analyses are described that were conducted to determine the possible relationship between School-design, Parents’ Environmental Attitudes and Behaviours and Teachers’ Environmental Attitudes and Behaviours and Children’s Environmental Attitudes and Behaviours. Section 4.5 continues with a Multivariate Analyses of Variance to investigate the impact of School-design on the five identified factors of Children’s Environmental Attitudes and Behaviours. This section determines if there are statistically significant differences between the Environmental Attitudes and Behaviours scores of children in schools designed for sustainability and those in conventional schools. The chapter concludes in Section 4.6 with a summary of the analyses findings.

4.2. Environmental measures designed for this thesis

As discussed in previous chapters the NEP and GEB were adapted for the purposes of this study to measure children’s and adults’ environmental attitudes and behaviours (Table 4-1). For
the purpose of this study, NEP (Parent), NEP (Teachers), GEB (Parent), and GEB (Teachers) were analysed as a uni-dimensional scales due to having respectable reliability estimates of .79, .85, .75, and .78 respectively (These scales could be found in Appendix B). NEP (Children@School) and GEB (Children@School) scales were subjected to factor analysis and reliability tests.

Table 4-1: Developed scales for this thesis

<table>
<thead>
<tr>
<th>Scale name</th>
<th>Number of the items</th>
<th>Number of the factors</th>
<th>Identified factors (Dimension)</th>
<th>Scale reliability estimate (ω)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitudes</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NEP (Parents)</td>
<td>15</td>
<td>1</td>
<td>Parents’ Environmental Attitudes</td>
<td>.79</td>
</tr>
<tr>
<td>NEP (Teachers)</td>
<td>21</td>
<td>1</td>
<td>Teachers’ Environmental Attitudes</td>
<td>.85</td>
</tr>
<tr>
<td>NEP (Children@School)</td>
<td>14</td>
<td>3</td>
<td>Human Intervention</td>
<td>.71</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ESD at School</td>
<td>.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Eco-Rights</td>
<td>.57</td>
</tr>
<tr>
<td>Behaviours</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GEB (Parents)</td>
<td>26</td>
<td>1</td>
<td>Parents’ Environmental Behaviours</td>
<td>.75</td>
</tr>
<tr>
<td>GEB (Teachers)</td>
<td>26</td>
<td>1</td>
<td>Teachers’ Environmental Behaviour</td>
<td>.78</td>
</tr>
<tr>
<td>GEB (Children@School)</td>
<td>10</td>
<td>2</td>
<td>Pro-active Eco-behaviours</td>
<td>.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Resource and Energy Conserve Behaviours</td>
<td>.51</td>
</tr>
</tbody>
</table>

4.2.1. Reliability of the NEP (Children@School)

Prior to conducting further analysis on collected data, the psychometric properties of the NEP (Children@School) were evaluated.

McDonald’s omega \(^{10}(\omega)\) was calculated for the NEP (Children@School) as the measure of reliability. The dimensionality of this scale was checked due to the need to calculate omega for each of the potential subscales – known as factors. Principal component analysis was conducted employing the Varimax rotation method. A KMO value of .803 and Bartlett’s Test of Sphericity

\(^{10}\) Omega was calculated with R package. R is an integrated, interactive environment for data manipulation and analysis that includes functions for standard descriptive statistics (means, variances, ranges).
significance value of .000 indicated that factor analysis was appropriate for this sample. The results suggested that there are three factors within the NEP (Children@School) scale: Human Intervention, ESD at School, and Eco-rights. Estimate reliability of omega was calculated for all the three identified factors. As the result, two items were dropped from the scale because the items decreased the reliability and also did not consistently reflect the factor it had the highest loading on.

It is worth underlying that all of the items within ‘Rights of Nature’ factor in Manoli et al. (2007) study have fallen into ‘Eco-right’ factor in this study. Moreover, the items classified in ‘Eco-crisis’ and ‘Human Exemptionalism’ in Manoli et al. (2007) study have been classified within the ‘Human Intervention’ factor in this study with some deletions and modifications. Five of the six new items in NEP (Children@School) scale were grouped within the ESD at School factor. The indication is that the NEP (Children@School) is constituted from fourteen items and three factors, as summarized in Table 4-2.
Table 4-2: Identified factors for the NEP (Children@School)

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Three Hypothesized Factors for the NEP (Children@School)</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>If things don’t change; we will have a big disaster in the environment soon.</td>
<td>Human Intervention</td>
<td>.697</td>
</tr>
<tr>
<td>People will someday know enough about how nature works to be able to control it.</td>
<td></td>
<td>.654</td>
</tr>
<tr>
<td>When people mess with nature it has bad results.</td>
<td></td>
<td>.379</td>
</tr>
<tr>
<td>People are clever enough to keep from ruining the earth.</td>
<td></td>
<td>.435</td>
</tr>
<tr>
<td>People are treating nature badly.</td>
<td></td>
<td>.231</td>
</tr>
<tr>
<td>I would be willing to go to a school which has a focus on nature.</td>
<td>ESD at School</td>
<td>.328</td>
</tr>
<tr>
<td>I believe that artificial light in classrooms should be generated by solar panels.</td>
<td></td>
<td>.279</td>
</tr>
<tr>
<td>I would be willing to grow food in the school garden.</td>
<td></td>
<td>.683</td>
</tr>
<tr>
<td>I feel more connected with nature when classes are held in outdoor spaces.</td>
<td></td>
<td>.680</td>
</tr>
<tr>
<td>It makes me feel better when we have natural day light rather than artificial light all day in classrooms.</td>
<td></td>
<td>.569</td>
</tr>
<tr>
<td>People must still obey the laws of nature.</td>
<td>Eco-Rights</td>
<td>.309</td>
</tr>
<tr>
<td>Nature will survive even with our bad habits on earth.</td>
<td></td>
<td>.679</td>
</tr>
<tr>
<td>People are supposed to rule over the rest of nature.</td>
<td></td>
<td>.582</td>
</tr>
<tr>
<td>Plants and animals have as much right as people to live.</td>
<td></td>
<td>.518</td>
</tr>
<tr>
<td>Eigenvalue</td>
<td></td>
<td>3.190</td>
</tr>
<tr>
<td>Percentage of Variance</td>
<td></td>
<td>19.93</td>
</tr>
<tr>
<td>omega</td>
<td></td>
<td>7.15</td>
</tr>
</tbody>
</table>

4.2.2. Reliability of the GEB (Children@School)

In order to check the reliability of the GEB (Children@School), firstly it is required to identify whether the scale consists of sub-scales. Factor analysis was conducted, employing Varimax rotation technique. The results indicated that the children’s sample is suitable for factor analysis (KMO=.626, and Sig. =.000). The factor analysis revealed that GEB (Children@School) is constituted from two factors: Pro-active Eco-behaviours and Resource and Energy Conservation. McDonald’s omega (ω) for Pro-active Eco-behaviours was .6, and for Resource and Energy Conservation was .51 which are acceptable values according to the psychological construct of the scale (Kline, 1993). Moreover, treating GEB (Children@School) as a uni-dimensional did
not also increase the omega value. The indication is that the GEB (Children@School) is constituted from ten items and two factors, as summarized in Table 4-3.

Table 4-3: Identified factors for GEB (Children@School)

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Two Hypothesized Factors For the GEB (Children@School)</th>
<th>Loadings</th>
</tr>
</thead>
<tbody>
<tr>
<td>I participate in recycling activities at School.</td>
<td></td>
<td>.700</td>
</tr>
<tr>
<td>I work in the school garden with teachers.</td>
<td></td>
<td>.654</td>
</tr>
<tr>
<td>I look at books about the environment (nature, trees, and animals).</td>
<td><strong>Pro-active Eco-behaviours</strong></td>
<td>.637</td>
</tr>
<tr>
<td>I pick up litter left behind by my friends during recess and lunch breaks.</td>
<td></td>
<td>.529</td>
</tr>
<tr>
<td>I don’t turn on the classroom lights because there is always enough light in my classroom.</td>
<td></td>
<td>.129</td>
</tr>
<tr>
<td>I leave the class window open while the heater is working.</td>
<td></td>
<td>.621</td>
</tr>
<tr>
<td>I forget to turn off water after washing my hands in the school toilets.</td>
<td><strong>Resource and Energy Conservation</strong></td>
<td>.616</td>
</tr>
<tr>
<td>I bring too much food to school and I have to throw away the extra food.</td>
<td></td>
<td>.576</td>
</tr>
<tr>
<td>I turn on the air conditioner rather than opening the glass window when it is warm inside.</td>
<td></td>
<td>.520</td>
</tr>
<tr>
<td>I forget to turn lights off when I leave a classroom.</td>
<td></td>
<td>.350</td>
</tr>
<tr>
<td>Eigenvalue</td>
<td>1.80</td>
<td>1.50</td>
</tr>
<tr>
<td>Percentage of Variance</td>
<td>18.019</td>
<td>15.034</td>
</tr>
<tr>
<td>omega</td>
<td>.6</td>
<td>.51</td>
</tr>
</tbody>
</table>

4.3. Calculation of the variables used for analyses

Factor analysis and reliability analysis suggested the NEP (Parents), NEP (Teachers), GEB (parents), and GEB (Teachers) all be treated as uni-dimensional scales. It was also concluded that the NEP (Children@School) worked as a three-dimensional, and GEB (Children@School) as two-dimensional scales. As such, new scores for each dimension/factor were calculated. The mean scores of all items in uni-dimensional scales were calculated as the scale score. The factor scores were calculated by the weighted average scores method in multi-dimensional scales (DiStefano, Zhu, & Mindrila, 2009) through the following procedure:
1- Multiplying the factor loading of each item of the factor into the raw score of that item;

2- Summing up all the values gained from step one (for all items of that factor);

3- Dividing this sum into the sum of the factor loadings (of all items of that factor).

The analyses were conducted using the dependent variables of – Children’s Environmental Attitudes towards Human Intervention, Children’s Environmental Attitudes via ESD at School, Children’s Environmental Attitudes towards Eco-rights, Children’s Pro-active Eco-behaviours, and Children’s Environmental Behaviours towards Resource and Energy Conservation – and independent variables of – School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours.

4.4. Multiple regression analyses

Multiple regression is commonly used to explore the predictive relationship between one continuous dependent variable and a number of independent variables. The regression considers the relationship between the dependant variable and: (1) all the independent variables as a whole (the model), and (2) the relative contribution of each independent variable to the model.

The purpose of conducting multiple regression analyses is not only to investigate relationships between school-design and children’s environmental attitudes and behaviours, but also to elucidate the impacts on the children of the other included extraneous variables; namely, parents’ and teachers’ environmental attitudes and behaviours. These analyses will therefore inform how these extraneous variables should be controlled for. Following sections outline how well five independent variables – School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental
Behaviours – were able to predict five dependant variables. The five dependant variables were the environmental attitudes and behaviours of children that were identified via the factor analysis of the NEP (Children@School): Human Intervention, ESD at School, Eco-rights, and GEB (Children@School): Pro-active Eco-behaviours, and Resource and Energy Conserve Behaviours. In order to explore these predictions, five multiple regression analyses were conducted.

4.4.1. Regression model for predicting Children’s Environmental Attitudes towards Human Intervention

The first regression explored the power of Sustainable School-design, Parents’ Environmental Attitudes and Behaviours, and Teachers’ Environmental Attitude and Behaviour in predicting Children’s Environmental Attitudes towards Human Intervention. This regression analysis aimed answer the following questions:

- How well the measures of School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours are able to predict Children’s Environmental Attitudes towards Human Intervention?;

- How much is the relevant contribution of each independent variable, and which independent variable is the most powerful in predicting Children’s Environmental Attitudes towards Human Intervention?

Preliminary analysis ensured the assumptions of enough sample size, normality of residuals, outliers, linearity, homoscedasticity, and independence of residuals were met. Table 1 in Appendix C shows the Pearson Correlation coefficients that corroborates the absence of multicollinearity and singularity between the independent variables.

Results indicated that 23.7 % of the variance in Children’s Environmental Attitudes
towards Human Intervention was explained by the model, $F(5,269)=18.066$, $p<.005$, adj. $R^2 = .237$. School-design and Teachers’ Environmental Attitudes significantly predicted Children’s Environmental Attitudes towards Human Intervention, $p<.05$. Teachers’ Environmental Attitudes ($\beta = .422$) made the strongest unique contribution when the variance explained by all other variables in the model was controlled for. The second strongest independent variable in terms of the power of prediction was School-design ($\beta = .126$).

Semi-partial correlation coefficients indicated that Teachers’ Environmental Attitudes and School-design respectively contributed 13.17%, and 1.48% to the total R2. Regression coefficients and standard errors can be found in Table 4-4.

Table 4-4: Summary of multiple regression analysis- Dependent variable: Children’s Environmental Attitudes towards Human Intervention.

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>$B$</th>
<th>$SE_B$</th>
<th>$\beta$</th>
<th>Part-Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-.074</td>
<td>.775</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-design</td>
<td>-.209</td>
<td>.091</td>
<td>-.126*</td>
<td>-.122</td>
</tr>
<tr>
<td>Parents’ Environmental Attitudes</td>
<td>.161</td>
<td>.111</td>
<td>.086</td>
<td>.077</td>
</tr>
<tr>
<td>Parents’ Environmental Behaviours</td>
<td>-.124</td>
<td>.132</td>
<td>-.056</td>
<td>-.049</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.876</td>
<td>.127</td>
<td>.422*</td>
<td>.363</td>
</tr>
<tr>
<td>Teachers’ Environmental Behaviours</td>
<td>.114</td>
<td>.138</td>
<td>.050</td>
<td>.044</td>
</tr>
</tbody>
</table>

*Note:* *p < .05; B= unstandardized regression coefficient; $SE_B=$ standard error of the coefficient; $\beta =$standardized coefficient.

4.4.2. Regression model for predicting Children’s Environmental Attitudes via ESD at School

A second Multiple regression model explored whether School-design, Parents’ Environmental Attitudes and Behaviours, and Teachers’ Environmental Attitudes and Behaviours could predict Children’s Environmental Attitudes via ESD at School. This regression analysis was expected to answer the following questions:

---

$^{11}$ R-squared is a statistical measure of how close the data are to the fitted regression line. $R^2 = .237$ indicates that the model explains 23% of the variability of the response data around its mean.
- How well the measures of School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours are able to predict Children’s Environmental Attitudes via ESD at School?

- How much is the relevant contribution of each independent variable, and which independent variable is the most powerful in predicting Children’s Environmental Attitudes via ESD at School?

Preliminary analysis ensured the assumptions of enough sample size, normality of residuals, outliers, linearity, homoscedasticity, and independence of residuals were met.

Table 2 in Appendix C shows the Pearson Correlation coefficients that corroborates the absence of multicollinearity and singularity between the independent variables.

Results indicated that 34.3% of the variance in Children’s Attitudes via ESD at School was explained by the model, $F(5,269)=29.564$, $p<.05$, adj. $R^2=.343$. School-design, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours significantly predicted the Children’s Environmental Attitudes via ESD at School, $p<.05$. School-design ($\beta=-.467$) was shown to make the strongest unique contribution when the variance explained by all other variables in the model was controlled for. The second and third strongest independent variable in terms of the power of prediction were respectively Teachers’ Environmental Attitudes ($\beta=.193$) and Teachers’ Environmental Behaviours ($\beta=.124$).

