Development of a Measurement Tool to assess Sustainability in the Built Environment Curriculum using Psychological Constructs

Noora Inka Annina Kokkarinen

A thesis submitted in partial fulfilment for the degree of Doctor of Philosophy at Liverpool John Moores University

October 2012

THE FOLLOWING HAVE NOT BEEN COPIED ON INSTRUCTION FROM THE UNIVERSITY

Figure 4 page 22

Figure 5 page 23

Figure 6 page 24

Table 1 page 33

Table 3 page 44

Appendix 1 redact contact information

Appendix 2 redact contact information

ORIGINAL COPY TIGHTLY BOUND

Text cut off in original

TEXT BOUND INTO

THE SPINE

Declaration

I declare that the work presented in this thesis is my own work. Where other sources of information have been used, every effort has been made to indicate this clearly.

Noora Kokkarinen

Acknowledgements

I would like to acknowledge the advice and support which I received from Alison Cotgrave over the past three years. We have now seen this process to completion and believe that my own future research and that of others will benefit from your guiding presence.

I would also like to thank other members of LJMU staff for the help they provided.

Perheelleni.

Abstract:

The concept of sustainable construction is increasingly being recognised, not only as a way to reduce the environmental impact of construction, but as a valuable business strategy. Stakeholders such as companies, professional bodies, government and the education sector all have the ability to have an influence on sustainability as it is being incorporated into agendas by the government and firms. Educational institutions can take it one step further by preparing future construction professionals to enter into a changing-and hopefully sustainable industry. This research focuses on the impact that education can have on this preparation with the use of psychological constructs. This thesis contributes to original knowledge by outlining the development of a measurement tool designed specifically to tap into sustainable construction attitudes. This tool was also used to assess the level of sustainability within built environment curriculum.

The research was conducted in four phases, with phase four making the contribution to knowledge. All phases were carried out using a sequential mixed methodology where quantitative data was collected in phases one and two and qualitative interviews were carried out in phase three. In phase four, quantitative data was collected before and after the intervention and subsequently analysed. This was followed by qualitative data in the form of reflective student essays. A phenomenographic approach was used to analyse qualitative data, which investigates the different ways individuals can experience or understand something.

The conclusions drawn from phase four were that the quantitative results indicated that student attitudes did not improve positively after the project. However, phenomenography revealed that all students experienced increased knowledge and attitudes did indeed change. With relation to psychological constructs, it was determined that the personality traits 'conscientiousness' and 'agreeableness' were associated with sustainability the most. Emotional intelligence was found to be most significant with social issues of sustainability followed by environmental issues which lends support to the view that emotional intelligence can extend from caring about others to caring for the environment.

Table of Contents

List of Tables

List of Figures

1. Introduction

1.1 Background, Context, Overview

Sustainability has become an important part of societal and legislative movements as companies have started reporting their sustainability goals (Myers, 2005) while the government is pledging to support sustainable development and passing policies by which to fulfill these promises (Department for Environment, Food, and Rural Affairs (DEFRA) 2011a). While the concept of sustainability has gained momentum, implementing it is still being contested by some (Department Education Association (DEA), 2010). However, it does raise the question whether the benefits of sustainability are being acknowledged by the construction industry.

Today, our built environment (BUE) and society use large amounts of materials and energy, impacting human health and degrading the natural environment of its resources (Forsberg and von Malmoborg, 2004). Energy use in buildings alone accounts for approximately 40-50% of the UK's carbon dioxide emissions (Raynsford, 1999). Osmani, Glass and Price (2006) estimated that about 420 million tonnes of materials are used by the UK construction industry each year. This results in about 150 million tonnes of waste generated, with approximately 10% of materials being wasted due to over-ordering, damage, or loss. This is about double the amount that Raynsford (1999) estimated only a few years before. In comparison, Poon (2007) stated that in 2004 the amount of waste reported in Hong Kong was 20 million tonnes. Of this amount, 12% went into landfill and the remainig 88% went to public filling areas. Comparing this with other countries shows the staggering amount of waste which the UK construction industry produces, but it may also reflect cultural differences in construction techniques and materials. After the Second World War, Europe, Japan and other developed countries began recycling building materials; in other Asian countries, the recycling of building materials started considerably later (Poon, 2007).

The large amounts of waste generated indicate that construction is a major industry which alters the natural environment (Raynsford, 1999; Ortiz, Castells and Sonnemann, 2009) and projections of the future of the environment are less than optimistic. The UK built environment is in the midst of experiencing legislative changes (Ball, 2002; DEFRA, 2005, 2011a, 2011b) which are forcing it to become more sustainable as many years of voluntary initiatives have not reduced the environmental impact. Although policies,

incentives and schemes have been set up in an attempt to persuade the industry to become more sustainable, these efforts have not had the desired level of effect. The concept of sustainable development is about assuring better quality of life for everyone at present and for future generations (Raynsford, 1999).Therefore it is hoped that educating future construction professionals and having them influence construction industry practices will set corporate precedents which will in turn fortify the aims the government has set.

Although it may appear that it is solely the responsibility of the built environment to ameliorate its procurement methods in order to spare the environment, the industry does not have to bear this burden on its own. Education may help by disseminating research findings into the industry and by preparing future construction professionals to think in a sustainable way. The interconnectedness between the two could be looked at as higher and lower levels of the hierarchy.

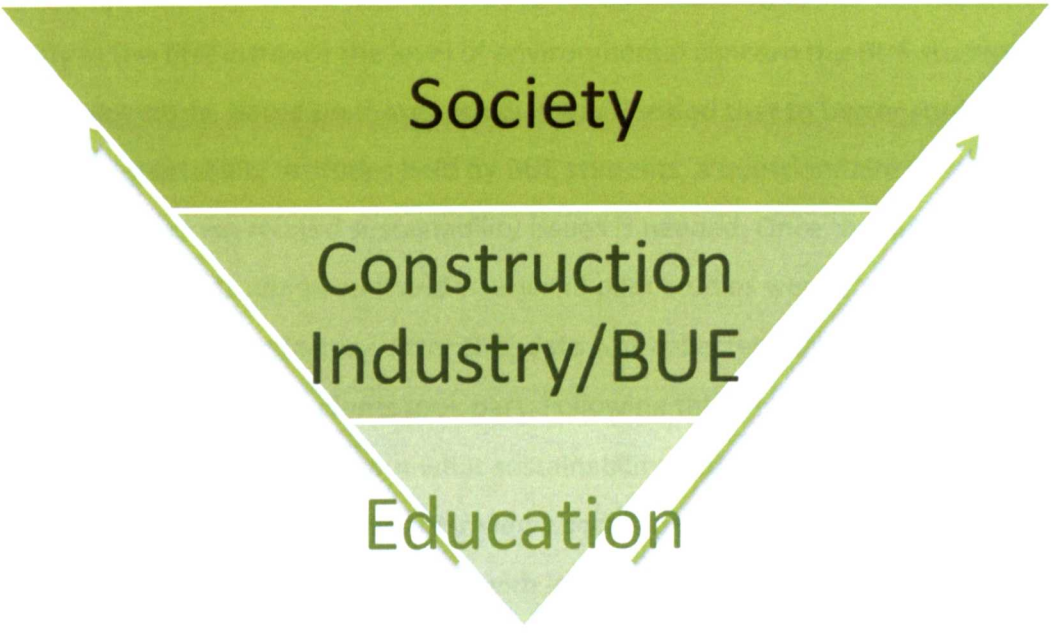


Figure 1. Links between education, built environment and society at large (self-study).

Figure 1 above represents what this research is trying to convey. These three areas, if looked at in the correct context, seem interconnected, and very relevant. As can be seen education is at the bottom of the inverted triangle, referring to the relatively small sample of the population being educated in construction areas. Once they have been educated, construction graduates will move onto the construction industry and other

areas of the built environment which is a considerably larger community. They will however have to work within the confines of society, ensuring that the projects that they are proposing are socially, economically and environmentally viable. These three terms are often called the 'triple bottom line' (Hueting and Reijnders, 2004; Murray, 2011) which will be further explained in section 2.1.1.

In terms of educating about sustainability, previous work has assessed the level of 'greenness' in the curriculum (Cotgrave and Alkhaddar, 2006; Cotgrave, 2008; Cotgrave and Kokkarinen, 2010 and 2011). It is now time to see how effective this teaching is in changing students' environmental attitudes. Personality has been found to influence academic performance in higher education (Furnham, Chamorro-Premuzic and McDougall, 2003), thus incorporating personality into a study about environmental attitudes formed in tertiary education is advantageous. Additionally, the inclusion of emotional intelligence (EI) into this research has been made because Fox and Spector (2000) have found it to be useful when solving problems that an individual feels are important to their well-being.

The various ways in which this research will assess the teaching within the curriculum is to identify in the first instance the level of environmental concern the BUE students have through a pilot study. Based on these results it was decided that to better study and understand sustainability attitudes held by BUE students, a questionnaire which addresses construction related sustainability issues is needed. Once the questionnaire was developed experts reviewed it and a series of pilot studies were conducted until reliability levels were satisfactory. After this, data was collected during a two-week project in which final year students took part. Following this phase, academics were interviewed for their opinions about what sustainability meant to them and their teaching areas. It was important to ascertain their views because they are the ones delivering the green curriculum- providing the students with information regarding sustainability.

Once the academics' experiences and views had been established it was time to see what kind of educational interventions could be implemented into BUE undergraduate modules without interfering with the existing lesson plan structure. Three sessions were held for the construction management, architectural technology and real estate management students. The sessions were designed to promote understanding of how sustainability could realistically fit in to each programme of study. A new cohort of students, including those who received the sustainability sessions underwent the two-week project where

before-and-after data was collected. Students were also asked to detail their experience of the project through a reflective essay.

These phases were conducted in order to gain a rounded view of the impact which following a greener curriculum has on Liverpool John Moores University (LJMU) from both an academic and student perspective. Adopting an interdisciplinary approach of reviewing learning theory, incorporating psychological constructs associated with academic success and consideration for others, will provide a more comprehensive account of knowledge and attitude formation as well as identifying any relationships between these and sustainability issues.

1.1.1 Research Problem

Previous work has assessed the level of sustainability in the curriculum while also attempting to change student attitudes using more simplistic methods. (Cotgrave and Alkhaddar, 2006; Cotgrave, 2008; Cotgrave and Kokkarinen, 2010 and 2011). The research problem is therefore whether a more refined way of assessing student attitudes will be successful in indicating how students consider the need for sustainability within the BUE and how well sustainability has been embedded into the undergraduate curriuclum in LJMU. Three of the four phases of this work will be conducted to either support or unsupport this argument.

1.2 Research Aims and Objectives

The coalition government has expressed its commitment towards sustainable development as well as setting goals which it hopes to achieve (DEFRA, 2011a; 2011b). The underpinnings for this were outlined in the government's 2005 proposal (DEFRA, 2005).A few of the ways in which the current government hopes to make changes are: greening the economy, tackling climate change, empowering communities to make appropriate changes at local level relating to sustainable development as well as improving operations and procurement practices. These commitments set by government will force the BUE into action or face the risk of penalties if they do not comply.

Education and research are part of the recommendations which the government has made towards its commitment to promote sustainable development. It is also through research and education that the BUE and construction sectors can learn to adopt best practice techniques in order to operate more sustainably.

Advancements have been made in higher education to promote sustainable literacy (Thomas, 2004; Murray and Cotgrave, 2007; Fortuin and Bush, 2010; Murray, 2011) amongst graduates who would in most instances then find a job in the construction industry. For this reason, future construction professionals will be targeted with more knowledge in an attempt to positively shift their attitude to sustainability during their time in tertiary education so that they can then translate theory into practice.

The overall research problem seeks to determine whether an educational intervention will be able to change attitudes of students towards sustainability within the BUE. This argument will either be supported or unsupported by the results of the analysed data. Additional aims and objectives will be outlined in later sections of the thesis. To address the research problem, the following aims had to be met:

1. An understanding was to be gained concerning what is being done in the construction industry and higher education regarding sustainability. This aim was achieved by revieweing the approaches and barriers which face the construction industry and academia regarding sustainability.

2. The level of students' environmental concern was to be assessed. This aim was achieved by conducting a pilot study to gain a snapshot of students' current level of environmental concern using the New Ecological Paradigm (NEP). The pilot study also included measuring students' personality and emotional intelligence to assess if there are any relationships between psychological factors and NEP scores.