Semi-partial correlation coefficients indicated that School-design, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours contributed 20.4%, 2.7% and 1.1% to the total $R^2$, respectively. Table 4-5 summarizes the regression coefficients and standard errors.
Table 4-5: Summary of multiple regression analysis- Dependent variable: Children’s Environmental Attitudes via ESD at School

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>B</th>
<th>SEβ</th>
<th>β</th>
<th>Part-Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.242</td>
<td>.829</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-design</td>
<td>-.895</td>
<td>.097</td>
<td>-.467*</td>
<td>-.452</td>
</tr>
<tr>
<td>Parents’ Environmental Attitudes</td>
<td>.178</td>
<td>.118</td>
<td>.083</td>
<td>.074</td>
</tr>
<tr>
<td>Parents’ Environmental Behaviours</td>
<td>-.088</td>
<td>.142</td>
<td>-.035</td>
<td>-.030</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.461</td>
<td>.136</td>
<td>.193*</td>
<td>.166</td>
</tr>
<tr>
<td>Teachers’ Environmental Behaviours</td>
<td>.327</td>
<td>.148</td>
<td>.124*</td>
<td>.108</td>
</tr>
</tbody>
</table>

Note: * p < .05; B= unstandardized regression coefficient; SEβ= standard error of the coefficient; β=standardized coefficient

4.4.3. Regression model for predicting Children’s Environmental Attitudes towards Eco-rights

A third multiple regression analysis was used to evaluate how well School-design, Parents’ Environmental Attitudes and Behaviours, and Teachers’ Environmental Attitudes and Behaviours could predict Children’s Environmental Attitudes towards Eco-rights. The outcome of this multiple regression was expected to answer the following questions:

- How well the measures of School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours are able to predict Children’s Environmental Attitudes towards Eco-right?;

- How much is the relevant contribution of each independent variable, and which independent variable is the most powerful in predicting Children’s Environmental Attitudes towards Eco-right?

Preliminary analysis ensured the assumptions of enough sample size, normality of residuals, outliers, linearity, homoscedasticity, and independence of residuals were met. Table 3 in Appendix C shows the Pearson Correlation coefficients that corroborates the absence of multicollinearity
and singularity between the independent variables.

Results indicated that 21.6% of the variance in Children’s Environmental Attitudes towards Eco-right was explained by the model, $F(5,269)=16.061$, $p<.005$, $\text{adj.R}^2=.216$. Of the five independent variables, Parents’ Environmental Attitudes and Parents’ Environmental Behaviours could significantly predict the dependent variable, $p<.05$. Parents’ Environmental Behaviours ($\beta =.479$) was shown to have the strongest unique contribution to the model when compared to Parents’ Environmental Attitudes ($\beta =.142$). According to Semi-partial correlation coefficients, Parents’ Environmental Behaviours and Parents’ Environmental Attitudes could respectively contributed 17.89% and 1.6% to the total R2. As such, the result of this multiple regression suggested that the only variable that could substantially predict the model was Parents’ Environmental Behaviours. Regression coefficients and standard errors can be found in Table 4-6.

Table 4-6: Summary of multiple regression analysis- Dependent variable: Children’s Environmental Attitudes towards Eco-right

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>B</th>
<th>SE$_B$</th>
<th>$\beta$</th>
<th>Part-Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-1.000</td>
<td>.704</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-design</td>
<td>.082</td>
<td>.082</td>
<td>.055</td>
<td>.053</td>
</tr>
<tr>
<td>Parents’ Environmental Attitudes</td>
<td>.238</td>
<td>.100</td>
<td>.142*</td>
<td>.127</td>
</tr>
<tr>
<td>Parents’ Environmental Behaviours</td>
<td>.950</td>
<td>.120</td>
<td>.479*</td>
<td>.423</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.114</td>
<td>.116</td>
<td>.061</td>
<td>.053</td>
</tr>
<tr>
<td>Teachers’ Environmental Behaviours</td>
<td>.231</td>
<td>.126</td>
<td>.113</td>
<td>.098</td>
</tr>
</tbody>
</table>

Note: * $p < .05$; $B$=unstandardized regression coefficient; SE$_B$=standard error of the coefficient; $\beta$=standardized coefficient

4.4.4. Regression model for predicting Children’s Pro-active Eco-behaviours

The forth multiple regression evaluated how well the independent variables of School-design, Parents’ Environmental Attitudes and Behaviours, and Teachers’ Environmental Attitudes
and Behaviours could predict Pro-active Eco-behaviours. This regression was expected to answer the following questions:

- How well the measures of *School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours* are able to predict *Children’s Pro-active Eco-behaviours*?
- How much is the relevant contribution of each independent variable, and which independent variable is the most powerful in predicting Children’s Pro-active Eco-behaviours?

Analysis supported the assumptions regarding sample size, normality of residuals, outliers, linearity, homoscedasticity, and independence of residuals were met. Pearson correlation coefficients demonstrated a lack of multicollinearity and singularity between the independent variables (See: Table 4 in Appendix C).

Results indicated that 20.4% of the variance in Children’s Pro-active Eco-behaviours was explained by the five-variable model containing School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes and Teachers’ Environmental Behaviours, $F(5,269)=15.061, p<.005$, adj.$R^2=.204$. Results also suggested that all predictor variables except, Parents’ environmental Attitudes, significantly predicted the dependent variable, $p<.05$. Of the four significant independent variables, School-design had the strongest unique contribution, $\beta=-.326$. Semi-partial correlation coefficients indicated that the contribution of School-design, Teachers’ Environmental Behaviours, Teachers’ Environmental Attitudes and Parents’ Environmental Behaviours to the total $R^2$ were 9.9%, 2.4%, 1.4%, 1.3%, respectively .

Table 4-7 shows the regression coefficients and standard errors of this multiple regression.
Table 4-7: Summary of multiple regression analysis- Dependent variable: Children's pro-active Eco-behaviours

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>B</th>
<th>SE_B</th>
<th>( \beta )</th>
<th>Part-Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>.013</td>
<td>.957</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-design</td>
<td>-.654</td>
<td>.112</td>
<td>-.326*</td>
<td>-.315</td>
</tr>
<tr>
<td>Parents’ Environmental Attitudes</td>
<td>-.067</td>
<td>.136</td>
<td>-.030</td>
<td>-.027</td>
</tr>
<tr>
<td>Parents’ Environmental Behaviours</td>
<td>.347</td>
<td>.163</td>
<td>.130*</td>
<td>.115</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.354</td>
<td>.157</td>
<td>.141*</td>
<td>.121</td>
</tr>
<tr>
<td>Teachers’ Environmental Behaviours</td>
<td>.490</td>
<td>.171</td>
<td>.178*</td>
<td>.155</td>
</tr>
</tbody>
</table>

Note: * p<.05; B=unstandardized regression coefficient; SE_B=standard error of the coefficient; \( \beta \)=standardized coefficient

4.4.5. Regression model for predicting Children’s Environmental Behaviours towards Resource and Energy Conservation

The fifth multiple regression analysis explored how well School-design, Parents’ Environmental Attitudes and Behaviours, and Teachers’ Environmental Attitudes and Behaviours could predict Children’s Environmental Behaviours towards Resource and Energy Conservation. This analysis aimed to answer the following questions:

- How well the measures of School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours are able to predict Children’s Environmental Behaviours towards Resource and Energy Conservation?
- How much is the relevant contribution of each independent variable, and which independent variable is the most powerful in predicting Children’s Environmental Behaviours towards Resource and Energy Conservation?

Preliminary analysis supported the assumptions regarding sample size, normality of residuals, outliers, linearity, homoscedasticity, and independence of residuals were met
satisfactorily. Table 5 in Appendix C shows the Pearson Correlation coefficients and corroborates the absence of multicollinearity and singularity between the independent variables.

Results showed that 20.2% of the variance in Children’s Environmental Behaviours towards Resource and Energy Conservation was explained by the five-variable model consisting of: Sustainable School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes and Teachers’ Environmental Behaviours, F(5,269)=14.873, \( p < .005 \), adj.R\(^2\)=.202. The results showed that three of the independent variables – School-design, Parents’ Environmental Behaviours and Parents’ Environmental Attitudes – made a statistically significant contribution to the prediction of the dependent variable, \( p < .05 \). The strongest predictor was School-design (\( \beta = -0.360 \)). The unique contribution of School-design, Parents’ Environmental Behaviours and Parents’ Environmental Attitudes to the total variance of Environmental Behaviours towards Resource and Energy Conservation were: 12.11\%, 4.4\%, and 2.5\%, respectively. Table 4-8 indicates the regression coefficients and standard errors of this multiple regression.

Table 4-8: Summary of multiple regression analysis- Dependent variable: Children’s Environmental Behaviours towards Resource and Energy Conservation

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>B</th>
<th>SE(_B)</th>
<th>( \beta )</th>
<th>Part-Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.196</td>
<td>.716</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School-design</td>
<td>-.540</td>
<td>.084</td>
<td>-.360*</td>
<td>-.348</td>
</tr>
<tr>
<td>Parents' Environmental Attitudes</td>
<td>.306</td>
<td>.102</td>
<td>.181*</td>
<td>.161</td>
</tr>
<tr>
<td>Parents’ Environmental Behaviours</td>
<td>.477</td>
<td>.122</td>
<td>.238*</td>
<td>.210</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.182</td>
<td>.118</td>
<td>.097</td>
<td>.084</td>
</tr>
<tr>
<td>Teachers’ Environmental Behaviours</td>
<td>.191</td>
<td>.128</td>
<td>.093</td>
<td>.081</td>
</tr>
</tbody>
</table>

Note: * \( p < .05 \); B= unstandardized regression coefficient; SE\(_B\)= standard error of the coefficient; \( \beta \)=standardized coefficient
4.5. The impact of School-design on children’s environmental attitudes and behaviours

One-way between groups multivariate analysis of variance (MANOVA) was used to assess the impact of School-design on children’s environmental attitudes and behaviours. This analysis looked for significant differences in children’s environmental attitudes and behaviours (Children’s Environmental Attitudes towards Human Intervention, Children’s Environmental Attitudes via ESD at School, Children’s Environmental Attitudes towards Eco-rights, Children’s Pro-active Eco-behaviours, Children’s Environmental Behaviours towards Resource and Energy Conservation) between two different types of School-design – schools designed for sustainability and conventional schools. Alternatively, a series of independent sample t-test could be conducted, but this can increase the risk of an ‘inflated type 1 error.’ Hence MANOVA was the selected analysis. This test was expected to answer the following questions:

- Do children in schools designed for sustainability significantly differ with children in conventional schools in terms of their environmental attitudes and behaviours?
- Do children in schools designed for sustainability possess higher levels of environmental attitudes and behaviours than children in conventional schools?

Preliminary analysis confirmed that no serious violation of the assumptions of normality, outliers, linearity, multicollinearity and singularity, and Homogeneity of variance-covariance matrices was noted.

Analysis output indicated that there was a statistically significant difference between children in schools designed for sustainability and children in conventional schools on the combined dependent variables, $F(5,269)=28.14, p=.000$; Pillai’s Trace=.343; partial $\eta^2=.343$. As the significant result was obtained in this stage, further investigations were carried out to determine
whether children in schools designed for sustainability and children in conventional schools differed on all of the dependent variables, or only some of them. When the results for the dependent variables were considered separately, using Bonferroni adjusted alpha level of 0.01 (Pallant, 2013, p. 305), all the dependent variables, except Children’s Environmental Attitudes towards Eco-right, reached statistical significant difference: Attitudes towards Human Intervention, F(1,273)=14.552, \( p = .000 \), partial \( \eta^2 = .051 \); Attitudes via ESD at School, F(1,273)=103.333, \( p = .000 \), partial \( \eta^2 = .275 \); Pro-active Eco-behaviours, F(1,273)=35.553, \( p = .000 \), partial \( \eta^2 = .115 \); and Resource and Energy Conservation Behaviours, F(1, 273)=42.569, \( p = .000 \), partial \( \eta^2 = .135 \). School-design had the greatest impact on the variable Children’s Environmental Attitudes via ESD at School, representing 27.5% of the variance in this variable, which is considered a large effect size (Cohen, 1988, p. 284), compared to Attitudes towards Human Intervention (5.1%) with a medium effect size, Pro-active Eco-behaviours (11.5%) with a large effect size, and Resource and Energy Conservation Behaviours (13.5%) with a large effect size (Table 4-9).

Table 4-9: Test of between-subjects effect

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>F</th>
<th>Error df</th>
<th>Sig.</th>
<th>Partial ( \eta^2 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children’s Environmental Attitudes towards Human Intervention</td>
<td>14.552</td>
<td>273</td>
<td>.000</td>
<td>.051</td>
</tr>
<tr>
<td>Children’s Environmental Attitudes via ESD at School</td>
<td>103.333</td>
<td>273</td>
<td>.000</td>
<td>.275</td>
</tr>
<tr>
<td>Children’s Environmental Attitudes towards Eco-rights</td>
<td>2.371</td>
<td>273</td>
<td>0.125</td>
<td>.009</td>
</tr>
<tr>
<td>Children’s Pro-active Eco-behaviours</td>
<td>35.553</td>
<td>273</td>
<td>.000</td>
<td>.115</td>
</tr>
<tr>
<td>Children’s Environmental Behaviours towards Resource and Energy Conservation</td>
<td>42.569</td>
<td>273</td>
<td>.000</td>
<td>.135</td>
</tr>
</tbody>
</table>

Children in schools designed for sustainability and children in conventional schools significantly differed in the four environmental attitudes and behaviours variables. Comparison of the mean scores suggested that children in schools designed for sustainability reported higher levels of Environmental Attitudes and Behaviours as summarized in Table 4-10.
Table 4-10: *Mean differences of the dependent variables for children in two types of School-design*

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>schools designed for sustainability</th>
<th>conventional schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children’s Environmental Attitudes towards Human Intervention</td>
<td>M=3.544, SD=.725</td>
<td>M=3.17, SD=.884</td>
</tr>
<tr>
<td>Children’s Environmental Attitudes via ESD at School</td>
<td>M=4.451, SD=.631</td>
<td>M=3.447, D=.958</td>
</tr>
<tr>
<td>Children’s Pro-active Eco-behaviours</td>
<td>M=3.355, SD=.951</td>
<td>M=2.673, D=.943</td>
</tr>
<tr>
<td>Children’s Environmental Behaviours towards Resource and Energy Conservation</td>
<td>M=4.322, SD=.617</td>
<td>M=3.771, D=.768</td>
</tr>
</tbody>
</table>

4.6. Conclusion

This chapter evaluated the relationship between School-design and five dependent variables: Children’s Environmental Attitudes towards Human Intervention, Children’s Environmental Attitudes via ESD at School, Children’s Environmental Attitudes towards Eco-rights, Children’s Pro-active Eco-behaviours, and Children’s Environmental Behaviours towards Resource and Energy Conservation.

In order to control for the possible impact of the extraneous variables – Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours – a series of multiple regressions were performed in Section 4.4. These analyses paved the way for the MANOVA (Section 4.5) that was directly related to the hypothesis of this study. Control of the extraneous variables was of particular concern, as Parents’ and Teachers’ Environmental Attitudes and Behaviours could significantly influence the impact of School-design on children’s environmental attitudes and behaviours. Results indicated that School-design is the most powerful predictor of Children’s Environmental Attitudes via ESD at School, Children’s Pro-active Eco-behaviours, and Children’s Environmental Behaviours toward Resource and Energy Conservation. However, Teachers’ Environmental Attitudes is the
determinant predictor of Children’s Environmental Attitudes toward Human Intervention, and Parents’ Environmental Behaviours is the most powerful predictor of Children’s Environmental Attitudes toward Eco-rights.

In Section 4.5, a MANOVA evaluated the impact of School-design on the compound variables representing children’s environmental attitudes and behaviours. Result indicated that all of the children’s environmental attitudes and behaviours except Children’s Environmental Attitudes towards Eco-right were significantly higher in schools designed for sustainability compared to conventional schools.
Chapter Five

Discussion
5.1. Introduction to the discussion

This chapter is composed of two parts: the first part (Section 5.3 and Section 5.4) summarises the findings of this study and discusses them in relation to the research question and previous research. The second part of this chapter (Section 5.5) interprets the findings and discusses their wider implications.

Section 5.2 discusses the hypothesis of this thesis according to the results achieved. Section 5.3 discusses the findings of the regression analysis that were conducted to evaluate the power of the independent variables - School-design, Parents’ Environmental Attitudes, Parents’ Environmental Behaviours, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours - in predicting children’s environmental attitudes and behaviours. Section 5.4 discusses the findings of a multivariate analysis of variance that was conducted to investigate the possible environmental attitude and behavioural differences between children attending schools designed for sustainably versus children attending conventional schools. Section 5.5 discusses the interpretations and implications of the findings. Finally, section 5.6 synthesises the findings and implications into an overall understanding of the study, and provides suggestions about how such an understanding might inform future research, pedagogy and the design of schools.