3. Ability to measure student attitudes regarding sustainable construction. The results gained in aim two highlighted the need to devise a questionnaire which addressed sustainability construction issues which would serve as one of the questionnaires used in phases two and four of the research.

4. Determine whether there were differences among student knowledge regarding sustainable construction. Educational interventions were designed and implemented in some programmes to test whether scores among those that did and did not have a sustainability session were different.

5. Measure student attitudes towards sustainable construction. Administer the devised questionnaire mentioned in aim three along with psychological measures to students before the start of a major project and then again after the project to see whether their knowledge and attitudes towards sustainability changed.

1.2.1 Contribution to Knowledge

Within this research, the application of an interdisciplinary practise-based approach allowed for a holistic study of undergraduate sustainability attitudes to be conducted. The contribution made to original knowledge is the creation of a measurement tool which assessed sustainability attitudes and knowledge in the BUE. A tool which did not exist prior to this research. The importance of this scale is that a new body of research can be created to understand sustainable construction mindsets and in the near future, shed light as to what is the best way to promote sustainability within the BUE.

1.3 Methodology Outline

1.3.1 Literature Phase

In order to thoroughly address the topics this research was to cover, a literature review was conducted which looked at the following areas and are depicted in figure 2 below:

1. Review definitions of sustainability and sustainable development
2. Describe and review the types of sustainability models which exist and how they help with the current project in its scope.
3. Argue how sustainability can help the constrction industry and why educating future construction professionals is vital for sustainability to become more prominent in construction.
4. The nature of the construction industry as well as the barriers and incentives to practise sustainability.
5. The nature of higher education and integrating sustainability into education while discussing what barriers and incentives exist.
6. An outline of relevant learning and psychology literature and its relation to changing sustainability knowledge and attitudes.

7. Review educational interventions in the medical field and environmental education programmess. Discussed in section 9.1.

8. Review literature regarding qualitative analysis techniques. Discussed in chapters 5 and 10.

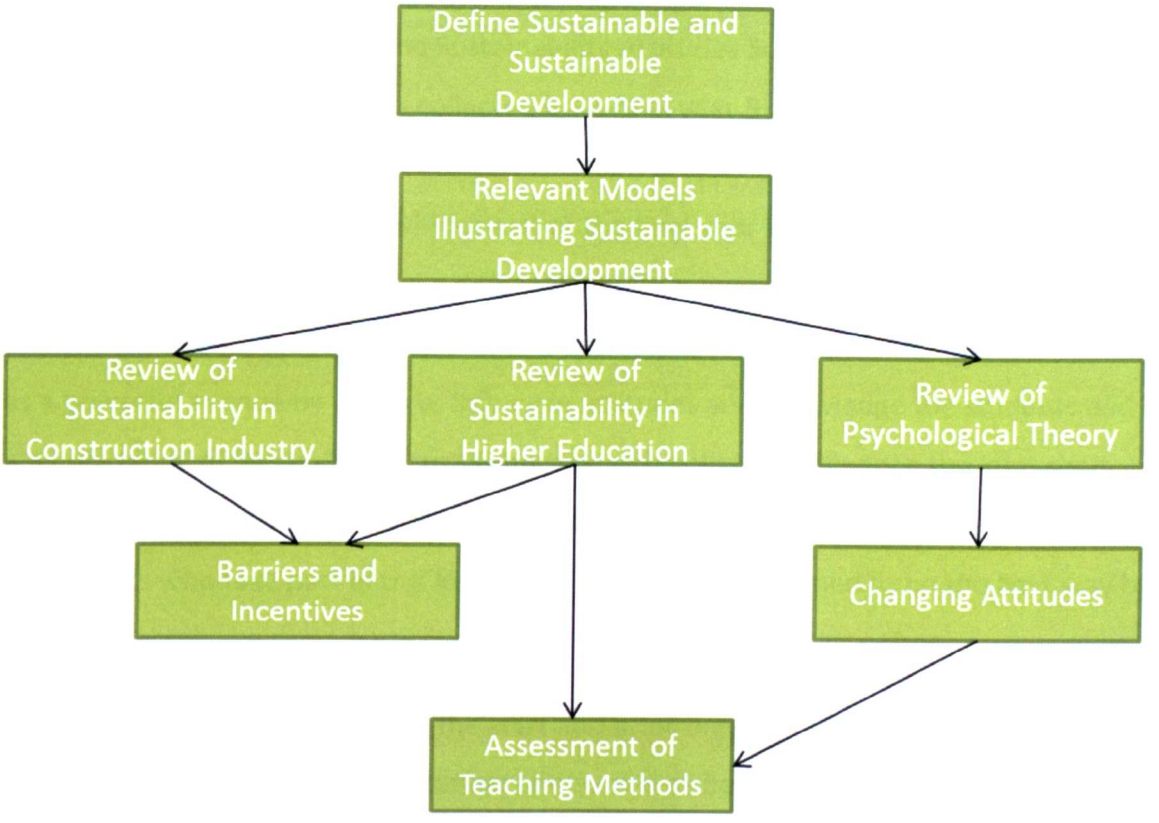


Figure 2. Overview of the necessary topics to be covered in the literature review (self-study)

1.3.2 Phase 1-Pilot Study

After the initial phase of conducting a literature review on the background and context, it was important to gain an insight into what students across the entire Liverpool John Moores School of the Built Environment rated their environmental concern to be. The aim of the pilot study was to provide a snapshot using a general environmental questionnaire in order to form a starting point from which to construct a more relevant environmental attitudes assessment tool related to construction practices.

Analysis of the pilot study pointed out gaps with the first assessment tool used because of its generic nature. It was clear that the NEP would not be appropriate to use for the subsequent phases of this study because it did not address sustainable construction topics. This led to the review of best practice publications on construction as well as

incorporating sustainable practices found in the literature review. These were turned into statements which were later edited into a 25-item questionnaire tailored specifically to assess sustainability and construction practices. Further details of the scale development and validity testing are discussed in section 6.2.

1.3.3 Phase 2

After the initial validation of the Sustainability Attitudes Scale was conducted, the first round of longitudinal data was collected from final year BUE students during a group project in 2011 called the Joint Project. The Joint project was identified as a key part within the BUE curriculum in which most of the final year BUE disciplines as well as fifth year architecture students from a different faculty merge to create a design for a prospective client. The joint project was identified by previous research (Cotgrave, 2008) as a powerful avenue by which to influence attitudes and knowledge the students had on a whole range of facets. The focus of this research being the influence the joint project has on students' knowledge and attitudes towards sustainability. Due to the large number of students who take part in the Joint project, it was also deemed to be the best way by which to recruit the same participants to complete both questionnaires.

Attitudes were measured before the start and after the end of the project. This data collection was completely quantitative and served as benchmark values for the following year's data collection which relied on the same questionnaires.

1.3.4 Phase 3

Phase three involved interviewing academics as well as creating educational interventions that could be implemented into the final year curriculum for undergraduate BUE students. This section relied on qualitative research methodology as phenomenography was used to identify themes which could help with the creation of educational interventions at later stages of the research.

In semester one (academic year 2011/2012) the educational interventions were implemented into one-off sessions for the Construction Management, Architectural Technology and Real Estate students. Rationales for why these three programmes received educational interventions were that Architectural Technology has a strong push from their professional body (Chartered Institute of Architectural Technologists, CIAT) to learn about sustainability. Construction Management students are experiencing a sustainability push internally from the school of the BUE and lastly Real Estate

Management was chosen because it seems to be the least likely profession to accept change or that sustainability is useful in their industry. Chapter 9 will further detail what the educational interventions consisted of.

1.3.5 Phase 4

After the implementation of educational interventions towards the end of semester one, the second round of longitudinal data was collected at the beginning of semester two (2012) at the beginning and end of the group project. Although the questionnaire presented to the students was the same as in the first round of the longitudinal study, there were certain changes to the methodological design of phase 4 compared to phase 2. For example, the 2011 cohort did not have educational interventions, nor were they contacted afterwards to provide qualitative data about the experience. On the other hand, the 2012 cohort were exposed to educational interventions in semester one and asked for qualitative data in the form of a reflective essay two weeks after the Joint Project ended.

1.3.6 Research Methodologies

Alongside the aims identified in section 1.2, a review of possible methodologies was conducted to determine which one would be the best for this research project. Overall, the research relies upon a sequential mixed methods approach (Teddlie and Tashakkori, 2009) as phases one and two focused on quantitative data whereas phase 3 relied upon qualitative data. Finally, phase 4 can be seen to rely on both quantitative and qualitative data. Figure 3 illustrates these phases while chapter 5 will outline more throroughly the methodological approaches and rationales implemented.

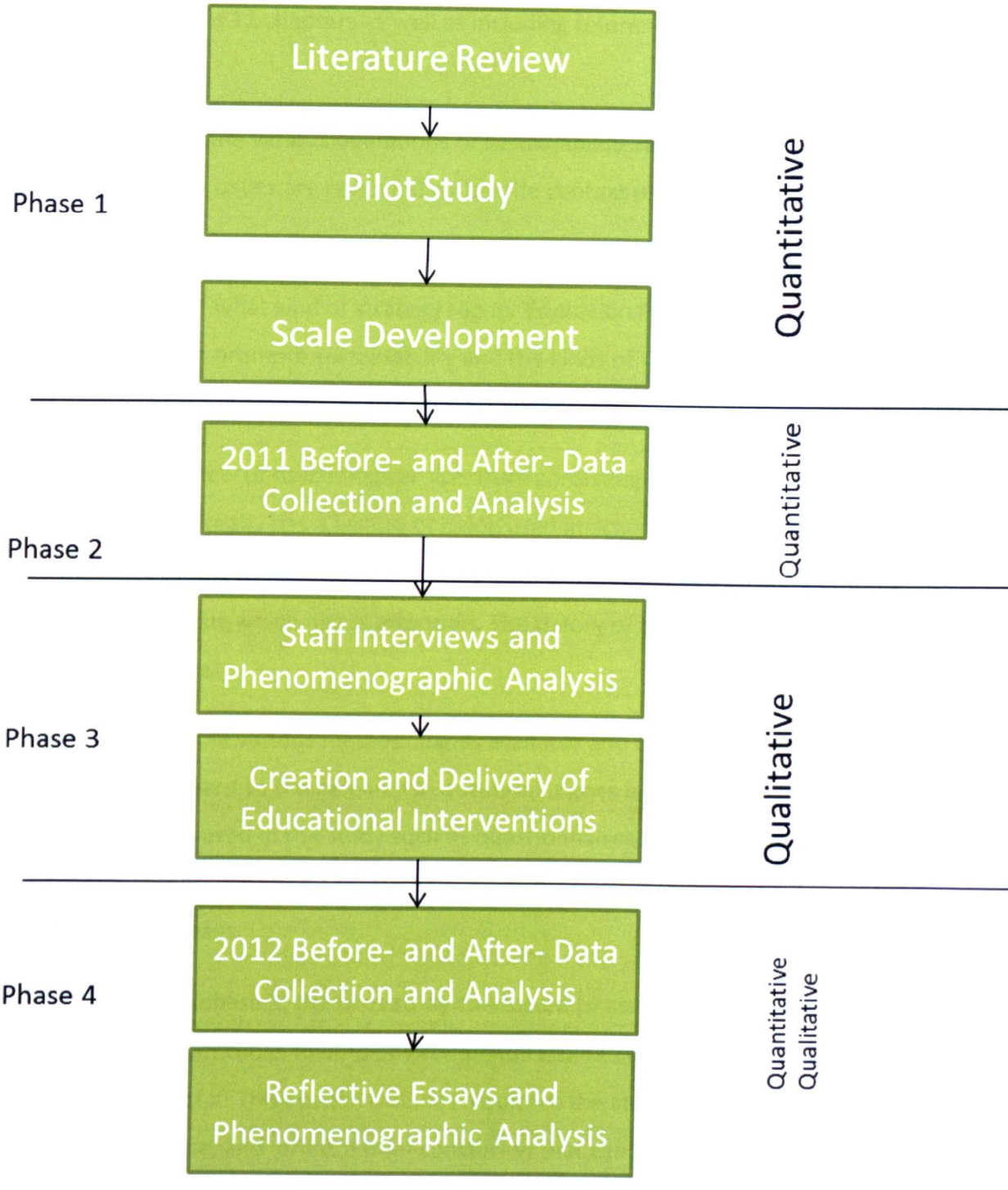


Figure 3. Overview of Research Method Stages (self-study)

1.4 Thesis structure

The thesis consists of 11 chapters as well as including references and appropriate appendices.

Chapters 2 outlines the various definitions of sustainability and the models used to depict them. Sustainability issues are reviewed within the context of construction industry.

Chapter 3 reviews the role of sustainability within institutions of higher education. This included finding out what kind of strategy Higher Education Funding Council for England has implemented to promote sustainability and the kinds of skills professional bodies would want future construction professionals to gain.

Chapter 4 is the review of psychological literature consisting of constructs such as personality which already has a history of being used in academic settings as well as emotional intelligence which may help understand how sustainability could be thought of as a more crucial issue which needs attention. The theory of transformational learning is also introduced here.

Chapter 5 explores the various methodologies available and comes to a conclusion as to which is most pertinent to the research in question. It goes into detail regarding the materials that were used in the study such as questionnaires and their validity and psychometric values while also summarising the relevant methodology techniques for each of the four phases.

Chapter 6 discusses phase 1, the pilot study conducted to assess students' current understanding and attitudes toward environmental issues, creation of a quesitonnaire and the validation of it. This section includes results of the analysis, the methodology adopted in this phase, and offers a brief conclusion that can be drawn from the results.

Chapter 7 summarises aspects of the purely quantitative phase 2 and includes results of the analysis, methodology adopted for this phase, and some conclusions.

Chapter 8 discusses phase 3 in which interviews were held with module and programme leaders to discuss how they would like sustainability information to be implemented in the curriculum. Initial thoughts on intervention types will be considered.

Chapter 9 relates to the choosing of approriate educational interventions by drawing

upon the research of other areas such as medical training and environmental education in order to come up with something effective for BUE students.

Chapter 10 narrates what phase 4 was about: the second collection of longitudinal data before and after the Joint Project. The section will assess whether the sustainability sessions implemented in semester 1 were effective. This section includes results from the quantitative and qualitative analyses which were conducted and offers conclusions.

Chapter 11 will discuss the other conclusions of the study, highlight the limitations and offer recommendations for future work.

1.5 Summary

This introductory chapter reviews the background and context from which this research stems as well as illustrating the approach that is going to be applied in order to test the aims of the various phases. It also sets the scene for the contribution to knowledge the work is going to make.

- Implementing psychology principles into the project in order to understand how mental processes such as attitudes, knoweldge, and values are formed and what can influence them may be beneficial in an educational setting.

- It is expected that this psychological insight will prove to be advantageous for the project as it can lead to knowledge contributions in the BUE education sector by exemplifying a refined approach by which to assess sustainability knowledge within the BUE curriculum.

- If the aim of the research is achieved, the endorsement of similar assessment of BUE curriculum may be made throughout higher education institutions across the UK as well as professional groups.

2. Understanding Sustainability

Chapter 1 briefly introduced the context as to how the construction industry operates, as a considerable amount of waste occurs, leading to a loss of money and natural resources despite government involvement. In order to investigate whether anything can be done to change this, a literature review must be conducted to further explore the relevant issues which will be significant to the overall aims of the research.

The objectives of the literature review are:

1. To review how sustainability and sustainable development are defined in the context of the construction industry and what models are used to represent it. The implications of sustainability will be explored from a business case perspective.

2. Explore factors such as building life cycle, energy use, waste management and the role which the property sector has on sustainability in the construction industry.

3. To establish how degrading construction practices are to the environment and to investigate what some of the barriers and incentives to acting sustainably in the construction industry.

2.1 Defining Sustainability and Sustainable Development

The first objective of the literature review is to assess the definitions that exist for both sustainability and sustainable development. Although these words are dominant in today's vocabulary, the concepts themselves are not new, even though they are only now getting the world's attention (Murray, 2011). As there are many definitions of what sustainability and sustainable development ought to mean, Costanza and Patten (1995) posit that the various definitions are merely predictions of actions to be engaged in, in the hope that sustainability will be the outcome. The following sections will describe the distinction between them.

2.1.1 Sustainability

Faber, Jorna and van Engelen (2005) mused that the reason why 'sustainability' came about was to be able to manage problems which may arise from economic development deteriorating the global ecology. Murray (2011) on the other hand considers sustainability as an aspiration. If one thinks of sustainability as the end result, then applying principles

of sustainable development can lead to the creation of a sustainable future. Costanza and Patten (1995, p. 193) offered their view on what sustainability meant, suggesting that a "basic idea of sustainability is quite straightforward: a sustainable system is one which survives or persists." Biologically, the authors take sustainability to signify the ability to survive and reproduce, as well as to avoid extinction. Economically, they state that sustainability would be achieved by avoiding major downfalls and unstable situations. Raynsford (1999) presented a wider definition for sustainability by including themes such as social progress, prudent use of natural resources, environmental protection and economic growth through stable levels of employment (Hueting and Reijnders, 2004).

Another way of defining sustainability is the 'triple bottom line' which considers environmental, economic and social terms. Companies are beginning to acknoweldge the triple bottom line as a means of measuring their success in more ways than traditional financial success (Murray, 2001). Others use alliteration describing sustainability with the notion: 'profit, people and planet' (Hueting and Reijnders, 2004). Faber *et al.* (2005) succinctly suggest "sustainability refers to an equilibrium between an artefact and its supporting environment, where they interact with each other without mutual detrimental effects" (p.5). Costanza and Patten (1995) added that if sustainability is to be thought of as an aspiration, determining whether a sustainable act was successful or not can only be assessed after it has been carried out. Therefore steps and measures have to be taken to ensure that the final outcome is sustainable and not the opposite.

2.1.2 Sustainable Development

If sustainability is considered the aspiration to create a sustainable future, then, sustainable development is the action by which the aspiration is reached (Murray, 2011). The most cited definition of sustainable development comes from the United Nations World Commission on Environment and Development (WCED, 1987) stating that "sustainable development seeks to make sure that developments meet the needs of the present without limiting future generations from meeting their needs". Cotgrave (2008) believes that this definition is appropriate within a construction context. Although vague, the definition gives direction as to which domains need to be considered, yet provides no clear method for achieving sustainability.

Leal Filho (2000) reviewed the ways in which sustainable development is defined based on the different perspectives from which it can be viewed. He listed four examples of the way in which sustainable devlopment was defined which were:

1. the systematic, long-term use of natural resources (affecting country and local policies)

2. the progress countries can make in terms of economic and societal aspects without destroying the environment (referring to country policies)

3. the social ramifications of development (ecomonic soundness, socially just, ethically acceptable)

4. giving environmental indicators the same weight as economic indicators (drawing comparisons between the close links between economic growth and sustainability)

The ambiguity of sustainability definitions may be due to different perspectives being adopted or due to regional differences as Lo, Zhao, and Cheng (2006) found. Similarly Faber *et al.* (2005) noted in their work on organisational sustainability that definitions should concern local aspects in order to achieve understanding on how sustainability is being defined by a certain group and how it can be promoted. As sustainability means different things to different people, there is a need for clear definitions, even if it is clear for one group or organisation. This resonates with what Costanza and Patten (1995) stated regarding how to choose what needs to be sustained as a clear definition would help lock this point down.

Raynsford (1999) offered his view on what sustainable development should be, particularly from a government perspective. Firstly, sustainable development should acknowledge the needs of everyone through social progress. Through this progress, it is expected that the damage to society's health will be reduced by addressing issues such as poverty, poor housing, pollution and unemployment. This would follow on with ensuring that employment levels are stable guaranteeing that the economy grows. In terms of protecting the environment, global and local threats need to be identified and prevented as well as protecting elements that society holds dear. Finally, resources should be

managed sensibly and renewable materials should be favoured over resources that are running low or are not renewable. The sustainable development strategy pointed out that the construction industry makes significant contributions in the use and management of materials which is guiding the way they are used on a day to day basis (DEFRA, 2005). When construction is undertaken sustainably, social issues such as poor housing and unemployment could be counteracted as best practice construction methods would be used when building homes and through increased need for builders; promoting employment opportunities.

While there are many definitions of sustainability and sustainable development, the basic premise of all of them appears to be how sustaining the well-being of living systems can be achieved over time (Moore, 2005c; Atkinson, 2008). To understand fully why sustainability is thought of as an elaborate concept, it is important to understand the indvidual components of sustainability.

2.1.3 Environmental Dimension of Sustainability

Dunlap and Jones (2002) provided examples of classifying the environmental component by categorising nature's biophysical facets. These include the atmosphere, water, land, plants, and animals. Humans have had the greatest impact on the environment by altering land and soil, influencing climates, changing bodies of water and altering the habitats of creatures (Goudie, 2000). Population is expected to further increase and more technology is constantly becoming available which will lead to increased consumption, resource use and pollution (Murray, 2011).

Carrying capacity is defined as the number of individuals from any species that can be supported in a habitat without leading to damage. If the population exceeds carrying capacity, either the resources required to support the species will be depleted, or waste produced may poison other species, thus leading to population decline (Senbel, McDaniels and Dowlatabadi, 2003). Pollution, energy use and consumption of fuel further degrade the environment (Kaiser, Hübner and Bogner, 2005) and are burdening nature and its capacity to sustain the growing number of people and their activities. While some measures exist to quantify levels of ecological sustainability, they do so in monetary terms, which may be biased in terms of natural resources. Senbel *et al.* (2003) believe

that the implications of ecological sustainability are under-represented and have advocated the use of the ecological footprint metric instead. The ecological footprint has adopted the concept of carrying capacity and applied it to humans. These analyses estimate how much biophysical output is required by the earth to meet resource consumption and waste absorption of a community (Senbel *el al.,* 2003).

Pappas (2012, p.3) pointed out that "it is important to note that, most often, sustainability is considered synonymous with environmentalism (or environmental sustainability). This limited scope neglects that sustainability must be considered a system of interdependent factors, and that a change in one factor is likely to result in an unpredictable change in other factors".

In a local context, environmental sustainability could be supported by ensuring that construction projects do not pollute bodies of water which may be near the site. Construction noise should be kept to a minimum so that the surrounding community is not disturbed too much unnecessarily. The government aims to reduce generated waste and greenhouse gases by 25% while also greening the supply chain and monitoring water consumption (DEFRA, 2011b).

2.1.4 Social Dimension of Sustainability

Out of the three domains, the social sphere has been dubbed the weakest component of sustainable development (Lehtonen, 2004). Larsen (2009) noted that people are the facilitators, benefactors and sufferers of developmental activities, which should lead to this area being heavily focused on. Victorian Essential Learning Standards (VELS; 2009) advocate that the social dimension of sustainability, or socio-cultural sustainability as they refer to it includes studying elements such as citizenship, cultural diversity, democracy, health, and social justice. While there are plenty of problems facing the world, poverty is the one which is harming a considerable number of people through malnourishment (Dodds, 2008) inadequate healthcare, educational hardships, poor housing, unemployment and pollution (Raynsford, 1999). Some of these hardships are caused by economic distribution and politics, a majority of the world's inhabitants live in social inequity and experience diminished or even minimal well-being because they are not being given the chance to make use of services which they are entitled to (Murray,

2011). Raynsford (1999) noted therefore that social problems should be reduced in order to achieve social sustainability, let alone for sustainable development to occur.

Within the UK, social sustainability could be fulfilled through sustainable communities whereby schools would be located at a convenient distance for children, and there would be good transportation links for commuters. Housing should be of better quality to promote a sense of safety and well-being to residents. Provision of employment opportunities would also make a big difference and specifically relate to building as a lot of the opportunities could come from the construction industry. The UK government is laying a lot of emphasis on the promotion of well-being as it wants to promote staff well-being as well as provide opportunities for cultural, leisure and tourism to empower communities (DEFRA, 2011a; 2011b).

2.1.5 Economic Dimension/Capital Approach to Sustainability

The capital approach is the most prominent within sustainability literature. Two arguments which have been put forth are that there are benefits to managing one's resources prudently; the second reason for its extensive use is that this capital approach has served as a useful framework in establishing the main elements of sustainability which are grounded within economic thinking of growth and development (Atkinson, 2008). The capital approach suggests that individuals will be concerned about sustainability and sustainable development in terms of wealth and what is happening to it, as this will have an impact on human well-being. For example, if wealth decreases, future levels of well-being will also decrease (Atkinson, 2008).