5.2. Response to the hypothesis

The result of the regression analyses indicates that parents’ and teachers’ environmental attitudes and behaviours, in addition to school design, can significantly predict children’s environmental attitudes and behaviours. In addition, the result of the MONOVA indicated that children who attended sustainably designed schools, compared to those who attended conventionally designed schools, held more pro-environmental attitudes and behaviours.
Therefore, it follows that schools designed for sustainability can be used as a pedagogical tool to elevate children’s environmental attitudes and behaviours.

5.3. Investigating the predicting power: Articulating the results of the regression analyses

The following five sections, 5.3.1- 5.3.5, discuss the power of School-design, Parents’ Environmental Attitudes and Behaviour, and Teachers’ Environmental Attitudes and Behaviour in predicting Children’s Environmental Attitudes and Behaviours. In Section 5.3.6, all the regressions will be compared in an effort to identify patterns or anomalies. Figure 5.1 illustrates the overall relationship between the independent variables and dependent variables in the regression analyses.

Figure 5.1: Five regression analyses- Investigating the power of the five IVs for predicting each of the five DVs. Each of the coloured arrow is representative of one regression analysis.
5.3.1. Power of School-design, Parents’ Environmental Attitudes and Behaviours, and Teachers’ Environmental Attitudes and Behaviour for Predicting Children’s Environmental Attitudes towards Human Intervention

The result of the regression analysis in Section 4.1.1 indicated that both Teachers’ Environmental Attitudes and School-design significantly predicted Children’s Environmental Attitudes towards Human Intervention. However, Teachers’ Environmental Attitudes was the most determinant variable in predicting Children’s Environmental Attitudes towards Human Intervention. In order to understand these findings it will be necessary to examine what constitutes the dependant variable Children’s Environmental Attitudes towards Human Intervention.

The items that constituted the Children’s Environmental Attitudes towards Human Intervention relate to the status of the environment on a macro level – i.e., long-term, large-scale

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12 Dashed arrows indicates null-significant correlation. Solid arrows are representative of a significant correlation. Thicker arrows have a larger effect size, and therefore have stronger predictive power.
human intervention in nature (Table 5-1). These items were about the relationship children had with the world on a larger scale as opposed to their relationship with their immediate environment. As such, these items did not always relate to ideas that were immediately practical or tangible. In other words, these items express broad attitudes not communicated experientially through a child’s everyday-life. Rather, it might be argued that decisions surrounding such broad concepts require children to make value judgements. Children of ten-twelve years old require formal education to understand the concepts and environmental values contained within the Children’s Environmental Attitudes towards Human Intervention factor, and as such, one would expect that those attitudes to be strongly informed by teachers.

<table>
<thead>
<tr>
<th>Table 5-1: Items constructing Children’s Environmental Attitudes towards Human Intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>If things don’t change; we will have a big disaster in the environment soon.</td>
</tr>
<tr>
<td>People will someday know enough about how nature works to be able to control it.</td>
</tr>
<tr>
<td>When people mess with nature it has bad results.</td>
</tr>
<tr>
<td>People are clever enough to keep from ruining the earth.</td>
</tr>
<tr>
<td>People are treating nature badly.</td>
</tr>
</tbody>
</table>

Children’s Environmental Attitudes towards Human Intervention were best predicted by Teachers’ Environmental Attitudes, not by the attitudes and behaviours of parents. Thus, it may be argued that although parents contribute to educating children, this communication does not occur via the type of knowledge exchange required to transmit broad attitudinal environmental concepts. These results suggest that the best way to improve Children’s Environmental Attitudes towards Human Intervention is to focus on improving the pro-environmental attitudes of teachers and pro-environmental pedagogy. While this study may be the first of its kind to investigate the relationship between teachers’ and children’s environmental attitudes, positive correlations between teachers’ attitudes and students’ learning outcomes has previously been demonstrated (Bhargava & Pathy, 2014).
Although the magnitude of the power of School-design in predicting Children’s Environmental Attitudes towards Human Intervention was small, the results indicate that School-design can inform the environmental attitudes of children towards the larger-scale interferences that mankind makes to the natural world.

5.3.2. Regression model for predicting Children’s Environmental Attitudes via ESD at School

The results of the regression analysis in Section 4.4.2 indicated that School-design, Teachers’ Environmental Attitudes, and Teachers’ Environmental Behaviours all significantly predicted Children’s Environmental Attitudes via ESD (Environmentally Sustainable Design) at School variable. Children’s Attitudes via ESD at School included the items shown in Table 5-2. These items address school sustainability features such as outdoor classrooms, solar panels, and food growth in the school garden.
The results indicated that sustainable School-design, compared to Teachers’ and Parents’ Environmental Attitudes and Behaviours, was the best predictor of children’s environmental attitudes towards the green learning spaces of their school environment. This suggests that sustainability in school-design can facilitate children’s connectedness with nature, either directly or via teachers, and improve children’s attitudes about environmental issues by increasing awareness of the impact of the built environment on the natural environment. This finding concurs with prior studies that identify the role of ‘green’ schools as teaching tools (Cole, 2013; Taylor & Enggass, 2009).

Table 5-2: Items constructing Children’s Environmental Attitudes via ESD at School

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would be willing to go to a school which has a focus on nature.</td>
</tr>
<tr>
<td>I believe that artificial light in classrooms should be generated by solar panels.</td>
</tr>
<tr>
<td>I would be willing to grow food in the school garden.</td>
</tr>
<tr>
<td>I feel more connected with nature when classes are held in outdoor spaces.</td>
</tr>
<tr>
<td>It makes me feel better when we have natural day light rather than artificial light all day in classrooms.</td>
</tr>
</tbody>
</table>

Teachers’ Environmental Attitudes and Behaviours were the second and third best predictors of Children’s Attitudes via ESD at School. Although the magnitude of their predictive power was small, the results indicated that teachers with pro-environmental attitudes and behaviours can inform pro-environmental attitudes in their pupils. This conclusion reinforces the findings of previous research that “a successful green school requires active, cross-curricular teaching to incorporate environmental themes into instruction” (Kerlin, Santos, & Bennett, 2015, p. 14).

As might be expected, the findings indicted that teachers were more likely to influence children’s environmental attitudes via and towards ESD features at School compared to parents. This finding emphasizes the role of teachers in transmitting environmental attitudes to children via tangible sustainability features in schools. As such, it is suggested that better teacher education
and training in the understanding and use of sustainability features will increase Children’s Environmental Attitudes via ESD at School.

Parents’ environmental attitudes and behaviours were not significant in predicting Children’s Environmental Attitudes via ESD at School. In line with this finding, previous research had also indicated a lack of correspondence between general children’s environmental attitudes, and parents’ environmental attitudes and behaviours (Evans et al., 2007; Malkus, 1992; Musser & Diamond, 1999). However, these previous studies do not clarify the specific nature of the environmental attitudes they refer to. A possible explanation for the null correlation between children’s and parents’ environmental attitudes in this study might be that Children’s Attitudes via ESD at School are better transmitted through the green physical spaces of schools rather than the home environment which might lack sustainable design features and green spaces.

If schools wish to elevate children’s pro-environmental attitudes it is recommended that schools incorporate sustainability features into their buildings and grounds. Similarly, architects are encouraged to optimize natural resources when designing schools for example, using those design features covered by the NEP (Children@School) and common to the three sustainable schools of the study: solar panels, the use of recycled water, and natural daylight. Designers might also pay close attention to outdoor classrooms, playgrounds, landscape and gardens so that children’s environmental attitudes are improved through engagement with green features in their school environment.

It might also be suggested that schools devise an environmental education program for teachers, with the focus of familiarizing them with the use of green features at their school. Educating teachers in this way may increase children’s pro-environmental attitudes. A suggestion
for future research might be to investigate the impact of such an education for teachers on children’s environmental attitudes via ESD at School.

5.3.3. Regression model for predicting Children’s Environmental Attitudes towards Eco-rights

![Diagram showing regression model]

Figure 5.4: Regression analysis for predicting Children’s Environmental Attitudes towards Eco-rights

Results of the regression analysis in Section 4.4.3 indicated that Parents’ Environmental Behaviours and Parents’ Environmental Attitudes significantly predict Children’s Environmental Attitudes towards Eco-rights.

Table 5-3 includes the items constituting Children’s Environmental Attitudes towards Eco-rights. It can be seen that the items in this factor are about the laws of nature and fundamental environmental rights that require life-long training. The process of transmitting these rights to children can be considered a developmental process by which they acquire beliefs or cognition. As an example, attitudes towards the laws of nature, as stated in Children’s Environmental Attitudes towards Eco-rights, is subjective and based on a person’s belief system. Teachers commonly do not approach these beliefs with children because a teacher’s role in the secular
system of Australia is to teach students critical thinking skills rather than teach them beliefs of any particular kind (Campbell, 2014). An example of a belief system that can impact on children’s ideas is religion. Religion is rarely approached by teachers after Australian public schools were defined in the 1970s as secular with strictly limited input from the churches (Bessant, 1984; Tebbel, 2014). Thus, it might be suggested that how children perceive their relationship to the natural environment is more likely to be informed by a belief system shaped by parents than by teachers, for research has long shown that parents are first and foremost among the agents of cognition development (Jennings & Niemi, 1968). Thus, parents are of paramount importance in forming their children’s environmental orientation towards rights of nature, whether a child is aware or unconscious of the parents’ impact, and whether the process is role-modelling or overt transmission (Jennings & Niemi, 1968).

There have also been studies finding no relationship between children’s environmental attitudes and parent’s environmental attitudes and behaviours (Evans et al., 2007; Malkus, 1992; Musser & Diamond, 1999). However, as stated in Section 5.3.2, these studies have rarely addressed different dimensions of children’s environmental attitudes. Consequently, their results cannot be directly related to the findings of this study or be seen to contradict this study’s argument.

It is worth underlining that Parents’ Environmental Behaviours was a much stronger predictor of Children’s Environmental Attitudes towards Eco-rights than Parents’ Environmental Attitudes. This suggests that parent’s role modelling has a greater impact than their attitudes in shaping children’s fundamental beliefs and cognitions about the environment.
Table 5-3: *Items constructing Children’s Environmental Attitudes towards Eco-rights*

<table>
<thead>
<tr>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>People must still obey the laws of nature.</td>
</tr>
<tr>
<td>Nature will survive even with our bad habits on earth</td>
</tr>
<tr>
<td>People are supposed to rule over the rest of nature.</td>
</tr>
<tr>
<td>Plants and animals have as much right as people to live.</td>
</tr>
</tbody>
</table>

5.3.4. Regression model for predicting Children’s Pro-active Eco-behaviours

The regression analysis in Section 4.4.4 indicated that School-design, Teachers’ Environmental Behaviours, Teachers’ Environmental Attitudes and Parents’ Environmental Behaviours significantly predicted Children’s Pro-active Eco-behaviours. To understand these findings it should be noted that items included in the Children’s Pro-active Eco-behaviours factor (Table 5-4) address behaviours that are self-initiated.

The results indicated that School-design stimulated these types of behaviours more than the other independent variables. The reason for this finding might be that schools designed for sustainability, compared to conventional schools, might have features and learning spaces that facilitate pro-active eco-behaviours such as working in the school garden, and participating in
recycling activities or vicarious social behaviours towards conservation. This finding aligns with previous research showing that the presence of sustainable facilities can ease the performance of pro-environmental behaviours (Kaiser & Biel, 2000b).

Table 5-4: *Items constructing Children’s Pro-active Eco-behaviours*

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>I participate in recycling activities at School.</td>
</tr>
<tr>
<td>I work in the school garden with teachers.</td>
</tr>
<tr>
<td>I look at books about the environment (nature, trees, and animals).</td>
</tr>
<tr>
<td>I pick up litter left behind by my friends during recess and lunch breaks.</td>
</tr>
</tbody>
</table>

The result of this regression analysis also suggests that teachers have greater influence than parents on the pro-active environmental behaviours. Teachers’ Environmental Behaviours were a more powerful predictor of Children’s Pro-active Eco-behaviours than Teachers’ Environmental Attitudes. This is likely because teachers model Pro-active Eco-behaviours at school by interacting with sustainability features (As discussed in Section 5.3.2), and indeed role modelling is considered an effective teaching tool (Charters, 2000; Wright & Carrese, 2002). However, despite the statistical significance of Teachers’ Environmental Attitudes and Behaviours, and Parents’ Environmental Behaviours, their predictive power was significantly less than School-design. Therefore, School-design was considered to be the only meaningful predictor of Children’s Pro-active Eco-behaviours.
5.3.5. Regression model for predicting Children’s Environmental Behaviours towards Resource and Energy Conservation

The regression analysis in Section 4.4.5 indicated that School-design, Parents’ Environmental Behaviours, and Parents’ Environmental Attitudes could significantly predict Children’s Environmental Behaviours towards Resource and Energy Conservation. The items included in Children’s Environmental Behaviours towards Resource and Energy Conservation factor are listed in Table 5-5.

School-design was shown to be the best predictor in this model. This finding might simply be explained through children having greater access to resource-conservation facilities at schools designed for sustainability. Equipment such as energy meters and water meters, being explicit examples of facilities in these schools, allow children to control and monitor resource consumption (Figure 5.7), and can encourage energy conservation behaviours.
Table 5-5: Items constructing Children’s Environmental Behaviours towards Resource and Energy Conservation

<table>
<thead>
<tr>
<th>Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>I don’t turn on the classroom lights because there is always enough light in my classroom.</td>
</tr>
<tr>
<td>I leave the class window open while the heater is working.</td>
</tr>
<tr>
<td>I forget to turn off water after washing my hands in the school toilets.</td>
</tr>
<tr>
<td>I bring too much food to school and I have to throw away the extra food.</td>
</tr>
<tr>
<td>I turn on the air conditioner rather than opening the glass window when it is warm inside.</td>
</tr>
<tr>
<td>I forget to turn lights off when I leave a classroom.</td>
</tr>
</tbody>
</table>

Figure 5.7: Resource conservation facilities in St Macartan’s Primary School. From left to right: Energy consumption display board for students to monitor; Fans for ventilating the room instead of air conditioners; Visible rain water tank with the gage to monitor water consumption; Rain water tanks with easy to handle hose for children to irrigate the garden.

As discussed in Section 5.3.4, the fourth regression model indicated that teachers had greater influence than parents on Children’s Pro-active Eco-behaviours. In contrast, the fifth regression model indicated that parents had the greater influence on Children’s Environmental Behaviours towards Resource and Energy Conservation. There could be a few reasons for this difference.

The schools designed for sustainability commonly have automatic facilities for controlling resource and energy consumption, such as motion sensing lights, automatic blinds and curtains, and occupancy sensors. As an example, motion sensors ensure that lights are not left on after occupants leave a room. These automated methods of resource-conservation do not allow teachers to communicate sustainable behaviours to children. However, automatic energy-saving facilities are rarely present at home, where family members control most resource consumption. As such, parents are highly able to communicate or role model Resource and Energy Conservation
behaviours with their children for the purposes of educating them about environmental issues and of reducing energy bills.

While this study has found a significant relationship between children’s resource and energy conservation behaviours and parents’ environmental behaviours and attitudes, Fell and Chiu (2014) found that energy use was rarely discussed between parents and primary school age children, and “children derived more motivation to save energy from responsibility conferred by school activities than other (e.g., environmental) concerns” (Fell & Chiu, 2014, p. 351). Parents also showed greater willingness to care about energy consumption when they considered it as part of their child’s education than as a private ecological concern (Fell & Chiu, 2014). Apart from the small sample size of the Fell and Chiu (2014) study, another possible reason for the different outcome could be that this previous study did not consider different dimensions of children’s behaviours considered in the current study.