Pearce (2006) also endorsed viewing sustainability from an economic perspective as his work noted that economists have maintained a consistent definition of sustainability, as the principal objective in societies is to promote well-being through increased wealth *per capita*. In line with what Pearce (2006) noted Atkinson (2008, p. 245-6) stated that "future well-being is closely linked to current assets or, to be more precise, to changes in (real) asset values." From this stance then, it is easy to see whether well-being has risen or declined through subjective well-being determinants, that is, how individuals classify their own well-being. It is important to note that to achieve sustainability the ways of working towards it must be in place. The opportunity to create well-being must be

present, and in line with the economic perspective, individuals must have assets, or at least access to assets, in order to attempt to increase their well-being (Pearce, 2006).

The UK government has made decisions on policies which would support the conversion to a green economy. This is proposed by the carbon price floor, export of clean technologies, the Green deal and by reviewing waste policies (DEFRA, 2011a). Emphasis should be made specifically to corporations that there are sound economic reasons for practicing sustainability. The Department for Business, Innovation and Skills (BIS) attempts to encourage a sustainable economy by investing in skills, boosting innovation, and helping individuals start and expand their businesses (BIS, 2012).

2.1.5.1 Classification of Assets- The Various forms of Capital

"Wealth is the stock of assets available to an individual" (Pearce, 2006, p. 202). Organisations can also benefit from the availability of assets or capital, in much larger quantities than an individual, in order to deliver their goods and services.

Pearce (2006) considered assets to generally cover four types which are: anything man-made that can be privately rented or owned such as houses and machines, as well as the use of roads and airports, which are also man-made but under public ownership. There can be environmental capital such as land and natural resources including solar energy, water, and wind. One of the aims of the coalition government is to transform the UK into a green economy. The government is currently taking stock of its natural capital not only to appraise it and give it a value but to make sure the policies which are made reflect its value (DEFRA, 2011a). However, Murray and Murray (2007) and Forum for the Future (2011) list five types of captial which are natural, human, social, financial and manufacturing capital. Under this classification system, financial capital is described as currency which can be traded or owned such as shares, banknotes and bonds (Forum for the Future, 2011). On the whole these assets are defined in a similar way to Pearce, however they note that manufacturing capital does not use as many natural resources but makes use of human capital to the fullest extent in the form of innovation. Pearce (2006) denotes human capital to be the work force with their knowledge and experiences as well as social capital which represents the interaction human capital can have between workers which enables trust within group members.

Tan, Plowman and Hancock (2007) reviewed the work of other researchers and how they classify assets while also discussing the notion of 'intellectual capital' which indicates enterprise value. They suggest that economies are now focusing more on information and knowledge, therefore attention should be given to the type of assets companies have at their disposal and use those to the best of their ability in order to create more wealth. A few of the models that Tan *et al.* (2007) looked at were the Value Platform model (Petrash, 1996) which classified intellectual capital as human, organisational and customer capital. In 1997, Stewart published his views on intellectual capital comprising of human, structural and customer capital whereas the European Commission (MERITUM, 2001) classify intellectual capital into human, structural and relationship capital (as cited in Tan *et al.*, 2007). As can be seen, all three classifiers seem to agree that human capital is a crucial form of intellectual capital while the other classifications of capital differ.

In relation to sustainability, Hueting and Reijnders (2004) proposed that environmental, economic, human and social capital be used as indicators of sustainability, which is supported by the Forum for the Future (2011) as they had created a framework by which businesses can understand sustainability through the concept of wealth creation. Their framework discusses why focusing on the types of capital are important and offers suggestions as to how those capitals can be maximised in order to achieve long-term financial, social and environmental profitability.

It is easily seen that all types of capital are important and may be dependent on one another. The amount of a certain type of capital will also be determined by the kinds of activities that take place in a certain industry. In the case of the construction industry, all five types of capital are needed to a varying degree at different levels from more human capital needed in managerial levels, and more man made capital at the production levels for example. Although Pearce (2006) acknowledged that there are variations within labels given to the assets, the author is satisfied with Pearce's classification system as even though financial capital is not mentioned, it is implied as "financial capital reflects the productive power of the other types of capital" (Forum for the Future, 2011, p. 6).

2.2 Interpreting Models

Myers (2005, p. 781) articulated that the challenge of sustainability is "to find a new vision where social and environmental benefits go hand in hand with lower costs and higher profits". Dodds (2008) proposed a similar notion by stating that for sustainability to be achieved, an integration of principles from various disciplines to solve problems should be adopted. Although the notion of sustainability can be summarised as the triple bottom line (Hueting and Reijnders, 2004; Murray, 2011), the way of depicting this concept is varied. Some researchers (Todorov and Marinova, 2009, Larsen, 2009, Kokkarinen and Cotgrave, 2010) have depicted the three domains in a Venn diagram (Figure 2). Others have chosen to depict sustainability as a three pillar model (Figure 3) (Goodhew, 2003; Hueting and Reijnders, 2004; Gibson, Hassan,Holtz,Tansey, and Whitelaw (2005); Murray and Cotgrave, 2007; Murray 2011).

Faber *et al.* (2005) consider the WCED definition a static perspective as it assumes that social and environmental stuctures stay the same over time. There are however other definitions such as Goodland and Ledec (1987, as cited in Faber *et al.*, 2005) which apparently are more dynamic as the definition actually states that there is a clear pattern of transformation going on that optimises social and economic benefits.

Figure 4. Dimensions of Sustainability (From Larsen, 2009).

Sustainability issues are regarded as a concept which explores the relationship between economic development, social equity and environmental quality (Rogers, Jalal and Boyd, 2008). Dodds (2008) put forth the need for various disciplines to integrate in order to solve problems. Figure 4 depicts this as there is only slight convergence between the social, economic and environmental spheres, indicating that sustainability is achievable through an interdisciplinary approach. "Sustainable development is a dynamic process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs" (Rogers *et al.*, 2008, p. 42). With this definition, moving towards the centre (4. sustainability) within figure 4 should theoretically be conceivable. While spheres 1, 2, and 3 are depicted as unsustainable, it should also be noted that these mergers between environmental and economic spheres for example have led to the emergence of fields such as ecological economics. Other disciplines which have emerged include environmental psychology and sub-dimensions of ecological studies.

Figure 5. Three pillar model of Sustainability (Adapted from O'Riordan, Cameron and Jordan, 2001; Goodhew, 2003).

An alternative depiction of sustainability in figure 5 above contains all the relevant information, yet the depiction of it does not represent interaction between the three domains which would lead to sustainability in an adequate way. The economic, social and environmental 'pillars' support sustainability yet it seems to merely indicate that the pillars are able to account or uphold a portion of sustainability on their own, as opposed to the Venn diagram which depicts that all three domains need to function simultaneously in order for sustainability to occur which, to the author, seems a more feasible depiction.

The perspective from which one chooses to view sustainability will depend on a person's training, work experience, and political and economic setting (Leal Filho, 2000). However, a concise explanation of what each domain entails can be seen in Gibson *et al.* (2005) and Murray's (2011) three pillars of sustainable development diagram (Figure 6) . Although set in a three pillar layout which does not adequately represent the dynamic synergy needed to achieve sustainability, it is the content within the pillars that is of great interest as it discusses in widely applicable terms how sustainability can be applied in many professional fields, not just construction.

Figure 6. Three pillars of sustainable development (Adapted from Gibson *et al.*, 2005; Murray, 2011).

The visual representations of sustainability have evolved over the years to accommodate and join the various notions which have been expressed by researchers. Hueting and Reijnders (2004) mentioned the triple bottom line and people, planet, profit as ways in which individuals and companies think of sustainability. Figure 7 depicts these two together, which further highlights that there is a legitimate business case behind adopting sustainability in the construction industry.

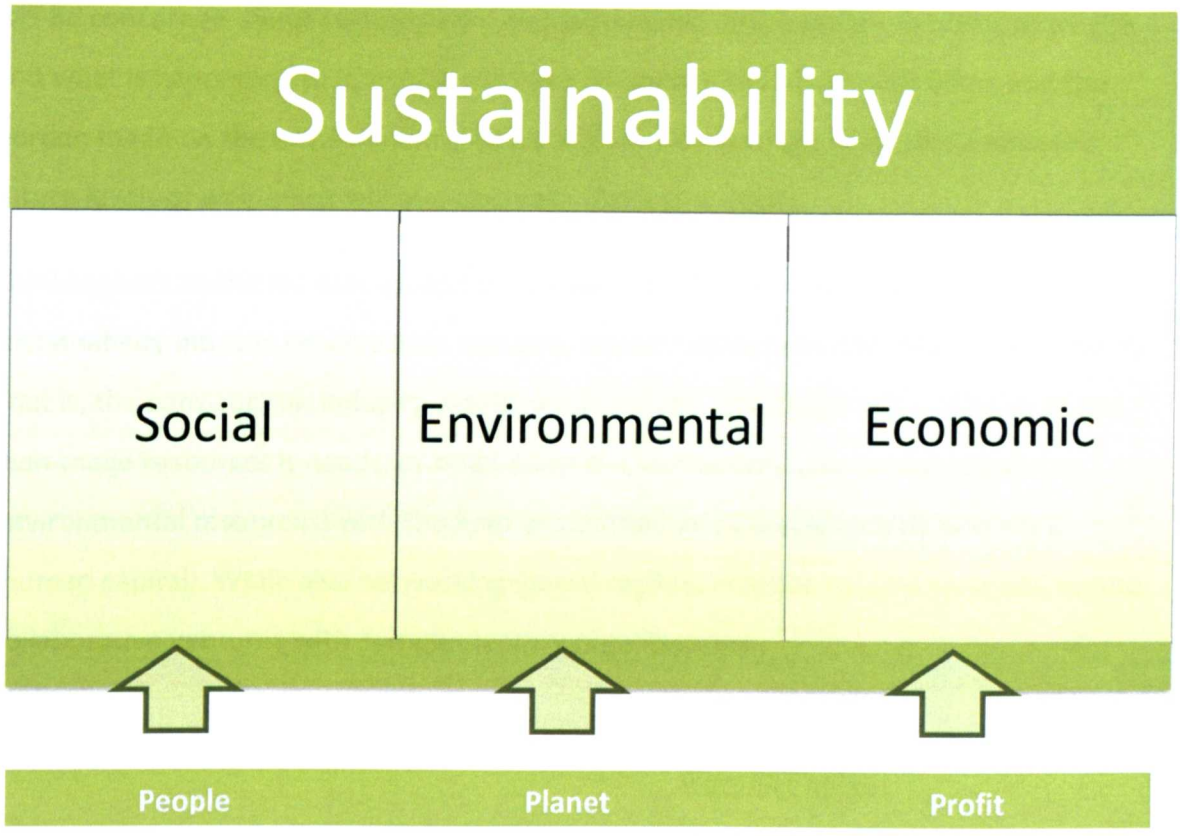


Figure 7. Representation of sustainability which emphasises the business case for sustainability by integrating the triple bottom line (self-study).

Figure 7 is the current way in which sustainability is viewed, as the triple bottom line is becoming an integral part of practicing sustainabilty not only because it is a way to preserve the environment, but because it can bring about positive social change and profit for companies.

2.3 The Benefit of Sustainability in the Construction Industry

The answer to the question 'what is the benefit of sustainability in construction?' can be best understood from the economic perspective; specifically the kind of benefit it would have on the construction industry as a whole. Industries aim to keep costs down while maximizing profits and therefore the capital approach is prominent within sustainability literature. Two arguments which have been put forth are that there are benefits to managing one's resources prudently; the second argument being that the capital approach has served as a useful framework in establishing the main elements of sustainability which are grounded within economic thinking of growth and development (Atkinson, 2008). This links well with the capital approach as it suggests that individuals

will be concerned about sustainability and sustainable development in terms of wealth and what is happening to it, as this will have an impact on human well-being and the burden made on the environment (Moore 2005c). For example, if wealth decreases, future levels of well-being will also decrease (Atkinson, 2008).

Thinking back to the economic/capital approach discussed, to be able to fully incorporate sustainability into the construction industry, capital needs to be allocated appropriately. That is, the construction industry would need to make sure that it has access to all the man-made resources it needs, or build them in a sustainable way (being mindful of environmental resources) with the help of qualified and knowledgeable personnel (human capital). While also networking (social capital) in order to build trust and secure collaborative ventures with complementary organisations .