While the results of this regression model convey that Teachers’ Environmental Attitudes and Behaviours cannot significantly predict Children’s Environmental Behaviours towards Resource and Energy Conservation, these findings do not deny the relationship between these variables. Rather, the results indicate that the strength of this relationship is minimal when compared with the other predictor variables.
5.3.6. Overall comparison of the independent variables' prediction power

Figure 5.8 illustrates that School-design was the best predictor of children’s environmental attitudes and behaviours when compared to the other independent variables. In order of significance, School-design could best predict: Children’s Environmental Attitudes via ESD at School, Children’s Environmental Behaviours towards Resource and Energy Conservation, Children’s Pro-active Eco-behaviours, and Children’s environmental Attitudes towards Human Intervention.

It can be seen that the common characteristic of the first of these three variables is their association with environmental behaviours (or attitudes that inform environmental behaviours). It
can also be seen that while School-design, was a significant predictor, it did not predict Children’s Environmental Attitudes towards Human Intervention in practice. It was therefore concluded that sustainably designed schools have significant potential to foster children’s environmental behaviours. As such, architects should be encouraged to promote ESD through design at schools.

Parents’ Environmental Behaviours were shown to be the second most powerful predictor and best predicted Children’s Environmental Attitudes towards Eco-rights. Parents’ Environmental Behaviours also significantly predicted Children’s Environmental Behaviours towards Resource and Energy Conservation.

Teachers’ Environmental Attitudes were the third most powerful predictor of children’s environmental attitudes and behaviours, and could best predict Children’s Environmental Attitudes towards Human Intervention.

Parents’ Environmental Attitudes and Teachers’ Environmental Behaviours were shown to be the least powerful significant predictors of children’s environmental attitudes and behaviours.
5.4. Children’s environmental attitudes and behaviours differences in schools designed for sustainability and conventional schools

A multivariate analysis of variance (MANOVA) was conducted (see: Section 4.5) to compare the environmental behaviours and attitudes of children between two different types of schools: schools designed for sustainability and conventionally designed schools (Figure 5.9).

This analysis, investigating the impact of School-design on children’s environmental attitudes and behaviours, aims to speak directly to the hypothesis and answer the central research question of this thesis:

- What is the impact of different types of School-design on children’s environmental attitudes and behaviours?
There was a statistically significant difference between the environmental attitudes and behaviours of children attending schools designed for sustainability compared to children attending conventional schools. The only exception was that there was no difference in children’s Attitudes towards Eco-rights between the two types of school.

Figure 5.10 illustrates that School-design most influences Children’s Attitudes via ESD at School. Figure 5.11 demonstrates that children attending schools designed for sustainability outperformed the children attending conventional school on all four aforementioned dependent variables.

Figure 5.10: The proportion of the variance in children’s environmental attitudes and behaviours that could be explained by School-design
In order to fully understand this finding and to contextualize it, this result needs to be considered in regards to previous research. The effectiveness of sustainable design in schools as a teaching tool has been looked at from varying perspectives. Some educationalists, environmentalist, and architects believe that sustainable school buildings, also termed ‘green’ school buildings, will positively affect the overall culture of sustainability (Lyons Higgs, 2006). It is also claimed “sustainable architectural design of schools can be an important aspect in raising educational standards, or altering the perception of a school” (Edwards, 2006, p. 1). Furthermore, it has been suggested that buildings with a low environmental impact provide a unique teaching opportunity to promote sustainability (Newton, Wilks, & Hes, 2009). Similarly, Cole (2013) suggests that the school building is “arguably the largest and most visible artefact of school sustainability and one that changes less often relative to other aspects of the school environment such as curriculum” (Cole, 2013, p. 3). Thus, the physical environment of a school has been referred to as a three-dimensional textbook (Taylor & Enggass, 2009), or silent curriculum, which can lead to positive or negative environmental experiences.
Acknowledging the likelihood that sustainable design can promote sustainable behaviours in children, the UK government has been directly involved in promoting school buildings and grounds as tools for sustainability education. The Department for Children, Schools and Families, UK, recommend a number of doorways for change for schools to become sustainable by 2020. It encourages schools to design their buildings and grounds to visibly represent sustainability. Such design is intended to create a sense of connectedness to the natural world for pupils, giving them “the chance to contribute to sustainable living, and demonstrate good practices to others” (Department for Children, 2008, p. 2), as well as supporting institutional goals and curricula. It can also “symbolize the school’s commitment to sustainability in a unique way” (Cole, 2013, p. 3). Thus, as supported by previous studies and literature, the findings of this analysis indicate that incorporating sustainability features into school design can inform environmental attitudes and behaviours in children.

5.5. Interpretations, opinions, and implications of the findings

This section discusses how the sustainable design strategies can improve children’s’ environmental education, and thus the importance of committing to sustainable design principles. Also discussed is how the learning efficacy of sustainability features at schools can be supported by other agents, such as teachers and parents.

To elucidate the implications and interpretations of the aforementioned findings, the following diagrams (Figure 5.12 and Figure 5.13) summarise the significant correlations between the independent variables and dependent variables in analyses conducted in this thesis.
Five Independent Variables

- Children's Environmental Attitudes towards Human Intervention
- Children's Environmental Attitudes via ESD at School
- Children's Environmental Attitudes towards Eco-rights
- Children's Pro-active Eco-behaviours
- Children's Environmental Behaviours towards Resource & Energy Conservation

Five Dependent Variables

- School-Design
- Parents' Environmental Attitudes
- Parents' Environmental Behaviours
- Teachers' Environmental Attitudes
- Teachers' Environmental Behaviours

Figure 5.12: Summary of the result of the five regression analyses (Only the significant correlations are shown. The thicker arrows show the stronger correlations)

Figure 5.13: Result of the MANOVA for comparing the mean differences between children in sustainably designed schools and conventional schools (Only the significant correlations are shown. The thicker arrows show the stronger correlation)
5.5.1. *Insight 1: Adapting environmental attitudes and behaviours instruments to consider the role of School-design*

This thesis attempted to address a significant research gap, and develop reliable and trustworthy instruments for evaluating the role of School-design in developing children’s environmental attitudes and behaviours. These new instruments were: NEP (Teachers), NEP (Children@School), and GEB (Children@School). The development of these new tools was necessary because pre-existing instruments were not able to address questions regarding school design and children’s environmental attitudes and behaviours (Evans et al., 2007; Manoli et al., 2007). This was because the existing tools did not contain items relating to the sustainable design of schools (Bogner & Wilhelm, 1996; Larson et al., 2011; Leeming et al., 1995; Musser & Malkus, 1994). These newly designed tools allowed for the consideration of the interrelated and nuanced dimensions at play when considering of the pedagogic role of sustainable design.

5.5.2. *Insight 2: Different dimensions of children’s environmental attitudes and behaviours*

The prime objective of this thesis has been to determine if sustainable School-design impacts children’s environmental attitudes and behaviours. However, it can be seen that the implications of the findings of this thesis are more nuanced than those revealed by the consideration of this question alone. In particular, the identification of different dimensions for children’s environmental attitudes and behaviours has revealed unexpected relationships and impacts.

A factor analysis revealed that the environmental attitudes and behaviours of children are not uni-dimensional constructs, but are actually constituted of different dimensions. Children’s environmental attitudes consist of three dimensions: Children’s environmental Attitudes towards Human Intervention, Children’s Environmental Attitudes via ESD at School, Children’s Environmental Attitudes towards Human Intervention. Children’s environmental behaviours
consist of two dimensions: Children’s Pro-active Eco-behaviours, and Children’s Environmental Behaviours towards Resource and Energy Conservation. Uncovering these dimensions has revealed specific motivators of environmental attitudes and behaviours.

5.5.3. Insight 3: Audiences of this thesis

The knowledge generated in this thesis is applicable to architects, parents, educationalists, and policy makers. Indeed, the findings suggest the need for a far closer collaboration between these stakeholders. For instance, Children’s Environmental Attitudes via ESD at School was best predicted by School-design, suggesting architects engagement in the design of the pedagogy for environmental education, while Environmental Attitudes towards Eco-right was best predicted by Parent’s Environmental Behaviour, thus suggesting a pedagogy that engages parents in their children’s learning.

5.5.4. Insight 4: School-design as the best overall predictor of children’s environmental attitudes and behaviours

School-design was the best overall predictor of children’s environmental attitudes and behaviours when compared to parents’ and teachers’ environmental attitudes and behaviours. School-design was not only revealed to predict children’s environmental behaviours, but also those types of attitudes that are associated with environmental behaviour. This finding implies that investing on sustainability features in schools can inform pro-environmental attitudes and behaviours in children. This finding is aligned with previous studies evidencing that sustainable design in schools can be used as a pedagogic tool to inform pro-environmental behaviours and actions in children – the principal goals of environmental education (Chawla & Cushing, 2007; Pooley & O’Connor, 2000). Thus, the findings of this thesis illustrate environmental behaviours can be enhanced in children via the ecologically sustainable design of school environments.
5.5.5. **Insight 5: Parents’ Environmental Behaviour as the most powerful predictor of Children’s Environmental Attitudes towards Eco-right**

Parents’ Environmental Behaviours was the second most powerful predictor of children’s environmental attitudes and behaviours, and best predicted those children’s environmental attitudes that address the rights of nature. Acquiring these fundamental attitudes about environmental rights is considered to be a developmental process in which environmental beliefs and cognitions are transmitted to children by their parents. This finding suggests that if an environmental education program is to better inform pro-environmental attitudes in children towards broad environmental concepts - such as the rights of nature – an effective strategy might be to design pedagogies that engage parents with their children’s learning. This might happen through supporting the interaction between parents and children when children are learning about the environment through sustainable design at school. Another way of enhancing parents’ pro-environmental attitudes might be through promoting community engagement in environmental programs at schools. Provision of interactive websites, green tours\(^{13}\) or short environmental courses or workshops for parents in the school environment might be helpful here, where, for example, schools showcase tangible examples of environmental discourse. Another way of promoting pro-environmental attitudes in parents might be through the child-parent knowledge exchange that occurs when children bring home news of the green facilities at school (Ballantyne, Connell, & Fien, 2006, p. 3).

Research into the relationships between children’s environmental attitudes and behaviours and parents’ environmental attitudes and behaviours is limited. Moreover, there is even less

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research into the underlying factors of children’s environmental attitudes and behaviours that might affect this relationship. This study found that there were a number of different dimensions of children’s environmental attitudes and behaviours that all played a significant and unique role and correlated differently with different aspects of parents’ environmental attitudes and behaviours. As such, future researchers should be mindful when generalizing children’s environmental behaviours and attitudes.

5.5.6. Insight 6: Teachers’ Environmental Attitudes are the best predictor of Children’s Environmental Attitudes towards Human Intervention

Teachers’ Environmental Attitudes were the third most powerful predictor of children’s environmental attitudes and behaviours, and could best predict Children’s Environmental Attitudes towards Human Intervention. It can be argued that these attitudes towards human intervention are not overt and tangible and therefore children appear to need a direct and explicit knowledge exchange via teachers to promote positive environmental attitudes towards human intervention. As such, to enhance Children’s Environmental Attitudes towards Human Intervention, educationalists might best consider strategies to inform pro-environmental attitudes in teachers (Goldman et al., 2006, p. 4).

5.5.7. Insight 7: Shift to a sustainable design based environmental education

Children’s attitudes and behaviours were significantly more pro-environmental in the sustainably designed schools. These findings corroborate the findings of previous research recognising sustainable school buildings as agents for raising environmental education efficacy (Cole, 2013; Lyons Higgs, 2006; Newton et al., 2009). As such, this study provides further support for the important role of sustainable School-design in shaping children’s environmental attitudes and behaviours.
Interestingly but not unexpectedly, Children’s Environmental Attitudes via ESD at School scores had the largest difference between the two types of schools. This suggests that schools need to have the fundamental infrastructure or, sustainability features to:

- Improve children’s bonds with nature
- Encourage children to use clean, non-polluting and renewable energy sources, such as solar energy
- Teach children to avoid unnecessary energy consumption, such as using natural day light rather than artificial light
- Teach children to grow their food locally, e.g. in their school garden, to avoid more carbon emission

These sustainable design features help inform pro-environmental attitudes in children and provide children with opportunity to link these attitudes to behaviours through experiential learning. This suggests that architects and educationalists sharpen their focus on the pedagogical potential of design for environmental education. Thus, this thesis suggests a shift towards sustainably designed schools to promote environmental education. It is also suggested that as well as having a sustainable design, schools engage educators, designers, parents and teachers in the process of developing and implementing design pedagogies (pedagogy through design).

5.6. Summary

The findings of this study suggest that implementing sustainable design in primary schools can be a possible strategy for elevating children’s environmental attitudes and behaviours. Thus, pedagogies can be developed that require children to directly engage when learning with sustainable design features such as solar panels, the use of recycled water, natural daylighting, and
outdoor classrooms. However, it is also important to consider the attitudes and behaviours of teachers and parents in shaping children’s environmental attitudes and behaviours. Therefore, it is suggested that teachers’ and parent’s environmental awareness should also be enhanced through engaging them with the sustainability features at schools, with community engagement, and with education programs such as workshops and information sessions. In other words, integrated and collaborative environmental education is required that engages all stakeholders with sustainable design. Such an integrated approach can be seen to be able to contribute to schools achieving cohesive and holistic environmental education objectives.
Chapter Six

Conclusion
6.1. Introduction to conclusion

This thesis examined the relationship between School-design and environmental awareness in primary school children. Whilst previous research has examined associations between the general architectural and physical characteristics of schools and the educational achievements of students (Leiringer & Cardellino, 2011), there has been limited research into the impact of sustainably designed schools on children’s environmental awareness. The findings of this thesis aim to inform future design strategies for schools that will communicate pro-environmental attitudes and behaviours to children through promoting engagement with sustainability features.

The thesis was structured as follows: Chapter 1 stated the research problem, questions, hypothesis, and design; Chapter 2 provided background about environmental education, school-design and educational outcomes, environmental literacy, sustainability assessment tools, and identified gaps in the existing research; Chapter 3 identified the participants – including the rationale for selecting sustainable versus conventional primary schools, the materials – including the scales developed for measuring environmental attitudes and behaviours, and the procedure – including the ethics approval, pilot study, and main study; Chapter 4 explained the analyses conducted to evaluate the power of School-design in predicting children’s environmental attitudes and behaviours, and investigate the impact of the schools designed for sustainability on Children’s environmental attitudes and behaviours; and Chapter 5 answered the research questions, discussed the implications of the findings and how they relate to existing knowledge.

In this concluding chapter, Section 6.2 contextualizes the findings of this study, the methods employed, results achieved, and the implications of the findings for designing and refurbishing future schools. Section 6.3 then discusses the original contribution of this study to the field of knowledge. Section 6.4 states the limitations of the current study and makes recommendations for
future research. Section 6.5 provides recommendations for designers, architects and educationalists; whose decisions will shape the future context of children’s environmental education. Section 6.6 closes this thesis with concluding statements drawn from the above findings.

6.2. What was researched and how it was done?

The present status of environmental challenges in Australia necessitates research into developing effective measures to deal with upcoming hazards. There have been two types of approaches to meeting these challenges, firstly, the direct approach - which addresses measures directly affecting the status of the environment, such as controlling carbon emissions. The second approach is a mediated approach - which impacts the status of the environment through mediatory agents such as environmental education. The aim of this thesis was to provide insights into the role of sustainable School-design as a mediatory agent in promoting environmental attitudes and behaviours in children.

Schools as a type of designed environment are recognised as central to informing the attitudes, performance and behaviour of their occupants (Clark, 2002; Day, 2007; Durán-Narucki, 2008). It is also believed that school “buildings have their own hidden curriculum that teaches as effectively as any course taught in them” (Orr, 1994, pp. 113-114), and “student’s interaction with physical settings often become their primary medium for learning” (Tanner, 2000, p. 313). Although there has been detailed research into the overall association between school buildings and children’s educational achievements, there is a paucity of research exploring the relationships between children’s environmental attitudes and behaviours and the design of schools.
The findings of this thesis supported the hypothesis that children attending sustainably designed schools reported more pro-environmental attitudes and behaviours compared to children attending conventionally designed schools. This finding corroborates prior research recognising the impact of sustainable design in schools on children’s environmental learning (Cole, 2013; Newton et al., 2009). Interestingly, but not unexpectedly, sustainable School-design most influenced children’s attitudes towards using the sustainability features of school buildings and grounds. This result suggests that experiential learning through sustainability features at school provides children with the opportunity to effect and thus be mindful of their consumption of energy and water. Such experiential education would also seem to increase a child’s relationship with nature through learning in outdoor classrooms and being given the opportunity to grow food in the school garden. This finding underlines the pedagogical potential of sustainable design for environmental education.

The findings of this study also indicated that, when compared to Parents’ and Teachers Environmental Attitudes and Behaviours, School-design was the most powerful predictor of children’s environmental attitudes and behaviours. School-design could best predict children’s environmental behaviours that were pro-active and resource- and energy-conserving, and those children’s environmental attitudes that encouraged environmental behaviours. This finding reinforces the suggestion that to better improve children’s environmental attitudes and behaviours, schools should invest in sustainability features that encourage environmental behaviours (Cole, 2013).

However, it is worth underlining that schools design has not been shown to be the determinant predictor of environmental attitudes unrelated to environmental behaviours. These
attitudes are those related to broad ideas not communicated experientially through a child’s everyday life\textsuperscript{14}, and those formed via the type developmental processes associated with beliefs and cognition domains\textsuperscript{15}.

Teacher’s Environmental Awareness was the best predictor of Children’s Environmental Attitudes towards Human Intervention, and Parent’s Environmental Awareness was the best predictor of Children’s Environmental Attitudes towards Eco-rights. Thus, depending on the objectives of environmental education, there needs to be focus on these different predictor variables. These findings imply that although sustainable design can play a crucial role in forming children’s environmental attitudes and behaviours, the influences of parents and teachers also need to be taken into account. This underlines the importance of developing pedagogy through design that also engages teachers and parents – who were shown to be two influential agents in children’s environmental education. Possible avenues to engage teachers and parents include: establishing environmental communities at schools, providing interactive websites, green tours at schools (where schools showcase tangible examples of environmental discourse), and short environmental courses. Parent’s engagement might also happen through the messages children carry back home about the sustainability features of their schools.

6.3. Contribution to the field of knowledge

This thesis has developed a comprehensive understanding of how School-design can inform environmental education. The thesis brought together the fragmented research findings from across the fields of sustainable architecture, environmental education and psychology and integrated them to achieve a coherent and novel understanding of the interrelationship between

\textsuperscript{14} Children’s Environmental Attitudes towards Human Intervention
\textsuperscript{15} Children’s Environmental Attitudes towards Eco-rights
these fields. A further unique contribution was the elucidation of the influence of teachers and parents alongside School-design on children’s environmental attitudes and behaviours. Although the interrelationship between children’s environmental awareness and parents’ and teachers’ environmental awareness has been studied previously (Evans et al., 2007; Goldman et al., 2006; Kerlin et al., 2015; Musser & Diamond, 1999), there has been no research addressing the impact on environmental learning of all three variables - School-design, teachers and parents environmental awareness. Furthermore, previous research has not evaluated the relative impacts of School-design, Parents and Teachers Environmental Awareness on the different dimensions of children’s environmental attitudes and behaviours identified in this thesis.

6.4. Study limitations and subsequent recommendations for future research

An individual’s environmental philosophy is moulded by many personal and extraneous factors, such that “differences in physical environment, family life, social and cultural interactions, religious traditions, political climate, and other factors lead to development of a personal perspective” (Goldman et al., 2006, p. 16). Thus, the limits of the study suggest the need to explore other potential influential variables on children’s environmental attitudes and behaviours, such as teachers’ and parents’ age and gender, older sibling’s role modelling, and the socioeconomic situation of pupils’ families. A further limitation of the study is variation in the physical context of each school, meaning there may have been an uncontrolled influence on children’s environmental attitudes and behaviours of differences in proximity and access to natural environments and parks, for the schools participating in this study were in dissimilar urban, suburban, and rural areas. Within the scope and methods of this thesis, these differences were unavoidable.
A theoretical method of avoiding some of these uncontrolled variables would be to evaluate equivalent groups of children’s environmental attitudes and behaviours when they experience both types of School-design. This would be possible if participant samples were surveyed before and after a renovation that added sustainability features to a school. This could enable the researcher to control many more potential influential variables. However, this method is clearly only feasible in rare cases.

It has been said that “sustainability is a fluid concept, a moving target that will change as factors affecting our lives change” (Hes, 2005, p. 237). It is therefore suggested that future research might be repeated within the same contexts to investigate whether School-design remains as a determinant factor in educating children for environmental attitudes and behaviours when certain factors change – such as curriculum\textsuperscript{16}, children’s age, or teachers and parents educational level.

Future research that made use of the instruments developed for this study, the NEP (Children@School), and GEB (Children@School), and NEP (Teachers), would further consolidate their reliability and validity. This would assist in maximizing the generalizability of current and future findings.

Another potential for future research is to investigate whether School-design can play a role in transforming children’s environmental attitudes to environmental behaviours.

\textsuperscript{16}This study found no evidence that the curriculums of schools in the sample included anything above and beyond the AusVELS, or that teachers had added extra-curricular environmental education to the national curriculum. However, some teachers in schools designed for sustainability did state that they modified the ways the curriculum were taught by using the ‘green’ features of the school as teaching tools. Thus, because all Victorian schools taught the same curriculum with regards to sustainability, this paper posits that the impact of curriculum on children’s environmental attitude is satisfactorily controlled for.
6.5. Recommendations for designers and educationalists

The sustainable design of schools has shown to be influential in elevating children’s environmental attitudes and behaviours. As such, architects need to consider “that the spatial language of a building [needs to] correlate in what it is saying to both adults, and children” (Russell, 2004, p. 2), and might be encouraged to create the type of design that facilitates learning through engagement with sustainability features. This is design used as pedagogy to convey environmental awareness to children.

The findings of this thesis revealed that design is not the only determinant contributor to children’s environmental attitudes and behaviours. Educationalist might also consider developing pedagogy that not only incorporates architecture as a pedagogic tool but also engages teachers and parents - the two agents identified in this study influencing children’s environmental attitudes and behaviours. Despite the relatively complex interrelationships between children’s, parents’ and teachers’ environmental awareness, several strategies for improving teachers’ and parents’ environmental awareness as a way of improving children’s environmental understanding were suggested. However, it is important to understand that teachers’ and parents’ environmental attitudes and behaviours influence some dimensions of children’s environmental attitudes and behaviours more than others. Therefore, when design is used as a pedagogic tool it ought to allow for flexibility of emphasis on teachers and parents according to the specific learning objectives of environmental education.

6.6. Concluding statement

The hypothesis of this thesis was supported: sustainably designed schools can be used to elevate children’s environmental attitudes and behaviours. Results suggest that sustainable School-
design informs a meaningful understanding in children of the symbiotic relationship between the built environment and the wider ecological context. Detailed analysis has also indicated that School-design had greater influence on the environmental attitudes and behaviours of children that relate to the tangible sustainability features of the built environment, rather than more conceptual environmental concepts. Sustainable-design in school buildings can therefore be seen to be a potent learning tool for shaping environmental attitudes and behaviours. As such, the results of this research encourage designers, architects, and decision-makers to pay greater attention to School-design as an efficacious factor in improving children’s environmental attitudes and behaviours.
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Appendices
Appendix A: Publications
This study aims to determine if primary school children’s environmental attitudes can be predicted by whether their school had been designed or adapted for sustainability. An NEP scale for children was adopted to measure attitudes, with supplementary questions added to align this scale to the Australian context of the study. In addition, the original adult NEP scale was used to determine relationships between children’s environmental attitudes, their School Design, and their Parents’ and Teachers’ Environmental Attitudes. Data collected from grade 4, 5, and 6 primary school children, their parents and teachers were analysed via three multiple regressions. The results indicate that sustainable design in schools improves the environmental attitudes of children towards perceptibly green building features, such as solar panels, the use of recycled water, natural daylighting, and outdoor classrooms including food-producing gardens.

**Keywords:** sustainable school design; children; environmental attitudes; New Ecological Paradigm scale

**Introduction**

In the quest to promote positive environmental attitudes, sustainable development and create an environmentally literate society, education plays a crucial role through advancing environmental awareness. Regardless of the specific objectives of environmental education (EE) programs, the most typical outcome of such initiatives is the enhancement of three spheres of awareness: environmental knowledge, attitudes, and behaviours (Leeming, Dwyer, and Bracken 1995; Stern, Powell, and Ardoin 2008). The ultimate aim of increasing awareness is clearly to change behaviours. Although there is no consensus on whether possessing pro-environmental attitudes results in pro-environmental behaviour, some researchers have found evidence of compatibility of environmental behaviour with environmental attitudes. For instance, Hines’ meta-
analysis coded ‘fifty-one outcome measures on attitude-behaviour relationship’ (1987), and found that those individuals with more positive attitudes towards the environment were more likely to participate in ecological behaviours. Strong correlation between pro-environmental concerns and pro-environmental behavioural intentions has also been reported (Shetzer, Stackman, and Moore 1991; Manoli, Johnson, and Dunlap 2007b; Pooley and O’Connor 2000). As such, environmental attitude research is critical both for finding attitude determinants and for designing environmental education programs that may lead to more pro-environmental behaviours (Newhouse 1990).

There is a growing body of literature examining schoolyards and pro-environmental attitudes, but less on learning spaces in both school buildings and grounds with respect to pro-environmental attitudes. This paper considers the school learning space as a medium and tool for providing such learning opportunities, and tests the hypothesis that schools designed for sustainability elevate children’s environmental attitudes, and thus offer the possibility of informing pro-environmental behaviours. The theoretical basis of this hypothesis and its testing is that which underpins Manoli et al.’s NEP scale for measuring environmental attitudes. Namely, that difference in behaviours or attitudes can be explained by underlying values, a world-view, or a paradigm. Thus, underlying the hypotheses of this study is the notion that learning spaces designed for sustainability reflect pro-environmental values that can in turn inform pro-environmental values in children. This hypothesis is in line with the idea that people learn from their surroundings, a possibility that David Orr (1997, 597-600) explains by his use of the phrase ‘architecture as pedagogy’ to describe, as Janda (2011, 15-22) reports, the belief that we learn from buildings, not just in them.
Background

Environmental education in Australia

The Environmental Education for a Sustainable Future: National Action Plan provided a nationwide approach in Australia for environmental education (Department of the Environment and Heritage 2000, 1). The plan informed the Australian Sustainable Schools Initiative (AuSSI), ‘a partnership of the Australian Government and the states and territories that seeks to support schools and their communities to become sustainable’ (Department of Sustainability 2010a). AuSSI was adopted in Victoria and New South Wales in 2002 (Henderson and Tilbury 2004), with other states following soon after. AuSSI, which encourages students to manage school resources such as water, waste, energy, landscape design, biodiversity, products and materials, has been said to have driven significant change in Australian schools towards sustainability (The Australian Government Department of the Environment 2009, 24). The Victorian Commissioner for Environmental Sustainability recommended that by 2015, 100% of Victorian government schools should adopt the ResourceSmart AuSSI Vic as the Victorian version of the AuSSI (refer to Methodology section for comprehensive information). Commonly, AuSSI has encouraged the use for teaching in schools of sustainable design features such as water tanks, solar panels, natural daylighting, outdoor classrooms, greenhouses and gardens for food production and indigenous planting.

The research reported in this paper investigates the efficacy of such sustainable design features as pedagogical tools for environmental learning through the demonstration and mediation of interrelationships between people, environmental systems and ecology. The study addresses a significant research gap, for while there has been much written about the relationship between school physical environments and educational outcomes (Woolner et al. 2007; Clark 2002; Earthman 1998; Leiringer and Cardellino 2011), few empirical studies have considered the impact
of School Design on children’s environmental understanding and attitudes (Cole 2013; Uzun 2009).

The role of sustainably designed schools in children’s environmental education

A number of studies, from various disciplinary perspectives, have considered School Design more broadly in relation to children’s environmental education, attitudes, behaviours and knowledge. For instance, some educationalists, environmentalist, and architects have argued that sustainable school buildings, also termed as ‘green’ school buildings, will positively affect the overall culture of sustainability (Lyons Higgs 2006). It is also claimed that sustainable design ‘can be an important aspect in raising educational standards or altering the perception of a school’ (Edwards 2006), and that buildings with a low environmental impact provide a teaching opportunity for promoting sustainability (Newton, Wilks, and Hes 2009). Furthermore, Cole suggests that the school building is ‘arguably the largest and most visible artefact of school sustainability and one that changes less often relative to other aspects of the school environment such as curriculum’ (2013). Thus, the physical environment of a school has been referred to as a three-dimensional textbook (Taylor and Enggass 2009), or silent curriculum, which might not be palpable but which can effectively lead to positive or negative environmental experiences. However, it is also suggested that the physical attributes of a school’s buildings and grounds are only effective as teaching tools when curriculum is enlightened by the communication of sustainability values (Barr 2011).

Acknowledging that sustainable architecture can promote sustainable attitudes and behaviours in children, the UK government has been directly involved in promoting school

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17 It should be noted here that while the term ‘greenwash’ is commonly used within environmental discourse ‘to describe the superficial adoption of sustainability initiatives,’ the term ‘green’ will be used in this paper to readily describe school architecture that is designed to meet the objectives of sustainable or reduced resource consumption.
buildings and grounds as tools for sustainability education. The Department for Children, Schools and Families, UK, recommend a number of pathways for change for schools to become sustainable by 2020. Alongside energy, water, travel and traffic, inclusion and participation, etc., there is a category that encourages schools to manage and design their buildings and grounds to visibly represent sustainability. Such design is intended to create a connectedness to the natural world for pupils, giving them ‘the chance to contribute to sustainable living, and demonstrate good practices to others’ (Department for Children 2008), as well as supporting institutional goals and curricula. It can also ‘symbolize the school’s commitment to sustainability in a unique way’ (Cole 2013).

**Methodology**

The environmental attitudes of children from the state of Victoria, Australia, attending two categories of school were compared in this study: schools designed for sustainability versus conventional schools. As will be detailed in the next section, rigorous criteria defined by ResourceSmart AuSSi Vic were used for identifying the schools designed for sustainability. To isolate the impact of sustainable design on children’s environmental attitudes, Teachers’ and Parents’ Environmental Attitudes were also measured for these are seen to be major influences on children (Lyons Higgs 2006; Ballantyne, Connell, and Fien 2006). The potential influence of contrasting curricula between the schools has been discounted because of the ‘centralization of control over curriculum’ through the national curriculum in Australia (Palmer 2002). In Victoria, ‘AusVELS is the Foundation to Year 10 curriculum that provides a single, coherent and comprehensive set of prescribed content and common achievement standards’ (AusVELS 2014). This study found no evidence that the curriculums of schools in the sample included anything above and beyond the AusVELS, or that teachers had added extra-curricular environmental
education to the national curriculum. However, it should be noted that some teachers in schools designed for sustainability did state that they modified the ways the curriculum were taught by using the ‘green’ features of the school as teaching tools. Thus, because all Victorian schools taught the same curriculum with regards to sustainability, this paper posits that the impact of curriculum on children’s environmental attitude is satisfactorily controlled for.

Method of selecting schools

Since the goals of ResourceSmart AuSSI Vic (a version of AuSSI contextualized for Victoria Schools) are to improve environmental attitudes and behaviours in children, and since many schools in Victoria have been involved in the program, ResourceSmart AuSSI Vic’s qualification criteria were selected for differentiating schools designed for sustainability from conventional schools. ResourceSmart AuSSI Vic defines the highest level of sustainability as 5-stars and provides a 5-star certificate for qualifying schools. 5-star is a modular approach comprising Core, Biodiversity, Energy, Waste, and Water. To advance through the stars, schools are required to set benchmarks within the modules and complete the criteria for each star (Sustainability Victoria 2014). 5-star gives schools the opportunity to show continuous improvement in their environmental performance through the five levels.