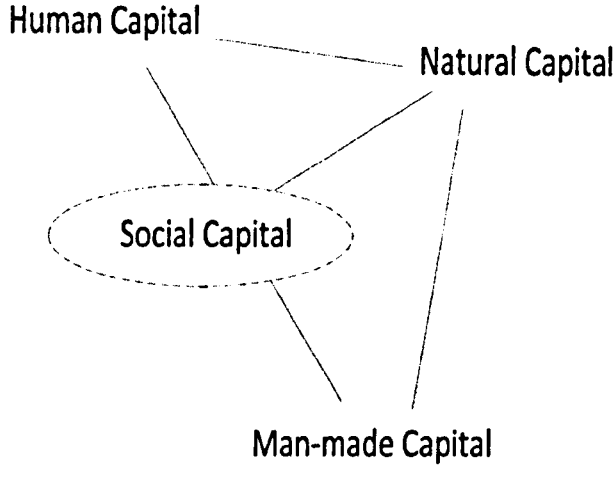


Figure 8. The Importance of Capital in the Construction Industry to Achieve Sustainability (Self-study)

Figure 8 indicates the relationships all four types of capital can have amongst each other to achieve sustainability within the construction industry as well as creating financial capital (Forum for the Future, 2011). Man-made capital and human capital are connected by a line, but also by social capital in the middle to depict that while human capital (the work force) is needed to either create or access man-made capital (buildings, infrastructure), it is the social capital (social relationships; networking) which may gain access to the man-made capital of others if needed. Human capital (the workforce) have knowledge and experience to be able to choose or assess what natural capital is needed or needs to be used more prudently, which in turn may reflect on the outcome of any buildings or infrastructure that are procured by the industry. With respect to natural capital, the UK government plans to value the natural capital it has in order to

appropriately measure it and create policies that are in line with this valuation (DEFRA, 2011a).

As more and more technological innovations are created, older models decrease in value, as do buildings and machines over time. However, Pearce (2006) stated that human capital tends to increase in value as a person gains more knowledge and experience year by year. Both aspects need to be considered in an industrial setting: you cannot have the best workforce with mediocre equipment, nor can you have the best equipment with an unskilled workforce to use it. Therefore allocation of the four types of capital is vital, especially when incorporating sustainability as it can improve the delivery of goods and services whilst increasing profits, and maximising the effectiveness and efficiency of the assets possessed.

2.4 The UK Construction Industry

Although the construction industry is considered to be a major polluter as it accounts for approximately 10% of the United Kingdom's (UK) gross domestic product (GDP) which is approximately three times that of the automobile industry and around five times that of the aerospace industry. The UK construction industry has a turnover of £200 billion and employs around two million people in more than a quarter of a million companies (Raynsford, 1999; Strategic Forum for Construction; 2012).

2.4.1 Sustainability in the Construction Industry

Sustainability within the construction industry is a very expansive topic as it includes building design, construction management, building use and management (Watson Wyatt, 2009). However, looked in further detail, there is an array of other aspects which are as important such as energy use, choice of materials, waste, water use, internal environment of the building as well as transport (Watson Wyatt, 2009).

The capital approach to sustainability was discussed in section 2.1.5 as a means of measuring sustainability. Once that method is moved into the construction industry however, its practical application becomes more dubious. Industries cannot be compared to nations in this respect, as technology and international competition guides the market and the way this affects industries-some may expand while others decline (Pearce, 2006). Socially and economically, the construction industry is a major source of employment and an area of significant financial investment (Ortiz, Castells and Sonnemann, 2009) which

could be described as opportunities to increase well-being. Ironically, from an environmental perspective, construction is commonly associated with a decrease in well-being as it is responsible for high levels of energy consumption, resource depletion, solid waste generation and other environmentally unfriendly practices (Ortiz *et al.*, 2009).

Figure 7 in section 2.2 depicted how sustainability could be practised while still being justifiable as a business strategy. Reports from professional bodies such as the Chartered Institute of Building (CIOB, 2001) have outlined how the construction industry can move sustainable development forward while still making a profit. Although these initiatives have been put into place, the level of desired effect has not been met and, it may be worthwhile to introduce an additional strategy such as education (Kokkarinen and Cotgrave, 2010b).

The Building Research Establishment (BRE) ran a scheme which attempted to assess the overall environmental impact buildings caused by assessing energy, indoor air quality, recycling and carbon dioxide emissions (Ball, 2002). When compared to similar schemes, the BRE undertook a more encompassing approach, thus assessing environmental impact more thoroughly. Based on these findings, incentives to promote sustainable practices have been put into place to reward those who are mindful of the potential economic, environmental and social opportunities their actions may create. For example, Legislative measures have also been put into place where those capable of acting sustainably are held accountable for nonconformity (Dainty and Brooke, 2004). Leftover material could be recycled or reused in future projects or sold to secondary markets (Teo and Loosemore, 2001; Dainty and Brooke, 2004). Some firms have even gained a competitive advantage by implementing waste minimisation strategies on building sites (Dainty and Brooke, 2004; Alkhaddar, Wooder, Sertyesilisik and Tunstall, 2012).

There are methods in construction which could help promote sustainability in the industry, and some may be particularly appealing due to financial aspects. These include building life cycle, energy use, sustainability within the property sector, and the practise of waste management (Yahya and Boussabaine, 2006). These will be discussed in further detail in the following sections.

2.4.2 Building Life Cycle

Although the construction industry is a large sector for employment and contributes significantly to the UK economy, it does so at the cost of the environment (Forsberg and van Malmoborg, 2004). Energy use in buildings accounts for approximately 40-50% of the UK's carbon dioxide emissions (Raynsford, 1999, Riley and Cotgrave, 2004; Cotgrave, 2008) due to the use of certain materials such as concrete, steel or aluminium which require a lot of embodied energy to be created (Riley and Cotgrave, 2004; Cotgrave, 2008; Ortiz *et al.*, 2009). Embodied energy is the sum of all the energy consumed during extraction, processing, manufacturing and transporting goods and materials at any stage of construction (Treloar, Gupta, Love and Nguyen, 2003) and therefore choosing building materials and finishes which have a lower embodied energy should be encouraged.

The life span of a building is typically 60 or more years and during this time the building will require repairs, maintenance, alterations as well as upgrades so that the building maintains an acceptable level of performance and user satisfaction (Riley and Cotgrave, 2004). A building will require regular spending which needs to be considered in conjunction with the initial cost of building (Riley and Cotgrave, 2004) thus consequently adding further cost and energy use of the overall building for example.

Ortiz *et al.* (2009) reviewed Life Cycle Assessment (LCA) which is a methodology for considering the environmental load of goods and services over their cradle to grave cycle. LCA can capture environment-related inputs and outputs of value chains from the supply of raw-materials through to product use and returns (Nidumolu, Prahalad, Rangaswami, 2009). As the package of expenditure reflects the whole life cycle of a building; designers can use this information to choose the best design solution not only from the point of view of initial cost but also for the entire life cycle cost (Riley and Cotgrave, 2004).

Life cycle costing is recognised as a ground-breaking methodology as how to improve sustainability in the construction industry as it can compile an inventory of the energy needed and consumed by materials and can also indicate how much emissions are released into the air, land and water (Ortiz *et al.*, 2009). For this reason, LCA has helped companies find out how much resources are being used by the supply chains and can therefore assist in emphasising the need for prudent use of these to be a proprity if sustainability is to be endrosed (Nidumolu *et al.*, 2009).

2.4.3 Sustainability in the Property Sector

As property professionals work in the built and natural environment, it is important for them to be aware of sustainability and relavant legislation (European Council for Real Estate Professions (CEPI), 2008). Although the current economic climate has brought new challenges to the construction as well as the property industry, there is still a push for buildings to meet sustainability standards regarding issues of land contamination, waste treatment, transport, energy and water use (CEPI, 2008; Watson Wyatt, 2009).

Approximately 80% of Europe's greenhouse gas emissions come from energy, and about 40% of energy is consumed by the buildings sector (CEPI, 2008). As so much energy is used by buildings, it would be the best sector to integrate energy efficienct strategies. In 2002 the European Union passed the Directive of Energy Performance of Buildings was passed (BRE, 2006; CEPI, 2008). It was passed with the intent to improve the energy performance of buildings through cost-effective measures (BRE, 2006). The Directive focuses on four aspects which cover the calculation of energy performance of a building, taking into account everything which influences energy use. The need to set minimum energy performance requirements for newly built and refurbished buildings. Energy performance certificates must be provided when a building is constructed, rented or sold (BRE, 2006; CEPI, 2008; Watson Wyatt, 2009). As well as inspecting air-conditioning and boilers at regular intervals (BRE, 2006).This directive alone has made a considerable impact on building developers, operators and owners across the UK but has also influenced the new Part L building regulations (Riley and Cotgrave, 2004; BRE, 2006).

The Royal Institute of Chartered Surveyors (RICS) emphasised the business case for sustainability within the property sector by stating that unsustainable construction, investment and management practises will lead to buildings becoming outdated faster, resulting in losses regarding financial performance and asset value (Watson Wyatt, 2009). There therefore appears to be an interest within the property sector to compile a green property portfolio which is expected to yield better investment returns in comparison to less efficient buildings which are believed will fetch lower prices (Watson Wyatt, 2009) thus resulting in lower profits for the property industry.

In terms of sustainability, the property sector has a very important role to play in achieving it as it not only considers environmental and economic aspects, but largely contributes to social sustainability as ideal buildings should have close access to public

transportation or cycle paths, be situated in areas that are conducive to community relations while not impacting on the local ecology, or visual impact of the local environment. Buildings should also be comfortable for the residents or users as well as be safe, and comfortable (Watson Wyatt, 2009).

2.4.4 Energy Use, Carbon Dioxide and Renewable Technologies

Energy use is vital when discussing sustainability because it is used for virtually every aspect of construction. A direct consequence of energy use is the emission of carbon dioxide (CO_2) (Watson Wyatt, 2009). Carbon is released into the atmosphere through natural waste, volcanic eruptions and decay but large quantities of carbon are also stored by limestone rocks and fossil fuels (Murray, 2011). With current human activity burning a vast amount of fossil fuels, more carbon dioxide is being emitted into the atmosphere, creating air pollution (Murray, 2011). As mentioned in section 2.4.2, the production of certain materials consumes more energy than others, therefore increasing the amount of embodied energy they have (Riley and Cotgrave, 2004; Cotgrave, 2008; Ortiz *et al.*, 2009). This, along with the energy used to operate machinery by which to install these materials into a construction site use enormous quantities of energy (Raynsford, 1999).

The government is striving for turn the UK into a low-carbon economy by reducing carbon emissions of the central government, companies, homes and offices (DEFRA, 2005; 2011a; 2011b). CO_2 reduction is also endorsed by the government as it is attempting to tackle climate change by reducing carbon emissions by 25% in 2015 when compared to the baseline figures of 2009/2010 (DEFRA, 2011b) and by a staggering 80% by the year 2050 (DEFRA, 2011a).

Watson Wyatt (2009) and Murray (2011) endorsed the use of renewable energies when feasible, adding that the renewable industry could promote social and economic sustainability by offer jobs in this sector. The type of renewable energies that were mentioned included using the sun and wind to generate power (Murray, 2011). In this way, thin-film photovoltaic panels could offer cheap and efficient power whereas if solar power was used to heat water, Murray (2011) estimated that approximately half of the world's hot water would be provided. If wind power was used, it would be able to generate around 20% of the world's energy or if off-shore wind was used, Europe's entire electricity needs would be met. Although the use of renewable energies seems promising,

Murray (2011) reminds us that the use of renewable energies alone is not the solution because technology has its drawbacks.

2.4.5 Waste Management in the Construction Industry

The construction industry is one of the largest environmental polluters, thus it is of great importance to be able to quantify and assess the impact that construction waste is having on the environment (Yahya and Boussabaine, 2006). Waste management is defined as the process involved in dealing with waste once it is created. This includes site planning, material handling,transportation, storage, sorting of materials, reuse, recycling and final waste disposal. Waste is defined as material by-products of industrial and human activity which has no residual value (Tam and Tam, 2006).

Pan, Gibb and Dainty (2007) advocate the use of modern methods of construction (MMC) as a way to design out waste. Design waste implies that waste which arises from construction sites is owed directly or indirectly to the design process (Osmani *et al.,* 2006). Offsite technologies are one type of MMC which would allow for less construction but more assembly of prefabricated parts to be carried out at the building site. Pre-fabrication in itself could serve as a strategy to minimise waste as the exact quantity of materials could be ordered and if indeed there is some left over material, it could be reused or recycled more readily. MMC can possibly lead to the reduction of time, environmental impact, cost, faults and health and safety risks. In turn, this would not only help manage waste but the general construction process as relying on specialised factories would address the issue of skill limitations on site (Pan *et al.,* 2007). Treloar *et al.* (2003) posit that if an individual is able to appreciate the principles of handling and using materials on construction sites, attitudes to prevent waste could be developed so that the construction process is managed more efficiently.