Three sustainable schools were selected randomly from Victorian primary schools awarded the ResourceSmart AuSSI Vic 5-star certificate. All three schools were established less than 10 years ago, and thus had newly constructed buildings and grounds. Four conventional schools were also chosen randomly, each largely consisting of buildings constructed in the last 40 years. The physical context of the seven schools varied from the suburban to the semi-rural. The difference in the number of schools selected from each category can be explained by the desire to have a near equal sample size of children in each type of school. All seven primary schools were public schools.
and located in the State of Victoria. It is worth noting here that students in Victoria are assigned to schools based on geographic boundaries, and thus are not able to choose a school based on any kind of preference. There thus can be notable demographic differences between school populations.

The first of the sustainable schools was a winner of *Energy School of the Year, Community Leadership Primary School of the Year* and student *Action Team Primary School of the Year*. It was also a finalist for: *Biodiversity Smart School of the Year*, and *Water School of the Year*. It is developing a sustainability centre where students can experience animal husbandry, growing plants and vegetables, propagation, planting, composting, and associated scientific concepts. It utilises solar panels, water tanks, and numerous outdoor learning spaces. This school did not use air conditioners for cooling the classrooms, but rather is designed for natural ventilation. The second sustainable school was the finalist for *Biodiversity Smart School of the Year* and winner of: *ResourceSmart School of the Year* (the top award), *Waste School of the Year* (twice), *Water School of the Year*, and *Teacher of the Year*. This school has large areas of solar panels and water tanks for harvesting rainwater designed to be highly visible from the children’s playground. There are 10 large water tanks in total, with messages printed on them such as: every drop counts; be water wise; learn water- live water; save water-save life; our water-our future. There is also a rainwater calculator for children to gauge how much water is saved in the tanks. There are also outdoor learning spaces, playgrounds constructed of natural material, and a hen house. The third school has energy and water audit equipment for maintaining records of resource consumption that can be accessed easily by both students and staff. Outdoor learning and play spaces are constructed from natural materials and feature water efficient indigenous planting and composting bins. All schools heavily use natural daylighting for internal learning spaces.
**Participants**

*Teachers and parents*

Data was collected from 42 teachers aged from 23-51 years old from seven primary schools. All teachers’ educational level was either bachelor or master degree (Table 1).

Out of 624 questionnaires sent to attending students’ homes, only 275 parent questionnaires (44 %) could be used for this research. Large numbers of questionnaires could not be used because many participants failed to follow or misunderstood protocols designed to allow data to be collected anonymously but matched between parent and child. Of 275 parents, 132 had children attending sustainable schools and 143 conventional schools (Table 2). Parents’ ages ranged from 24 to 70 and a noticeable discrepancy in gender response rate was observed. 79% of total parent participants were female, and 21% was male. However, these large variances did not bias the result as the age and gender distribution was similar in the two types of schools.

*Children*

The children participants included students in the fourth, fifth, and sixth grades (ages 10 to 12). The schools made all their children available for data collection. The children selected for participation were thus simply those students who were present on the day of survey who had brought their parents’ questionnaires. Parents’ questionnaires were needed on the day of data collection because children’s and parent’s data had to be paired and the surveys had no identifying information.

Thus, while 624 children completed the survey, data from only 275 was analysed (Table 3). The grade level composition of the participants was: 101 children from grade four (ages 9 to 10), 91 from grade five (ages 10 to 11), and 83 from grade six (ages 11 to 12). Grade level composition distributions were not equally spread across the two categories of schools.
**Instrument for measuring environmental attitudes**

While efforts to measure environmental attitudes have led to the development of many assessment instruments (Leeming, Dwyer, and Bracken 1995), the New Ecological Paradigm (NEP), developed by Dunlap and Van Liere in 1978 (1978), is the most widely used (Dunlap et al. 2000). Employing the NEP, which has been previously tested numerous times for internal consistency and validity (Noe and Snow 1990a; Vining and Ebreo 1992), allows for results comparison and adds to knowledge in a consistent manner. Unlike previous environmental scales, which have predominantly focused on attitudes towards specific problems such as energy consumption, waste disposal, and air/water pollution (Albrecht et al. 1982), Dunlap and Van Liere broadened their investigation to a more general position about the environment (Noe and Snow 1990b). It is worthy of mention that Dunlap and Van Liere believed that the NEP was unidimensional (Manoli, Johnson, and Dunlap 2007a), while others have found that it measures two factors (human domination of nature and natural balance), three factors (natural balance, limits to growth, and humans above nature), or even four (natural balance, limits to growth, god and nature, adaptation before modification) (see (Bechtel, Corral Verdugo, and de Queiroz Pinheiro 1999; Edgell and Nowell 1989; Gooch 1995; Hammitt and Noe 1992; Furman 1998; Noe and Snow 1990a, b; Roberts and Bacon 1997; Scott and Willits 1994; Shetzer, Stackman, and Moore 1991)).

**Revised NEP for children**

While there are many environmental education programs for children, there are few studies that have used an appropriately developed scale for evaluating children’s environmental orientation. Clearly, for a scale to be appropriate for use with children it needs to be specifically designed for them and be applicable to them. Thus, ‘instruments that exclusively employed complex question structure to address broad attitudinal dimensions and global concepts in adult
and teenage populations are less relevant for younger children’ (Evans et al. 2007; Kellert 2002; Manoli, Johnson, and Dunlap 2007b). Researchers have developed some child-appropriate instruments, such as CATES (Musser and Malkus 1994), CHEAKS (Leeming, Dwyer, and Bracken 1995), 2-MEV (Bogner and Wilhelm 1996), and CEP (Children’s Environmental Perceptions Scale) (Larson, Green, and Castleberry 2011), but issues such as unskilful bipolar answer structure, complexity and extensive time requirements have restricted the utility of these.

Manoli et al. adapted the NEP for adults to make an appropriate scale to use with children (2007b) – the NEP for Children. The NEP for Children consists of 10 items using a 5-point Likert-scale and, according to Manoli et al., measures three interrelated dimensions: Rights of Nature, Eco-Crisis, and Human Exemptionalism (referring to the scenario when humans are exempt from the constraint of nature). It is suggested that ‘it is possible to treat the scale as a uni-dimensional measure providing one overall score on the anthropocentric to eco-centric continuum’ (Manoli, Johnson, and Dunlap 2007b). The NEP for Children is employed as the basis for the scale in this study to measure children’s environmental attitude differences, but with items added to make it appropriate for the specific context of the study. Thus, six items were added based on expert opinion and the requirements of ResourceSmart AuSSI Vic, and some existing items were paraphrased to make them more comprehensible for Australian children. The revised NEP for Children scale used in this study, termed NEP (Children@School) (see Appendix), used a five-point Likert scale from strongly disagree to strongly agree with a neutral midpoint. Experts from different areas of specialization – primary school teachers, science educators, ecology university lecturers, sustainability teachers, and environmental educators – assessed item content, comprehensibility and clarity, face validity, and matching of the items to corresponding dimensions (as recommended by Erdogan et al. (2012)). Consequently, some sentences were re-
worded and shortened, and some technical terms were replaced by terms more familiar to children. For example, the original item ‘it makes me feel bad to use recycled water for watering the garden or flushing school toilets’ asks about two issues simultaneously – watering the garden and flushing the toilets – and thus made it difficult for some children to choose an answer. This item was therefore changed to ‘it makes me feel bad to use recycled water for watering the garden.’ After assessing the face validity of the revised attitudes scale for children (*NEP (Children@School)*), the reliability was measured calculating McDonald’s omega (ω) with R package (an integrated, interactive environment for data manipulation and analysis that includes functions for standard descriptive statistics (means, variances, ranges)). Since there is a need to calculate omega for each of the potential dimensions of the revised scale, factor analysis was conducted prior to calculating omega. Factor analysis is a data reduction technique that categories a set of variables into a smaller number of factors or components according to inter-correlation between the original variables.

The revised *NEP (Children@School)* scale, with 16 items, was subject to factor analysis. A KMO value of .803 and Bartlett’s Test of Sphericity significant value of .000 indicated that factor analysis was appropriate for this sample. The results revealed three dimensions within the *NEP (Children@School)* scale. In order to interpret whether the three dimensions are meaningful, or if rather this scale should be treated as unidimensional, the rotated loadings were investigated by orthogonal rotation through the Varimax technique. The rotated component loadings suggest that the items could be meaningfully classified into three different components: Human Intervention, ESD (environmentally sustainable design) at School, and Eco-rights (Table 4). All of the items within the ‘Rights of Nature’ factor of the Manoli et al. (2007b) study fell into the ‘Eco-rights’ factor of this study. The items classified in ‘Eco-crisis’ and ‘Human Exemptionalism’ in the Manoli et al. study have been classified within the ‘Human Intervention’ factor in this study,
with some deletions and modifications. The new factor, termed ‘ESD at School’, groups four of
the six new items added to the *NEP for Children* (Table 4).

Items no. 2 (there are too many people on earth) and 13 (it makes me feel bad to use
recycled water for watering the garden) were deleted from the scale. Analysis shows the first factor
‘Human Intervention’ has omega value of .66 that increases to .71 when item 2 is deleted. Item 2
may be seen as ambiguous for 10-12 year old children who could see a loss of people as a threat
to their wellbeing. Further rationale for deleting item number 2 was that it did not consistently
reflect the dimension it had the highest loading on; ‘Human Intervention.’ Omega value for the
second dimension, ‘ESD at school’, increases from .66 to .70 if item 13 was deleted. Negative
loading of this item on dimension 2 indicates the need for reverse coding (De Vaus 2014). However
the item was theoretically in the same direction of its underlying dimension as it had already been
reverse coded. As such, a possible misconception around the direction of the question (it makes
me feel bad to do something good) was seen to contaminate the analysis and thus the item was
dropped from the scale.

The third dimension, ‘Eco-rights’, has omega of .57, which although not very high can be
argued as acceptable because of the psychological construct of the scale and the diversity of the
construct being measured (Kline 1993). Moreover, some researchers believe that reliability
coefficients as low as .50 will suffice in the early stages of research (Nunnally 1978).

The indication is that *NEP (Children@School)* is constituted from 14 items and three
dimensions, as summarized in Table 4.

**NEP for parents and teachers**

In order to control for the potential influence of parents and teachers on the children,*Teachers’* and *Parents’ Environmental Attitudes* were measured. The adult version of the *NEP*
scale (Dunlap et al. 2000), the most widely used measure of environmental concerns (Manoli, Johnson, and Dunlap 2007b; Dunlap 2008; Evans et al. 2007) was employed for the parents (Table 5). The output of the factor analysis for parents suggests that *NEP for Parents* could be treated as a uni-dimensional scale. Assuming one dimension, an estimate reliability omega value of .79 is obtained. If any item of the scale is deleted, reliability will drop. As such, the environmental attitudes score for each parent was achieved by calculating the mean for all of the items in *NEP for Parents*.

A 21-item *NEP for Teachers*’ scale was developed from the *NEP* by adding 6 new items (Table 6) addressing the environmental attitudes associated with the school environment – such as attitudes towards growing food in the school garden, or towards teaching in outdoor classrooms. The rationale for adding these items was to develop a scale that includes environmental attitudes that have the potential to be fostered in connection with the ecologically sustainable design features of the school. Since correlation coefficients among the variables are less reliable in small samples, factor analysis was assessed to be inappropriate for teacher data from only 42 participants (Pallant 2013, 190; Tabachnick and Fidell 2013, 613), and thus *NEP for Teachers* was considered as a unidimensional scale. An omega of .85 corroborates the soundness of the decision to retain only one dimension. The environmental attitude score for each teacher was therefore obtained by averaging all items in the *NEP for Teachers*.

**Results**

*Predictive power of School Design, Parents’ and Teachers’ Environmental Attitudes*

To determine how well the three independent variables – *School Design, Parents’ Environmental Attitudes, and Teachers’ Environmental Attitudes* – predict the three identified Children’s Environmental Attitudes factors, a series of multiple regressions were conducted. In preparation for the regression model, teachers’ and parents’ data was matched to individual
children. Preliminary analysis ensured the assumptions of normality of residuals, linearity, multicollinearity, and homoscedasticity were met.

Regression model for predicting children’s environmental attitudes towards Human Intervention

Multiple regression was employed to assess the power of Sustainable School Design, Parents’ Environmental Attitudes, and Teachers’ Environmental Attitudes in predicting Children’s Environmental Attitudes towards ‘Human Intervention’ – the first dimension of NEP (Children@School). 24% of the variance in Children’s Environmental Attitudes towards ‘Human Intervention’ was explained by the model, F (3, 271) = 29.687, p < .05, adj. R2 = .240. All three variables significantly predicted the dependent variable, p < .05. Teachers’ Environmental Attitudes makes the strongest unique contribution to explaining Children’s Environmental Attitudes towards ‘Human Intervention’, when the variance explained by all other variables in the model is controlled for, β = .444. The Beta value for School Design and Parents’ Environmental Attitudes were respectively .130 and .110, indicating that they made less of a unique contribution to the model than Teachers’ Environmental Attitudes. Semi-partial correlation coefficients indicate that Teachers’ Environmental Attitudes, School Design, and Parents’ Environmental Attitudes respectively contributed 18.92%, 1.60%, and 1.10% to the total R2. The result of this analysis suggests that of three predictor variables, Teachers’ Environmental Attitudes is the most determinant variable in predicting Children’s Environmental Attitudes towards ‘Human Intervention.’ Although the two other independent variables also significantly contributed to the model, their contribution was very small. Regression coefficients and standard errors can be found in Table 7.

Regression model for predicting children’s environmental attitudes via ESD at School

To determine if School Design could predict Children’s Environmental Attitudes via ‘ESD
at School’ – the second identified dimension – another regression model is explored. This analysis indicated that 34.20 % of the variance in Children’s Attitudes via ‘ESD at School’ was explained by School Design, Parents’ Environmental Attitudes, and Teachers’ Environmental Attitudes, F (3, 271) = 47.046, p < .05, adj. R2 = .342. The two variables of School Design and Teachers’ Environmental Attitudes were significant, p < .05, contributing respectively 20.70%, and 6.10%, to the total R2.

This outcome suggests that Parents’ Environmental Attitudes have no significant power in predicting Children’s Attitudes via ‘ESD at School.’ Table 8 summarizes the regression coefficients and standard errors.

Regression model for predicting children’s environmental attitudes towards Eco-rights

The third dependent variable, identified through the factor analysis of the NEP (Children@School) scale, was children’s attitudes towards ‘Eco-rights.’ While it was not expected that School Design would influence this variable, for the sake of a complete understanding of what might shape children’s attitudes to each of the factors revealed by the factor analysis, a multiple regression was conducted to explore the predictive power on children’s ‘Eco-rights’ attitudes of the three independent variables of School Design, Parents’ Environmental Attitudes, and Teachers’ Environmental Attitudes. Results show that the predictor variables could only explain 3.50% of the variance in children’s environmental attitudes towards ‘Eco-rights’, F (3, 271) = 3.229, p < .05, adj. R2 = .035. The only variable that contributed significantly to the prediction of the model was Teachers’ Environmental Attitudes, p < .05. Although this variable was significant, its unique contribution was too small (2%) to be considered as a good predictor of the model. As such, and as R2 suggests, School Design, Parents’ Environmental Attitudes, and Teachers’ Environmental Attitudes are not greatly contributing to predicting children’s environmental attitudes towards ‘Eco-rights.’ Table 9 summarizes the regression coefficients and standard errors.
Discussion and conclusion

This study aimed to determine if primary school children’s environmental attitudes could be predicted by whether their school had been designed or adapted for sustainability. An NEP scale for children was adopted and supplementary questions were added to align this scale with the Australian context of the study. In addition, the original adult NEP scale was used to determine relationships between children’s environmental attitudes, School Design, and their Parents’ and Teachers’ Environmental Attitudes. Regression models were employed to evaluate how well the measures of School Design, Parents’ Environmental Attitudes, and Teachers’ Environmental Attitudes were able to predict ‘Human Intervention’, ‘ESD at School’, and ‘Eco-rights’ – the three identified dimensions of NEP (Children@School) scale. A number of conclusions are drawn:

- The output of the first multiple regression indicated that although School Design significantly contributes to predicting children’s environmental attitudes towards ‘Human Intervention’, its contribution to the total R2 is very small, with only 1.60% of the total variance in the children’s environmental attitudes towards ‘Human Intervention’ uniquely explained by school design. Similarly, the predictor variable Parents’ Environmental Attitudes explains only 1.10% of the total variance of children’s environmental attitudes towards ‘Human Intervention.’ Results show that Teachers’ Environmental Attitudes most powerfully predict the same dimension. This could be because the items in the ‘Human Intervention’ dimension address the type of environmental knowledge—i.e., long-term, large-scale human intervention—which is usually transmitted by teachers. This result suggests that the best way to improve children’s environmental attitudes towards human environmental intervention is to improve Teachers’ Environmental Attitudes. While this study may be one of the first of its kind to investigate the relationship between teachers’ and children’s environmental attitudes, positive correlation between the teachers’ attitudes...
and students’ learning outcomes has previously been demonstrated (Bhargava and Pathy 2014). This finding encourages future researchers to investigate whether Teacher’s Environmental Attitudes mediate School Design and children’s environmental attitudes, or whether the sustainable design of schools mediates teachers’ and children’s environmental attitudes. Such research might illuminate the question of whether sustainable schools alter teacher’s views or if environmentally concerned teachers chose to teach in sustainable schools.

- The second regression revealed that, when compared to Teachers’ and Parents’ Environmental Attitudes, sustainable School Design is the best predictor of children’s environmental attitudes towards the green learning spaces of their school environment. This indicates that sustainability in School Design can facilitate children’s connectedness with nature, either directly or via teachers, and improve children’s attitudes about environmental issues by increasing awareness of the impact of the built environment on the natural environment. This result is aligned with the findings of prior studies that identify the role of ‘green’ schools as teaching tools (Taylor and Enggass 2009; Cole 2013). Teachers’ Environmental Attitudes was the second best predictor, also having a statistically significant contribution to the total R2. This indicates that teachers with pro-environmental attitudes can inform pro-environmental attitudes in their pupils, and reinforces the possibility that ‘a successful green school requires active, cross-curricular teaching to incorporate environmental themes into instruction’ (Kerlin, Santos, and Bennett 2015). In line with this finding, Barr et al. have also stated that ‘the physical attributes [of green schools] were found to be dynamic teaching tools when culture are aligned with principles and values of stakeholders; values formed the nexus for whole-school sustainability
programs’ (Barr, Leigh, and Dunbar 2011). The predicting power of Parents’ Environmental Attitudes was not significant, indicating that the environmental attitudes of parents do not influence the environmental attitudes of children at school. As such, in order to elevate children’s pro-environmental attitudes within and towards their school learning spaces, it is recommended that schools fortify their focus on nature. Thus, architects might be encouraged to design for the best use of natural resources: i.e., using those design features covered by the Revised NEP for children and common to the three sustainable schools of the study: solar panels, the use of recycled water and natural daylighting. Designers might also pay close attention to outdoor classrooms, playgrounds, landscape and gardens for growing food, also common across the three sustainable schools participating in this study, so that children’s environmental attitudes are improved through engagement with nature in their school environment.

- Teachers’ Environmental Attitudes was the only variable that significantly contributed to the model predicting children’s environmental attitudes towards ‘Eco-rights.’ However, the magnitude of this contribution was very small. Thus, none of the three variables can be said to predict pupils’ attitudes to ‘Eco-rights.’ The reason could be that the ‘Eco-rights’ dimension addresses the type of fundamental beliefs towards the environment that are not taught to 10-12 year olds through schooling or parenting.

- The results of this study suggest that sustainable design at schools can significantly influence children’s environmental attitudes towards and within the school environment. In other words, School Design is more potent in influencing children’s environmental attitudes to the tangible sustainability features of the built environment, rather than their attitudes to the more conceptual dimensions of ‘Eco-rights’ and ‘Human Intervention.’
Sustainable design in school buildings can therefore be seen to be a potent learning tool for shaping positive attitudes towards the important goal of minimising the consumption by building occupants of finite resources such as water and energy. This result suggests the need for similar research to evaluate the possible predicting power of School Design on children’s environmental behaviours.

This research supports the hypothesis that sustainably designed primary schools can enhance children’s pro-environmental attitudes within the context of the built environment. The predictive power of School Design suggests the need for increased investment in the sustainable design of primary schools to elevate children’s environmental attitudes. Although the limits of the study suggest the need to explore other potential predictor variables, such as teachers’ and parents’ environmental behaviours, age, and gender, older sibling’s role modelling, the socioeconomic situation of pupils’ families and other demographic differences. A further limitation of the study is variation in the physical context of each school, meaning there may have been an uncontrolled influence on children’s environmental awareness and attitudes of differences in proximity and access to natural environments and parks.

We suggest that sustainable School Design informs a meaningful understanding in children of the symbiotic relationship between the built environment and the wider ecological context. The mechanism for this knowledge-transfer from the perception of ‘green’ building features, to learning, and to more pro-environmental attitudes and behaviours is unclear and requires future research. However, as teachers have stated that the green building features can allow them to teach sustainability differently, it can be speculated that active learning-by-doing, and modelling by teachers, can facilitate the direct use of school buildings as pedagogic tools. Thus, the results of this research encourage designers, architects, and decision-makers to pay greater attention to
School Design as an efficacious factor in improving children’s environmental education and attitudes.

References


Barr, Stephanie, Katharine Leigh, and Brian Dunbar. 2011. "Green schools that teach."


The final NEP for Children Scale developed for this study:

1. Plants and animals have as much right as people to live.
2. There are too many people on earth.
3. Clever people will prevent the Earth from being ruined.
4. People must still obey the laws of nature.
5. When people mess with nature, it has bad results.
6. Nature will survive even with our bad habits on earth.
7. People are supposed to rule over the rest of nature.
8. People are treating nature badly.
9. At some stage, people will know enough about how nature works to properly manage it.
10. If things don’t change, we will have a big disaster in the environment soon.
11. I would be willing to go to a school that has a focus on nature.
12. I believe that the artificial light in classrooms should be generated by solar panels.
13. It makes me feel bad to use recycled water for watering the garden.
14. I would be willing to grow food in the school garden.
15. I feel more connected with nature when classes are held in outdoor spaces.
16. It makes me feel better when we have natural day light rather than artificial light all day in classrooms.
## Tables:

**Table 1. Teachers’ participants.**

<table>
<thead>
<tr>
<th>Teachers</th>
<th>Conventional Schools</th>
<th>Sustainable Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>School 1</td>
<td>School 2</td>
</tr>
<tr>
<td>N</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

**Table 2. Parents’ participants.**

<table>
<thead>
<tr>
<th>Parents</th>
<th>Conventional Schools</th>
<th>Sustainable Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>School 1</td>
<td>School 2</td>
</tr>
<tr>
<td>N (Matchable with their corresponding children)</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3. Children’s participants.**

<table>
<thead>
<tr>
<th>Children</th>
<th>Conventional Schools</th>
<th>Sustainable Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>School 1</td>
<td>School 2</td>
</tr>
<tr>
<td>N (Matchable with their corresponding parents)</td>
<td>15</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>143</td>
<td></td>
</tr>
</tbody>
</table>
Table 4. Factor analysis of NEP (Children@School) with Varimax rotation.

<table>
<thead>
<tr>
<th>Scale items</th>
<th>Three Hypothesized dimensions for NEP (Children@School)</th>
<th>Omega</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 10. If things don’t change; we will have a big disaster in the environment soon.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 9. People will someday know enough about how nature works to be able to control it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 5. When people mess with nature, it has bad results.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 3. People are clever enough to keep from ruining the earth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 8. People are treating nature badly.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 11. I would be willing to go to a school that has a focus on nature.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 12. I believe that the artificial light in classrooms should be generated by solar panels.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 14. I would be willing to grow food in the school garden.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 15. I feel more connected with nature when classes are held in outdoor spaces.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 16. It makes me feel better when we have natural daylight rather than artificial light all day in classrooms.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 4. People must still obey the laws of nature.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 6. Nature will survive even with our bad habits on earth.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 7. People are supposed to rule over the rest of nature.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Item 1. Plants and animals have as much right as people to live.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Items 3, 6, 7, 9 (anti-environmental) were reverse coded.

Table 5. NEP for parents scale

NEP for Parents Items

1. We are approaching the limit of the number of the people the earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature, it often produces disastrous consequences.
4. Human ingenuity will ensure that we do not make the earth unlivable.
5. Humans are severely abusing the environment.
6. The earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite our special abilities, humans are still subject to the laws of nature.
10. The so-called “ecological crisis” facing humankind has been greatly exaggerated.
11. The earth is like a spaceship with very limited room and resources.
12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological catastrophe.

Note: Items 2, 4, 6, 8, 10, 12, and 14 (anti-environmental) were reverse coded.
Table 6. NEP for teachers scale

NEP for Teachers items

1. We are approaching the limit of the number of the people the earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature, it often produces disastrous consequences.
4. Human ingenuity will ensure that we do not make the earth unlivable.
5. Humans are severely abusing the environment.
6. The earth has plenty of natural resources if we just learn how to develop them.
7. Plants and animals have as much right as humans to exist.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
9. Despite our special abilities, humans are still subject to the laws of nature.
10. The so-called ‘ecological crisis’ facing humankind has been greatly exaggerated.
11. The earth is like a spaceship with very limited room and resources.
12. Humans were meant to rule over the rest of nature.
13. The balance of nature is very delicate and easily upset.
14. Humans will eventually learn enough about how nature works to be able to control it.
15. If things continue on their present course, we will soon experience a major ecological catastrophe.
16. I would be willing to teach in a school that is part of nature.
17. I believe that the light in a classroom should be generated by solar panels.
18. I feel uncomfortable to use recycled water for irrigating the school garden.
19. I'd be willing to grow food in the school garden.
20. I feel more connected with nature when I hold my classes in outdoor space.
21. It makes me feel better when we have daylight rather than artificial light all day in a classroom.

Table 7. Summary of multiple regression analysis- dependent variable: children’s environmental attitudes towards Human Intervention

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>B</th>
<th>SE_B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>-.352</td>
<td>.553</td>
<td></td>
</tr>
<tr>
<td>School Design</td>
<td>-.217</td>
<td>.090</td>
<td>-.130</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.920</td>
<td>.111</td>
<td>.444</td>
</tr>
<tr>
<td>Parents’ Environmental Attitudes</td>
<td>.206</td>
<td>.099</td>
<td>.110</td>
</tr>
</tbody>
</table>

Note: * p < .05; B= unstandardized regression coefficient; SEB= standard error of the coefficient; β=standardized coefficient

Table 8. Summary of multiple regression analysis- dependent variable: children’s environmental attitudes via ESD at School

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>B</th>
<th>SE_B</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.464</td>
<td>.596</td>
<td></td>
</tr>
<tr>
<td>School Design</td>
<td>-.894</td>
<td>.097</td>
<td>-.467</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.602</td>
<td>.120</td>
<td>.252</td>
</tr>
<tr>
<td>Parents’ Environmental Attitudes</td>
<td>.208</td>
<td>.107</td>
<td>.097</td>
</tr>
</tbody>
</table>

Note: * p < .05; B= unstandardized regression coefficient; SEB= standard error of the coefficient; β=standardized coefficient
Table 9. Summary of multiple regression analysis- dependent variable: children’s environmental attitudes towards Eco-rights

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>B</th>
<th>SEB</th>
<th>β</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.021</td>
<td>.561</td>
<td></td>
</tr>
<tr>
<td>School Design</td>
<td>.167</td>
<td>.091</td>
<td>.112</td>
</tr>
<tr>
<td>Teachers’ Environmental Attitudes</td>
<td>.269</td>
<td>.113</td>
<td>.145*</td>
</tr>
<tr>
<td>Parents’ Environmental Attitudes</td>
<td>-.114</td>
<td>.101</td>
<td>-.068</td>
</tr>
</tbody>
</table>

Note: * p < .05; B= unstandardized regression coefficient; SEB= standard error of the coefficient; β=standardized coefficient
2- The Catalyst Role of School Architecture in Enhancing Children’s Environmental Behavior

Izadpanahi, Parisa; Elkadi, Hisham

30th Annual International Conference of Passive Low Energy Architecture (PLEA), Ahmedabad, India, 2014- Won the Best Paper Award

ABSTRACT:

The interrelationships between school design and children learning are well established. Less evident is the relationship between sustainable school design and the level of environmental behaviour of the children in attendance. Newly erected primary schools in Australia have been broadly graded as either sustainable or conventional. This paper evaluates the impact of both sustainable and conventional school design on children’s environmental behaviour, and examines the correlation between school design and children’s environmental behaviour.

624 children, aged 10-12 years old, completed a survey. This sample, from seven selected primary schools in Victoria (Australia), includes four conventional schools and three sustainable ones. The survey was developed according to GEB (General Ecological Behavior) scale and a few more school specific variables.

The outcome of the survey was analyzed using an independent sample t-test and two-way between groups ANOVA in order to assess environmental behavior differences of children in both sustainable and conventional schools taking into account factors that either explicitly and/or implicitly impact on their behaviour such as sustainable school design, teachers’ environmental behaviour and parents’ environmental behaviour.
The results show statistically significant differences in environmental behaviour of children in sustainable schools and those in conventional schools. Comparing the means of children’s environmental behaviour indicates that children in sustainable schools possess higher levels of pro-environmental behaviour than children in conventional schools.

The paper highlights the strong relationships between school design and children’s environmental behaviour, and expands recognition of the role of environmentally sensitive school design not only to improve learning environments but more specifically to engage children ecologically with their immediate built environment.

Keywords: Sustainable School Design; Environmental Behaviour; Children
3- Designing School Buildings with Change: Impacts on Children’s Environmental Attitude

Izadpanahi, Parisa; Elkadi, Hisham

45th Annual Conference of the *Environmental Design Research Association* (EDRA), New Orleans, Louisiana, USA, 2014

ABSTRACT:

This paper investigates the differences in environmental attitude among children in sustainable schools and conventional schools and discusses the impact of changing the school design approach—from conventional to sustainable design—on children’s environmental awareness. 597 children aged 10-12 from six randomly selected primary schools in Victoria, Australia, took part in a survey. Three of the selected schools were sustainably designed and three had traditional designs. NEP scale was used to examine whether those who attend schools with a sustainable design bear higher levels of environmental attitude compared with those attending conventional schools. Outcomes of the research indicate that sustainable design of the school building provides the opportunity for children to obtain higher level of environmental attitude.
4-Impact of Sustainable School Design on Primary School Children's Environmental Attitude and Behavior

Izadpanahi, Parisa; Elkadi, Hisham

42th Annual Conference of North American association for Environmental Education (NAAEE), Baltimore, Maryland, USA, 2013

ABSTRACT:
This paper argues whether primary school children's environmental attitude and behaviour is correlated with the sustainable design of their schools. 481 students were selected randomly from 3 claimed sustainable designed and 3 conventional primary schools in Victoria, Australia. Data was collected through interactive keypads in groups of 50 each time. Analysis revealed that children, who are educated in claimed sustainable designed schools, possess higher pro-environmental attitude and more frequently behave environmental friendly compared to those in the schools with conventional architectural design. The paper also shows different environmental attitude and behaviour based on gender differences.

Keywords: Primary school children, environmental attitude, environmental behaviour, sustainable school design
Appendix B: Questionnaires
Table 1: NEP (Parents)

<table>
<thead>
<tr>
<th>Educational level:</th>
<th>Parent’s Gender: Female</th>
<th>Male</th>
<th>Parent’s Age:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below Secondary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bachelor</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Master</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PhD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major (If applicable):</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This questionnaire has 2 Sides.