The construction industry is one which is resistant to change, which could be attributed as the main reason for not implementing waste management or other sustainable strategies on site (Lingard, Graham and Smithers, 2000). DEFRA (2011c) has followed the waste management of the UK and has noted a decrease in the amount that is generated year on year. This can be see in table 1 below.

Table 1. Statistics indicating that less waste is being generated in the UK (Adapted from DEFRA, 2011c).

Waste derived from construction and demolition has a strong impact on the environment via air and water pollution as well as its related energy use during recycling activity operations, which need electrical power to be carried out. Air and water pollution occur mainly when the waste is transported and when waste which has been sent to landfill begins to decompose (Yahya and Boussabaine, 2006).

As this and 2.4.3 section have indicated, waste is not only a concern for construction practices, but also to the property market as it can have adverse impacts on communities and surrounding area.

2.4.6 Barriers to Sustainability in the Construction Industry

The vague WCED definition along with regional differences may account for why there is no 'one size fits all' definition of sustainability. Lo *et al.* (2006) found that environmental priorities varied between regions within China. While one region was concerned with water pollution due to its vicinity to rivers, the other was more concerned with air pollution. These results suggest that sustainability priorities and needs vary even within countries, providing insight as to why sustainability is so challenging to define. The results of the study also pointed out that energy consumption was not considered a hindrance to sustainability as it was considered a part of economic growth and demand by consumers in the area (Lo *et al.,* 2006). However, as section 2.4.4 pointed out, increased energy use leads to larger quantities of CO_2 emissions. Therefore reducing the amount of energy consumed would be beneficial. Blake (1999) identified barriers to action which account for why pro-environmental behaviour is not being acted upon. The main two which reflect industrial barriers are lack of responsibility as well as social and institutional constraints. This mindset of Chinese construction professionals reflects unawareness of environmental damage either through lack of knowledge or deferred responsibility as

they may be making comparisons between their own usage and that of other countries, thus justifying their own consumption.

Myers (2005) reviewed sustainability attitudes which the industry has assessed through disclosures provided by companies and affiliated media. What this audit determined was that a large proportion of construction firms do not report, or presumably engage, in sustainability practices. There are however some construction companies that are beginning to acknowledge sustainability as not only an issue of corporate social responsibility (CSR) but as a business strategy. The companies are few and far between, and their efforts may be overshadowed by larger market-dominating companies who still engage in traditional procedures.

Work conducted by Teo and Loosemore (2001) indicated that attitudes toward waste management are not negative, though they are hindered by a perception of lack of support from managers. The researchers found that construction professionals held negative views on the reuse or recycling of construction material which in turn reflects a wasteful mindset within the construction industry.

Practising construction professionals may not fully understand sustainability issues or be able to make adequate decisions regarding sustainable development (Murray and Cotgrave, 2007). This is because the shift to sustainable literacy has only recently emerged as an important educational outcome. Professionals may be unaware of sustainable procedures or may find it hard to keep up-to-date with new methods. Alkhaddar *et al.* (2012) conducted a study assessing whether deep or surface learning was needed to make construction industry professionals more aware of sustainability issues. Their findings suggest that those who work in office-based job roles seemed to have better understanding of sustainability on the whole. They also found that both office- and site- based employees seemed to adopt a surface learning approach when it came to sustainability; meaning that construction industry employees are memorising facts to meet the minimal sustainability requirements (Alkhaddar *et al.,* 2012).This suggests that construction industry professionals still view sustainability as a 'fad' or something that will soon be out of fashion and do not need to exert more effort and energy on it. Therefore, there is debate about where construction professionals go to update their knowledge on sustainability practices (Chan, Chan, Scott and Chan, 2002). A problem such as this one

could be addressed by equipping future construction professionals with adequate sustainability knowledge or literacy (Thomas, 2004) and providing intensive refresher courses for those already working in industry.

2.4.6.1 Barriers to Waste Management and Minimisation

Waste in the construction industry is perceived, and even accepted as an unavoidable by-product of building (Osmani et al., 2006). The aims of construction are often in conflict with waste minimisation due to productivity goals and rate of construction (Lingard *et al.*, 2000). Lack of awareness of the value of leftover material or that waste minimisation can be cost effective either by long-term financial benefits or legislative reward schemes are disregarded also. Deterrents to waste reduction can also be due to little knowledge of whom to contact to dispose of certain waste (Teo and Loosemore, 2001). Osmani *et al.*(2006) added that other reasons affecting the implementation of waste management strategies were the lack of information on drawings, not designing with waste reduction in mind, and not following standard dimensions.

There has not been a standardised way of reducing waste in the construction industry or enough attempts to try and incorporate more active waste management techniques in construction, hence why most people may not be carrying it out due to unawareness of what impact waste has on the environment, or how to dispose of it correctly (Teo and Loosemore, 2001). This can be linked with training. However, training on waste reduction techniques has been reported as lacking or being of poor quality throughout the construction industry (Teo and Loosemore, 2001). When Osmani *et al.* (2006) assessed architects and contractors regarding their attitudes towards construction waste 70% of architects and 84% of contractors believed that training would act as a major incentive to practice waste minimisation. They also suggested that rewarding stakeholders on good waste management performance would endorse the right kind of action, especially if fiscal measures such are fines are introduced when waste minimisation performance is substandard.

The construction industry is one which is resistant to change which could be attributed as the main reason for not implementing waste management strategies on site (Lingard *et al.*, 2000; Teo and Loosemore, 2001). Pan *et al.* (2007) also found that the construction

industry is slow to embrace innovative building technologies. This may explain why traditional construction methods are adhered to as opposed to MMC for example.

Table 2 below summarises the major barriers and incentives to acting sustainably in the construction industry.

Barriers	Incentives
• **Organisational culture: Industry resistant to change (therefore old, unsustainable methods of construction are used)**	• Indicates commitment to CSR if changes are made • Competitive advantage can be gained if changes are made • Sustainable properties may have a higher price than unsustainable properties
• **Waste management and minimisation**	• Financial: -savings can be made -stakeholders could be rewarded -fines or penalties if waste is not managed appropriately • Pre-fabrication: less construction on site • Cost and quality of recycled product can be just as good as or better than natural resource
• **Vague definition** • **Lack of knowledge** • **Who is responsible?** • **Lack of managerial support**	• What is easily achievable/locally relevant? • Training and continuous professional development • Sustainable literacy

Table 2. Barriers and incentives for sustainability in the construction industry (Self-study).

2.4.6.2 Sustainability Incentives

There are various incentives which try to persuade the construction industry intobecome more sustainable. These incentives include economic, legislative, environmental, and educational methods. To these, Osmani *et al.* (2006) added the industrial incentive as well.

The UK government tends to offer two strategies by which it expects the construction industry to incorporate sustainability; these being reports and legislation. Examples of these reports include the Office of Government Commerce (OGC, 2007) which provided details as to how the construction industry can achieve sustainable procurement. Means to induce responsible waste management in the industry has been helped by introducing taxes on those that do not recycle a majority of their waste. The Duty of Care legislation which was set up by the UK Government is another such example which places the responsibility of appropriately disposing of waste on those who are in contact with the materials, including producers, and importers of products (Dainty and Brooke, 2004). Australia has implemented tipping fees to hinder the use of landfills to dispose of waste (Lingard *et al.,* 2000; Kokkarinen and Cotgrave, 2010c). Osmani *et al.,* (2006) pointed out that similar legislative drivers are in place in the UK to make waste disposal too expensive for companies, thus forcing them to explore other methods of waste management. One such example is DEFRA's revised Waste Framework Directive which makes it compuslory for at least 70% of waste generated by construction and demolition to be recycled or recovered by 2020 (DEFRA, 2011c).

While numerous initiatives similar to these are in place more can be done by complementary institutions to push for sustainability. As the UK government is implementing new initiatives which aim to reduce the negative effects that construction has on the environment, engagement from various sectors such as higher education institutions in order to tackle, or at least significantly reduce the volume of detrimental effects would be another way to support the government's initiatives.

Education and, more specifically, formal education is an effective way to disseminate information to future professionals in any field. Therefore legislative facts would be taught to students in order to know the legal boundaries in which they can work. For this reason educating future construction professionals on ways in which waste management

strategies can be implemented at the various stages of construction seems viable. Previous research also supports this notion, not only with regards to future construction professionals but with practising professionals as Lingard *et al.* (2000) found that site managers wanted more information on solid waste management methods. It then seems obvious that students be taught about waste management strategies while training for their future vocation, but also to send practising professionals on refresher courses as part of their continuous professional development.

In terms of environmental incentives, the reuse of materials will help in the conservation of energy because no additional energy will have to be used in the production of a new material. This echoes the sentiments Treloar *et al.* (2003) had regarding using recycled materials because of their lower embodied energy.

In terms of industrial incentives, Yahya and Boussabaine (2006) believe that if stakeholders are made aware of the economic benefits of adequate waste management strategies, this would be incentive enough for them to push for such policies on construction sites. Osmani *et al.* (2006) hint at the possibility that merely being the first in setting a successful waste management precedent within the industry would serve as an incentive. The reason for this would be that if a prominent company is able to make the public more aware of sustainable waste management practices, their value in the public's eye might increase as they would be engaging in corporate social responsibility.

2.4.7 Summary of Findings

The main findings from the review of sustainability in the construction industry literature are as follows:

- Although sustainability is something that is being encouraged as the right thing to do for the environment, there also appears to be a strong business case for practising it.

- Calculating the cost of a building during its life cycle may help construction professionals make design decisions which are cost-effective and contain low embodied energy.

- The property sector has a significant role in sustainability because it strongly links with all three facets of sustainability by providing jobs for the surrounding community and financial gain as well as indicate to potential owners or building users about its environmental performance.

- The less energy that is used in construction and elsewhere will result in less carbon emissions which is in line with Government initiatives. The use of renewable energy is considered as a way by which to reduce society's dependance on fossil fuels but it is not the only solution.

- While there are barriers which hinder the adoption of sustainability in the construction industry. There are ways in which the industry would be able to continue providing its services while minimising the environmental impact such as Life Cycle Assessment, waste management, and educating workers.

3. Sustainability in Higher Education

Academia is the starting point which guides the construction professional on how to live and work in more sustainable ways (Murray and Cotgrave, 2007). While students may be environmentally aware in a broad sense by the time they enter higher education, they do not have the skills to assess environmental problems and take action (Thomas, 2004). "Students must be in a position to examine critiques of scientism and technical rationality, and related life styles" (Wals & Jickling, 2002; p. 223).

During the time that students receive an introduction to their course, sustainability education should be incorporated as well so that students begin to think of all elements together and make links. Thomas (2004) pointed out that there is a need to instil graduates with sustainability literacy skills so that they can apply these skills in their careers once they receive a degree. This sentiment is also expressed by the Sustainable Development Strategy (DEFRA, 2005, p. 39) "we need to make 'sustainability literacy' a core competency for professional graduates". By hitting the ground running, sustainability could be achieved in conjunction with normal practices, rather than having to change an individual's way of doing things to accommodate sustainability into their job description later on. Although education can be used to mould knowledge and attitudes (Cotgrave, 2008), modern approaches are required to accomplish this successfully. Successful methods would include feedback, as well as correct and innovative framing and modelling of sustainability messages rather than simply providing students with the information (Dodds, 2008).

In line with legislative initiatives put forth by the government limiting the damage being done by the industry, there have been many initiatives to integrate sustainability policies into higher education such as the Talloires Declaration, Stockholm Declaration and Agenda 21 (Wright, 2002). While some institutions only sign the declarations, others have attempted to incorporate the sustainability declarations into their University policies (Wright, 2002). Regardless of these declarations and external drivers such as professional bodies influencing higher education to some extent, this, and having an integrated approach towards environmental issues does not appear to promote student learning regarding environmental issues (Cotgrave and Alhkaddar, 2006). Sibbel (2009) noted that higher education trains future professionals, therefore higher education institutions are

responsible for imparting sustainability knowledge to society through the freedom academia provides for exploring such concepts:

> "Sustainable development principles must lie at the core of the education system, such that schools, colleges and universities become showcases of sustainable development among the communities that they serve" (DEFRA, 2005, p, 37).