<table>
<thead>
<tr>
<th>Scale Item (Attitude):</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- We are approaching the limit of the number of people the earth can support.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2- Humans have the right to modify the natural environment to suit their needs.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3- When humans interfere with nature it often produces disastrous consequences.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4- Human ingenuity will insure that we do NOT make the earth unlivable.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5- Humans are severely abusing the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6- The earth has plenty of natural resources if we just learn how to develop them.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7- Plants and animals have as much right as humans to exist.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8- The balance of nature is strong enough to cope with the impacts of modern industrial nations.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9- Despite our special abilities humans are still subject to the laws of nature.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10- The so-called “ecological crisis” facing humankind has been greatly exaggerated.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11- The earth is like a spaceship with very limited room and resources.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12- Humans were meant to rule over the rest of nature.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13- The balance of nature is very delicate and easily upset.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14- Humans will eventually learn enough about how nature works to be able to control it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15- If things continue on their present course, we will soon experience a major ecological catastrophe.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2: NEP (Teachers)

<table>
<thead>
<tr>
<th>Grade(s) you are teaching:</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>Number of the students in your class:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher's Gender: Female</td>
<td></td>
<td></td>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Teacher's Age:</td>
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<td></td>
<td>Teacher's Educational level:</td>
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<td></td>
<td>Secondary school</td>
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<tr>
<td>Major (If applicable):.....</td>
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<td>.................</td>
</tr>
</tbody>
</table>

Does your curriculum include any environmental/sustainable content? Yes ☐ No ☐

- If yes, how many hours do you teach students about nature and environment?

<table>
<thead>
<tr>
<th>Scale Item (Attitude):</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Not Sure</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- We are approaching the limit of the number of people the earth can support.</td>
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<tr>
<td>2- Humans have the right to modify the natural environment to suit their needs.</td>
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<tr>
<td>3- When humans interfere with nature it often produces disastrous consequences.</td>
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<tr>
<td>4- Human ingenuity will insure that we do NOT make the earth uninhabitable.</td>
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<tr>
<td>5- Humans are severely abusing the environment.</td>
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<tr>
<td>6- The earth has plenty of natural resources if we just learn how to develop them.</td>
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<tr>
<td>7- Plants and animals have as much right as humans to exist.</td>
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<tr>
<td>8- The balance of nature is strong enough to cope with the impacts of modern industrial nations.</td>
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<tr>
<td>9- Despite our special abilities humans are still subject to the laws of nature.</td>
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<tr>
<td>10- The so-called &quot;ecological crisis&quot; facing humankind has been greatly exaggerated.</td>
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<tr>
<td>11- The earth is like a spaceship with very limited room and resources.</td>
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<tr>
<td>12- Humans were meant to rule over the rest of nature.</td>
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<tr>
<td>13- The balance of nature is very delicate and easily upset.</td>
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<tr>
<td>14- Humans will eventually learn enough about how nature works to be able to control it.</td>
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<tr>
<td>15- If things continue on their present course, we will soon experience a major ecological catastrophe.</td>
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<tr>
<td>16- I would be willing to teach in a school which is designed as part of the nature.</td>
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<tr>
<td>17- I believe that the Light in classroom should be generated by solar panels.</td>
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<tr>
<td>18- I feel uncomfortable to use recycled water for irrigating the school garden.</td>
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<tr>
<td>19- I'd be willing to grow food in the school garden.</td>
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<tr>
<td>20- I feel more connected with nature when I hold my classes in outdoor space.</td>
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<tr>
<td>21- It makes me feel better when we have day light rather than artificial light all day in classroom.</td>
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</tr>
</tbody>
</table>
# Table 3: NEP (Children@School)

<table>
<thead>
<tr>
<th>What is your gender?</th>
<th>1. Female</th>
<th>2. Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>What grade are you in?</td>
<td>1. Four</td>
<td>2. Five</td>
</tr>
<tr>
<td>Who is your teachers?</td>
<td>1. Ms.</td>
<td>2. Mr.</td>
</tr>
<tr>
<td>How long have you been in this school (Including this year)?</td>
<td>1. One-Two</td>
<td>2. Three-Four</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scale Items (Attitudes)</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Not Sure</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Plants and animals have as much right as people to live.</td>
<td></td>
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<tr>
<td>2-There are too many people on earth.</td>
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<tr>
<td>3-People are clever enough to keep from ruining the earth.</td>
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<tr>
<td>4-People must still obey the laws of nature.</td>
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<tr>
<td>5-When people mess with nature it has bad results.</td>
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<tr>
<td>6-Nature will survive even with our bad habits on earth</td>
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<tr>
<td>7-People are supposed to rule over the rest of nature.</td>
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<tr>
<td>8-People are treating nature badly.</td>
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<tr>
<td>9-People will someday know enough about how nature works to be able to control it.</td>
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</tr>
<tr>
<td>10-If things don’t change; we will have a big disaster in the environment soon.</td>
<td></td>
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</tr>
<tr>
<td>11-I would be willing to go to a school which has a focus on nature.</td>
<td></td>
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<tr>
<td>12-I believe that artificial light in classrooms should be generated by solar panels.</td>
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<td>13-It makes me feel bad to use recycled water for watering the garden.</td>
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</tbody>
</table>
Table 4: GEB (Parents)

<table>
<thead>
<tr>
<th>Scale Item (Behavior):</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - I put dead batteries in the garbage.</td>
<td></td>
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<tr>
<td>2 - After meals, I dispose of leftovers as rubbish.</td>
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<tr>
<td>3 - I collect and recycle used paper.</td>
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<td>4 - I bring empty bottles to a recycling bin.</td>
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<tr>
<td>5 - I prefer to shower rather than to take a bath.</td>
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<tr>
<td>6 - In the winter, I keep the heater on so that I do not have to wear a sweater.</td>
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<td>7 - I wait until I have a full load before doing my laundry.</td>
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<td>8 - In the winter, I leave the windows open for long periods of time to let in fresh air.</td>
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<td>9 - I wash dirty clothes without prewashing.</td>
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<td>10 - I use fabric softener with my laundry.</td>
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<td>12 - If there are insects in my apartment I kill them with a chemical insecticide.</td>
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<td>15 - I use a cleaner made especially for bathrooms rather than an all purpose cleaner.</td>
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<td>17 - I buy beverages in cans.</td>
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<td>18 - In supermarkets, I buy fruits and vegetables from the open bins.</td>
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<td>19 - If I am offered a plastic bag in a store I will take it.</td>
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<td>20 - When I go shopping, I prefer to take my reusable shopping bags instead of using plastic bags.</td>
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<td>22 - I participate in environmental activities of an organization.</td>
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<td>23 - I point out to someone his/her uneological behavior.</td>
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<tr>
<td>26 - When possible in nearby areas (around 30 km; i.e., 18.73 miles), I use public transportation or ride a bike.</td>
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</tbody>
</table>
Table 5: GEB (Teachers)

<table>
<thead>
<tr>
<th>Scale Item (Behavior)</th>
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</tbody>
</table>
Table 6: GEB (*Children@School*)

<table>
<thead>
<tr>
<th>Scale Items (Behaviours)</th>
<th>Never</th>
<th>Seldom</th>
<th>Sometimes</th>
<th>Usually</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-I participate in recycling activities at School.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2-I work in the school garden with teachers.</td>
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</tr>
<tr>
<td>3-I forget to turn lights off when I leave a classroom.</td>
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<tr>
<td>4-I pick up litter left behind by my friends during recess and lunch breaks.</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>5-I forget to turn off water after washing my hands in the school toilets.</td>
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<td></td>
</tr>
<tr>
<td>6-I bring too much food to school and I have to throw away the extra food.</td>
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</tr>
<tr>
<td>7-I look at books about the environment (nature, trees, and animals).</td>
<td></td>
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</tr>
<tr>
<td>8-I leave the class window open while the heater is working.</td>
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</tr>
<tr>
<td>9-I turn on the air conditioner rather than opening the glass window when it is warm inside.</td>
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</tr>
<tr>
<td>10-I don’t turn on the classroom lights because there is always enough light in my classroom.</td>
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</tr>
</tbody>
</table>
Appendix C: Correlation tables
Table 1: Correlation inspection for checking multicollinearity and singularity- Dependent variable: Children’s Environmental Attitudes towards Human Intervention

<table>
<thead>
<tr>
<th>Children’s Environmental Attitudes towards Human Intervention</th>
<th>School-design</th>
<th>Teachers’ Environmental Attitudes</th>
<th>Teachers’ Environmental Behaviours</th>
<th>Parents’ Environmental Attitudes</th>
<th>Parents’ Environmental Behaviours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Children’s Environmental Attitudes towards Human Intervention</td>
<td>1.000</td>
<td>-.225</td>
<td>.464</td>
<td>.255</td>
<td>.109</td>
</tr>
<tr>
<td>School-design</td>
<td>-.225</td>
<td>1.000</td>
<td>-.186</td>
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<td>Teachers’ Environmental Attitudes</td>
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<td>Parents’ Environmental Attitudes</td>
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<tr>
<td>Parents’ Environmental Behaviours</td>
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Table 2: Correlation inspection for checking multicollinearity and singularity- Dependent variable: Children’s Environmental Attitudes via ESD at School

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Table 3: Correlation inspection for checking multicollinearity and singularity-Dependent variable: Children’s Environmental Attitudes towards Eco-right

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<tr>
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<tr>
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Table 4: Correlation inspection for checking multicollinearity and singularity- Dependent variable: Children’s Pro-active Eco-behaviours

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Table 5: Correlation inspection for checking multicollinearity and singularity- Dependent variable: Children’s Environmental Behaviours towards Resource and Energy Conservation

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</tr>
</tbody>
</table>
Appendix D: Ethics approval and documentation
2012_001422

Mrs Parisa Izadpanahi
School of Architecture and Building
Deakin University
Gheringhap Street
GEELONG 3220

Dear Mrs Izadpanahi

Thank you for your application of 23 January 2012 in which you request permission to conduct research in Victorian government schools and/or early childhood settings titled The role of children's participation in developing creative learning environment of primary school.

I am pleased to advise that on the basis of the information you have provided your research proposal is approved in principle subject to the conditions detailed below.

1. The research is conducted in accordance with the final documentation you provided to the Department of Education and Early Childhood Development.

2. Separate approval for the research needs to be sought from school principals and/or centre directors. This is to be supported by the DEECD approved documentation and, if applicable, the letter of approval from a relevant and formally constituted Human Research Ethics Committee.

3. The project is commenced within 12 months of this approval letter and any extensions or variations to your study, including those requested by an ethics committee must be submitted to the Department of Education and Early Childhood Development for its consideration before you proceed.

4. As a matter of courtesy, you advise the relevant Regional Director of the schools or governing body of the early childhood settings that you intend to approach. An outline of your research and a copy of this letter should be provided to the Regional Director or governing body.

5. You acknowledge the support of the Department of Education and Early Childhood Development in any publications arising from the research.

6. The Research Agreement conditions, which include the reporting requirements at the conclusion of your study, are upheld. A reminder will be sent for reports not submitted by the study’s indicative completion date.

7. If DEECD has commissioned you to undertake this research, the responsible Branch/Division will need to approve any material you provide for publication on the Department's Research Register.
I wish you well with your research study. Should you have further enquiries on this matter, please contact Kathleen Nolan, Research Officer, Education Policy and Research, by telephone on (93) 9637 3244 or by email at nolan.kathleen.j@edumail.vic.gov.au.

Yours sincerely

[Signature Redacted by Library]

Dr Elvira Vacirca
A/Group Manager
Education Policy and Research

30/01/2012

enc
Memorandum

To: Prof Hisham Elkadi
   School of Architecture & Building
F

cc: Mrs Parisa Izadpanahi

From: Deakin University Human Research Ethics Committee (DUHREC)

Date: 02 March, 2012

Subject: 2012-016

The Role of Children’s Participation in Developing Creative Learning Environment of Primary School

Please quote this project number in all future communications

Approval for this project was granted by the Deakin University Human Research Ethics Committee Executive on 2/03/2012.

Approval has been given for Mrs Parisa Izadpanahi, under the supervision of Prof Hisham Elkadi, School of Architecture & Building, to undertake this project for four years from 2/03/2012.

The approval given by the Deakin University Human Research Ethics Committee is given only for the project and for the period as stated in the approval. It is your responsibility to contact the Human Research Ethics Unit immediately should any of the following occur:

- Serious or unexpected adverse effects on the participants
- Any proposed changes in the protocol, including extensions of time.
- Any events which might affect the continuing ethical acceptability of the project.
- The project is discontinued before the expected date of completion.
- Modifications are requested by other HRECs.

In addition you will be required to report on the progress of your project at least once every year and at the conclusion of the project. Failure to report as required will result in suspension of your approval to proceed with the project.

DUHREC may need to audit this project as part of the requirements for monitoring set out in the National Statement on Ethical Conduct in Human Research (2007).

Human Research Ethics Unit
research-ethics@deakin.edu.au
Telephone: 03 9251 7123
CONSENT FORM

TO: Parents/Guardians of Children

Date: 08/02/2012 – 31/12/2013

Full Project Title: Green and not heard: The relationship between sustainably designed primary schools and children’s environmental attitudes and behaviours

Reference Number: 2012-016

I have read, and I understand the attached Plain Language Statement.

I give my permission for …………………………………………………… (Name of participant) to participate in this project according to the conditions in the Plain Language Statement.

I have been given a copy of Plain Language Statement and Consent Form to keep.

The researcher has agreed not to reveal the identity and personal details of the participant, including where information about this project is published, or presented in any public form.

I give permission to:

- Fill out the parent’s questionnaire.
- My child to participate voluntarily in the survey.

Participant’s Name (printed) ……………………………………………………

Name of Person giving Consent (printed) ……………………………………………………

Relationship to Participant: ………………………………………………………

Signature ……………………………………………………… Date

…………………………
TO: Parents

Date: 08/02/2012 – 31/12/2013

Full Project Title: Green and not heard: The relationship between sustainably designed primary schools and children’s environmental attitudes and behaviours

Principal Investigator/s: Hisham Elkadi

Student Researcher/s (if applicable): Parisa Izadpanahi

Purpose:
The purpose of this research is to know the impact of the sustainable school design on children’s environmental attitudes and behaviours. In other words, the aim of this project is to know what the architecture of school can offer to promote children’s environmental understanding.

- Methods:
Questions of the survey will be shown to students on an interactive white board. All the students of grade 4, 5, and 6 are invited to attend on voluntarily basis. The session duration is 20-30 minutes. Parents and teachers are also given a survey to answer.

-Demands
There is no special demand.

-Risks and potential benefits to participants:
Children’s, parents’, and teacher’s voices can be heard through this survey.

There is no foreseeable risk to the participants.

-Any expected benefits to the wider community:
The community will benefit from the knowledge and information gathered by the researcher.

-Provision of services to participants adversely affected by the research [if adverse effects are anticipated]:
There are no foreseeable adverse effects.

-What techniques will be used to document the research process?
The researchers will gather the information through questionnaire.

-How privacy and confidentiality will be protected:

All the information will be gathered through de-identified process (no names). The consent forms will be separated from other documents. No one will be able to identify participants.

All data will be stored securely at Deakin, for a period of at least five years after the final publication of the research outcomes. The consent forms will be stored securely in a locked filing cabinet at the PhD office of School of Architecture and Building, Deakin University, and Only Parisa Izadpanahi has the key to access the data. After storing for five years, the consent forms and the questionnaires will be shredded.

-The likelihood and form of dissemination of the research results, including publication and how research participants can access results of the study if they want to:

The results of this project will be made available through a PhD dissertation, conference presentations and journal papers. A summary of the research report will be sent to the participants upon request.

-How the research will be monitored:

Parisa Izadpanahi, will monitor the progress of this project to make sure your rights are protected.

-Any payments to participants:

There is no payment to participants.

-The participant's right to withdraw from further participation at any stage:

Participants can withdraw from this project at any time without any consequences.

The principal of primary school is also available for immediate referral if any issue arises during the data collection.

-Contact details of the researchers

Parisa Izadpanahi

Email: pizadpan@deakin.edu.au

Tel (office): 522 78331

Mobile: 0435 774 519

Complaints

If you have any complaints about any aspect of the project, the way it is being conducted or any questions about your rights as a research participant, then you may contact:

The Manager, Office of Research Integrity, Deakin University, 221 Burwood Highway, Burwood Victoria 3125, Telephone: 9251 7129, Facsimile: 9244 6581; Email: research-ethics@deakin.edu.au

Project ID: 2012-016.