The fact that the results from these educational declarations have left a lot to be desired does not mean that these are the wrong areas in which to promote change. Cotgrave and Al Khaddar (2006) noted that construction industry professional bodies had some influence over curriculum design but that a majority of the responsibility lies within the University itself. Chan *et al.* (2002) added that more influence from professional bodies should be incorporated into the education of future construction professionals so that they receive academic as well as industrial perspectives. Incorporating topics such as new legislation and government policies may also be beneficial to the programme (Cotgrave and Al Khaddar, 2006) and engaging with the material in this way would reinforce student understanding (Chan *et al.,* 2002) and also demonstrate that government recommendations are being followed.

Research conducted by Ballantyne and Packer (2005) on informal or free-choice learning by which individuals update their knowledge and understanding of environmental issues and challenges through the media, along with the internet . The point of informal learning is that individuals choose what kind of information, experiences and messages they expose themselves to (most often outside a classroom setting such as encounters with nature, school field trips, exhibitions, and sustainable tourism). This however only works if people have an inherent interest in sustainability which may work to educate them as a hobby. Formal learning settings however are able to target more individuals with more standard teaching approaches. Formal education would also have the added advantage of eliminating bias as all students that are enrolled onto a course would have to have access to information and learning materials whereas with informal learning, it would be the individual's responsibility to gather their own materials.

It was contended by Barraza and Robottom (2008) that education for sustainable development directs educational tactics to the promotion, understanding and

implementation of sustainable development through bringing together seemingly discordant ideas of conservation and development. Wright (2010) advocates that the promotion of sustainability in higher education (SHE) should be embedded into the curriculum hence promoting sustainability literacy. Pappas (2012) is of the opinion that the university has the responsibility to provide students with an education that will allow them to deal with the complexities of sustainability through an interdisciplinary approach and in an all-encompassing fashion. Section 2.1.5.1 discussed the types of capital which companies and inidividuals have available to them in order to become more sustainable. Although most of these assets appear to be things that can be learned on the job, academia could give future construction professionals a head start by building up their knowledge and skills which in turn would increase the value of their human capital. These skills could include communication, decision making, and problem solving skills for example (Pappas, 2012). Similarly, by giving students the chance to understand the limitations of natural capital and possibly giving them some practice in the art of networking and forging professional relationships which could in turn help increase the value of their social capital to potential employers in the construction industry.

Sibbel's (2009) argument about training future professionals justifies why investment in social institutions such as higher education is important to bring about change. Likewise Teo and Loosemore's (2001) work pointed out that environmental consciousness is not something that is taught in educational programmes for professions in the construction industry which this research project is aiming to do.

3.1 Higher Education Funding Council for England Strategy

The Higher Education Funding Council for England (HEFCE) has contributed towards promoting sustainable development in higher education since 2005 (HEFCE, 2011). The council has aspirations for the higher education sector of England to be recognised as a major supporter of the efforts made by society to achieve sustainability. A notable contribution has been support for the development of the 'Sustainability Exchange' website which offers the most recent developments of best practice regardging sustainability in higher and further education (HEFCE, 2011).

Another notable contribution has been the sustainable development strategy in higher education which was updated in 2008 following the 2005 consultation report (HEFCE, 2009). In its action plan, HEFCE pledged to help higher education institutions by identifying sector-wide business cases which would in turn allow universities to help the environment whilst receiving direct financial savings (HEFCE, 2009). This coincides with previous literature which emphasises the business case sustainability can offer (Hueting and Reijnders, 2004; Pearce, 2006; Atkinson, 2008).

Section 2.1.2 pointed out that sustainability is viewed differently by everyone (Leal Filho, 2000, Faber *et al.,* 2006; Lo *et al.,* 2006). HEFCE's (2009) action plan reflects this as they provide a non-prescriptive approach for how higher education can contribute towards sustainable development. This idea is supported by Pappas (2012) as he stated that it is not necessary for all aspects of sustainability to be covered by every discipline.

In terms of their own action plan, HEFCE (2009) outlined their CSR policy which is publicly reported every year so that their progress can be followed. In this policy, they defined their targets and objectives which relate to business ethics, management of environmental impacts, procurement, the community and people. Reporting sustainable progress was endorsed and evaluated by Myers (2005) as a way to monitor which companies are acting sustainably and which ones are not. This practice of reporting sustainable progress should not be limited to companies reporting their progress as all organisations have an evironmental impact and different views and practices as to how to make less of an impact.

3.2 Sustainable and Skill Requirements set by Professional Bodies

Professional bodies have significant influence over what is to be covered in degree programmes as they provide guidelines to be followed in order to become accredited.

Table 3. The educational input professional bodies have outlined for sustainable literacy (Adapted from Murray and Cotgrave, 2007)

Table 3 above presents the influence which professional bodies have had on undegraduate construction degree programmes as well as outlining how sustainability has been focused on in their criteria. The information provided in the matrix is vague, therefore allowing for varied interpretations of how undergraduate curriculum could be influenced by the recommendations made by a few of the professional bodies.

It was pointed out by Cotgrave (2008) that due to the loose interpretations that could be made from these suggestions may result in universities with little expertise or intention to incorporate sustainability into their curriculum are still have their courses accredited. However, Cotgrave (2008) was optimistic regarding the fact that if one professional body provides detailed requirements as to how sustainability should be integrated into curriculum, that it could encourage other professional bodies to do the same.

The subsequent sections will look in more detail at the way in which sustainability has been specified to knowledge and skills as well as how it has been incorporated into construction educational frameworks.

3.2.1 CIOB Education Framework 2007

Updated in 2007, the CIOB education framework identified one major change as compared to the 2002 framework which was that a specific learning outcome related to sustainability had been created (Cotgrave, 2008). Although the framework does not outline any changes for the industry, it is clear from the framework outcomes that the CIOB is keen to promote knowledge and awareness of sustainable design and construction to future construction professionals. For undergraduate programmes, the framework only mentioned environmental sustainabilty, but at masters level sustainability was being focused on much more in depth (CIOB, 2007).

The framework required that a multidisciplinary practise-base approach should be created which is centred on a body of knowledge, research and practise (CIOB, 2007). This approach to sustainable education is endorsed by Dodds (2008) as well as Pappas (2012) as the authors argued that by interacting with members from another profession would foster a wider appreciation for how sustainability is thought of and undertaken in other professions.

As well as gaining uunderstanding on sustainable design and construction, some of the other skills which the CIOB wanted students to gain were communication skills, the ability to work with others, as well as the development of critical, analytical, transferable and study skills (CIOB, 2007).

3.2.2 Chartered Institute of Architectural Technologists

A professional group which was not listed in Murray and Cotgrave's (2007) table 3 was the qualifying body for architectural technologists, CIAT. The Quality Assurance Agency for Higher Education (QAA) published a subject benchmark statement for architectural technology (QAA, 2007) in order to assist course providers to create a programme which

reflects the current state of architectural technology as a profession as well as meeting the needs of students.

When reviewing the benchmark statement, sustainability was only mentioned in relation to the design of the degree programme so that the needs of industry and the profession are typically met stating that the programme should "emphasise the value placed on detailed design, health and safety and production information, including technical regulatory factors affecting buildability, sustainability and performance" (QAA, 2007, p. 2). Likewise, the careers and membership handbook did not mention sustainability very often either. It only gained mention when the units for the professional and occupational performance (POP) record were outlined (CIAT, 2011).

In terms of skills outlined in the benchmark provided by QAA (2007) awareness and knowledged were to be developed regarding the architectural technology profession. It was suggested that students question current theories and practise, develop problem solving and analytic skills as well as be able to synthesise and evaluate technological information or data. Students are also expected to recognise and implement good practise, have good IT skills and be able to present architectural information in drawings, written, or verbal form to a variety of audiences (QAA, 2007).

3.2.3 Royal Institute of British Architects

The Royal Institute of British Architects (RIBA) validates architecture programmes at over 40 UK schools (RIBA, 2011). The RIBA validation process is peer reviewed which monitors the compliance with minimum standards which have been internationally recognised for architectural education. Through the validation process, RIBA identifies courses and types of examination which are the most effective in achieveing the necessary standards to prepare future architects to practise professionally (RIBA, 2011).

The RIBA validation procedure outlined that sustainability should be understood through the legal framework specifically in relation to "environmental and sustainable legislation" which are relevant to architectural design and construction (RIBA, 2011, p. 56).

In terms of skills which RIBA would like architecture students and professionals to demonstrate included being able to use both digital and analogue media, demonstrate practical and theoretical skills, have the ability to make decisions based on complex and unpredictable circumstances, identify individual learning needs, possess good communication skills as well as work well as part of a team (RIBA, 2011).

3.3 Educational Barriers to Sustainability

If individuals are provided with adequate information about the environmental outcomes that human activities have on the planet this may prompt people to be more likely to conserve resources, or minimise resource use, rather than to continue depleting them. They may opt to pollute less or promote preservation rather than development (Dunlap and Jones, 2002). However, the following barriers have been identified as being the most prominent as to why this has not happened. The work of various authors (Velázquez, Munguía, and Sánchez, 2005; Moore, 2005b; Thomas, 2004; Leal Filho, 2000) have identified various barriers for introducing sustainability into higher education. However, some of these barriers may not be relevant in higher education institutions in other countries, as these barriers were identified in Mexico, Canada, Australia and Germany respectively.

It was pointed out by Thomas (2004) that there is a need to instil graduates with sustainability literacy skills so these can be applied in their careers upon degree completion. However, higher education institutions may find it challenging to integrate sustainability into the curriculum because the delivery of course modules tends to be "arranged in tidy boxes" (Moore, 2005b, p. 543) at undergraduate level. While there are elective environmental courses that students are allowed to choose, these opportunities are few and far between (Thomas, 2004).Though it may only be subjects such as environmental and ecological studies (Dale and Newman, 2005) which receive in-depth theoretical knowledge on sustainability, therefore disseminating sustainability information is limited to a select few disciplines. The various definitions of sustainability emphasise the multidimensionality of the concept, as it is not a subject in the traditional sense (Leal Filho, 2000) which one can study, but a facet that can and needs to be incorporated into disciplines which have a long standing tradition of being studied rigorously. Pappas (2012, p.12) added that "we need to further our understanding of each

discipline's contribution to defining and teaching sustainability as well as the influence each context has on the others."

Academics have full work schedules as it is, thus attempting to add sustainability into the curriculum can be challenging. There are few 'experts' on sustainability because academics are conducting research and learning about sustainability themselves. Therefore the information they impart to their students may not be comprehensive or up-to-date. As a result of this 'knowledge in training', causation of sustainable or unsustainable phenomena cannot be explained and possible other avenues may not have been identified, let alone explored by the academics (Kokkarinen and Cotgrave, 2010a).

Velázquez *et al.* (2005) noted that lack of awareness or interest is also a significant barrier to implementing sustainability education as staff members, administrators and students alike may not have grasped what their responsibility (or the impact of their small actions) is, such as leaving lights on after a classroom becomes empty, not using the allocated recycling bins and leaving computers turned on all day. Leal Filho (2000) found that universities tend not to engage in pro-environmental behaviour because there is no individual appointed to that position. Yet again, the social and definitional position that sustainability has been given indicates that it is the responsibility of everyone as society at large is affected and as it is not a 'subject', it can have no real occupational position, therefore anyone who understands the benefits of recycling, energy and water conservation is capable enough to engage in small ecologically friendly behaviours which in the long run aid in the movement towards sustainability.

Lack of time and appropriate training on the part of academic staff was also identified as a barrier (Velázquez *et al.,* 2005). As earlier mentioned, academics already have other work commitments, thus attempting to add sustainability into the curriculum can be challenging. Also, as new sustainability issues emerge constantly, and no one way of promoting sustainability has been identified as the gold standard, academics are learning and teaching about sustainability simultaneously, hence there is room for error.

The lack of education or re-education of construction professionals has also been identified as a barrier towards sustainability as there is debate about whether the industry should assume responsibility for educating workers on environmental issues; or

whether higher education institutions should provide most of the environmental education (Chan *et al.*, 2002). Another point raised by the same authors is that professionals need to commit to on-going learning. However, neither the industry nor higher education has assumed full responsibility for providing this to practicing professionals. Therefore, emphasising sustainability practices in conjunction with the basic educational requirements would provide students with the opportunity to consider all the elements together and begin making links with otherwise traditional methods of procurement. This would also lessen the time that human resources have to spend on supplementing professionals with training before they could undertake their normal job roles. To this, Barraza and Robottom (2008) add that education for sustainable development directs educational tactics to the promotion, understanding and implementation of sustainable development through bringing together seemingly discordant ideas of conservation and development. Consequently justifying why investing in social institutions of this calibre is important to bring about change (Sibbel, 2009).

Barriers	Incentives
• **Who is responsible?**	• Training and continuous professional development
• **Lack of knowledge**	• Sustainability literacy
• **Lack of time**	• Better understanding of what sustainability is might make it easier for sustainability to be linked into topics and teach them all at once
• **Sustainability taught separately to core subjects**	• Change curriculum • Link topics and sustainability together

Table 4. Barriers and Incentives promoting sustainability in higher education (Self-study)

Table 4 above and table 2 in section 2.4.6.1 had common barriers identified such as the lack of knowledge and who is responsible for sustainability. In both cases, training and continuous professional development and sustainable literacy were identified as ways by which to incentivise acting sustainably. This further emphasises that sustainability is still a growing field and that new information is emerging constantly which can only be satisfied by the close and continuous cycle of education and industry links.

Identifying barriers to sustainability education at tertiary level would lead to an exhaustive list, yet it is important to be aware of them. While it would be inconceivable to attempt to tackle every single barrier, it would be beneficial to address the ones that seem to be the most feasible to overcome in each given institution.

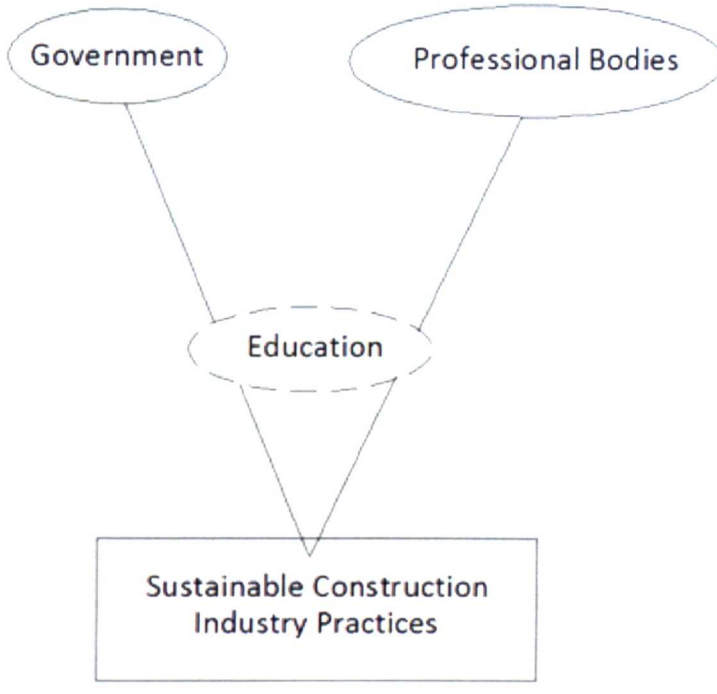


Figure 9. Influence of various drivers for change on the construction industry (Self-study)

Figure 9 depicts how both Government and Professional Bodies directly influence the construction industry. However, as mentioned by Kokkarinen and Cotgrave (2010b) in section 2.4.1 both can also influence the educational sector as strategies put into place can be taught to future construction professionals, thus possibly making a difference to sustainable construction practices.

3.4 Summary of Main Findings

The main findings that the review on sustainability in higher education literature identified were:

- HEFCE has identified and emphasised the business case for sustainability in higher education by pledging to help higher education institutions find a way by which to practise sustainability while gaining financial advantage.

- Professional body recommendations for integrating sustainability into degree programmes has left considerable room for interpretation of guidelines.

- Professional bodies only tend to focus on environmental sustainability at undergraduate level while at masters level a more in-depth approach to sustainability is reported by the CIOB.

- Higher education also has barriers as to why sustainability isn't more prevalent in the curriculum. Regardless of these shortcomings, education has been identified as a significant medium by which to change attitudes.

- The reviewed literature indicated that there were similar barriers being experienced by both the construction industry in chapter 2 and this chapter relating to higher education. Experiencing similar barriers would suggest that the message going out to both students and existing professionals should be the same but that perhaps the way in which the message is delivered may differ.

4. Psychological Theory

Psychology is an umbrella term for the vast areas in which it is able to provide insight. Some of the areas which can benefit from psychological research include the identification and measurement of social characteristics (Goleman, 1996; Furnham *et al.*, 2003; Fitness and Curtis, 2005), understand thought processes and behaviour (Wood, 2000; Ajzen, 2001; Kollmus and Agyeman, 2002; Maio and Haddock, 2010) as well as all levels of education (Dirkx, 1998; Mezirow, 2003; Entwistle and Tomlinson, 2007; Marton, 2007).

As psychology can influence an array of areas, there are many approaches by which to study phenomena. In the case of this work, a purely educational approach could be applied as the research will be conducted in higherer education. However, the following sections will indicate that psychological constructs have already been used to study environmental attitudes. Due to this reason, it was deemed that this research would benefit by continuing to study how psychological constructs could influence in a BUE context while a relevant theory from educational psychology was included by which to address the educational aspect.

4.1 Psychological Constructs

As changing the attitudes, or mindset of the students is the main focus of this project, the first section will begin by talking about attitudes and how they are influenced. Sections about personality and emotional intelligence and transformational learning theory will follow.

4.2 Attitudes and Attitude Formation

Attitudes represent a person's evaluation of an object or situation that predisposes them to behave in a certain way (Teo and Loosemore, 2001; Murray, 2011). These evaluations can also be of others and one's self including positive-negative, like-dislike, and harmful-beneficial dimensions for example (Petty, Wegener and Fabrigar, 1997; Ajzen, 2001). Schultz, Shriver, Tabanico and Khazian (2004, p. 31) defined an attitude as an evaluative judgement about an entity. They also defined environmental attitudes as a collection of beliefs, emotions and behavioural intents a person has regarding environmentally related actions or concerns. They also defined worldview as a "person's belief about humanity's relationship with nature". Maio and Haddock (2010; p. 4) defined attitudes as "an overall evaluation of an object that is based on cognitive, affective, and behavioural information".

Murray (2011) further elaborated by stating that in social psychology these three attitudinal components express what an individual is feeling because attitudes communicate what their values and beliefs are; they are emotional because they manifest feelings and are behavioural as they predispose individuals to react in a specific way in specific contexts.

Maio and Haddock (2010) classified attitudes into three components calling them cognitive, affective and behavioural. Murray (2011) also classified attitudes into three components calling them emotional, behavioural, and expressive, expressive because attitudes communicate the values and beliefs a person holds. Teo and Loosemore (2001) on the other hand classified attitudes into four dimesions which they labelled as affective, behavioural, cognitive and evaluative. The affective aspect of attitudes relates to the feelings and emotions the individual has and manifests about a certain object, place or person. Behavioural dimenions of attitudes relate to the actions and intentions people act upon, and as such, can be described as the predisposition to react in a specific way. Cognitive aspects of attitudes are about the knowledge and belief one holds and the evaluative dimension is coming to the conclusion whether something is liked or disliked (Teo and Loosemore, 2001). Maio and Haddock (2010) elaborate that making evaluative judgements can vary in two ways. Firstly, attitudes can have different valence, or direction. These can include positive, negative or disinterested attitudes. Secondly, attitudes also vary in terms of their strength. Some people may not favour something, while others absolutely hate or love it. Valence and strength of attitudes guide the ways in which the influence of attitudes, how individuals process information, and how they behave is understood.

Attitudes are shaped over time and are influenced by numerous factors (Teo and Loosemore, 2001). A significant factor is direct experience (Petty *et al.,* 1997) which has been found to make attitude formation likelier to occur than if it is simply talked about. Work by Knussen *et al.* (2004) supports this finding as they found that attitudes which had formed due to direct experience were better predictors of future recycling habits. Other contributing factors include what generation the person was born in because this will dictate what kind of social, economonic, and political environment one grew up in (Teo and Loosemore, 2001). This suggests that current generations would be the most

environmentally aware due to the media attention which is surrounding environmental issues in current times as opposed to older generations. Kollmus and Agyeman (2002) argue that values are most often influenced by the 'microsystem' of the individual which comprises of one's immediate social circle. Family and parents are a considerable shaping force as they have the control over the type of information an individual has access to during their formative years (Teo and Loosemore, 2001). The wider community plays a part on values as it dictates what the norms of a particular culture are. A place of work can also influence the attitudes one tends to form as peer pressure and group acceptance are a large part of wanting to fit in. More strongly in work environments is the organisational culture which is mandated by the type of people that work there. Therefore commonalities in education and background also determine the type of information workers have access to (Teo and Loosemore, 2001) within an organisation. In some instances, an individual's mood can influence their attitude (Maio and Haddock, 2010).

Petty *et al.* (1997) mentioned another procedure which can influence attitudes which is the mere presence, or exposure to an object. The more times the individual comes across the object increases the likelihood of the individual evaluating the object in a positive way. If an individual holds a positive attitude towards the environment it may still not reflect a high understanding of environmental issues (Schlegelmilch, Bohlen, and Diamantopoulos, 1996), it may simply be an emotive reaction to environmental stimuli or part of wanting to be accepted by ones peers. "Along with attitudinal and behavioural components, knowledge items that capture individuals' level of factual information about specific or general aspects of environmental, ecological or energy-saving phenomena should be contained within any operationalization of environmental consciousness" (Schlegelmilch *et al.*, 1996; p. 38).

Murray (2011) noted that 'attitude scales' tend to rely on Likert type ranking systems, yet these surveys tend to measure beliefs rather than attitudes. Murray (2011) wrote about attitudes that support sustainability which were caring, compassion, openness and respectfulness. In his work, Murray describes how caring is a trait which is the most noteworthy in making connections with others and with nature. Compassion then, was described as caring but also understanding the feelings of others and empathising with

them but also feeling the need to do something in order to improve someone else's negative state. An open mind, or openness is needed to explore new ideas and ways of thinking and to allow for positive change to occur. Lastly, Murray wrote that to approach new things and sustainability, it was important to do so with an active and positive outlook.

4.2.1 Changing Attitudes

Section 4.2 outlined the utility of attitudes which is to produce an evaluation of an object or person (Ajzen, 2001; Teo and Loosemore, 2001) thus being both an intellectual and emotive function. Shepherd, Kuskova and Patzelt (2009) and Murray (2011) also mentioned values and beliefs as preceding, yet being influential on, the formation of attitudes. Research has been able to determine factors which influence attitudes such as direct experience with the attitude object, age, and one's social circles.Therefore by being able to either manipulate or work with these determinants, it would seem fairly simple for attitudes to be readily changed.

Asch (1940, as cited in Wood, 2000) stated that attitude change occurs when the definition and meaning given to an object changes. However, Ajzen (2001) argued that when an attitude changes, the new attitude can take priority over the initial attitude, but may not replace it altogether. Wood (2000) and Ajzen (2001) discussed that individuals do not just have one attitude towards any issue or object. Therefore attitudes are not necessarily permanent or fixed, as the context or knowledge one has regarding a matter is likely to change over time. There may be instances where an individual expresses multiple attitudes on the same matter (Ajzen, 2001). This may be because they are being pressured to be accepted by a group. It is therefore possible that individuals have what are called public and private attitudes (Wood, 2000) or multiple attitudes as they are able to see the important attributes to arguments from various angles which fit in line with different groups that they identify with. If an attitude is the same across public and private scenarios, it is thought that this has resulted from careful cognitive processing associated with accuracy motives. If however attitudes are expressed in public but not in private it is a sign of normative pressures such as wanting to be accepted into a certain peer-group (Maio and Haddock, 2010). Wood (2000) noted that attitude change can occur for three reasons which are:

- to ensure a favourable and rational evaluation of one's self,
- maintaining good relations with others regarding the rewards and punishments they can offer, as well as
- understanding the topic featured in influence appeals made by others.

Literature has suggested persuasion as a way of changing someone's attitude (Petty *et al.*, 1997; Wood, 2000; Maio and Haddock, 2010; Murray, 2011; Ross and Tomlinson, 2011). With much of this work looking to persuade individuals to reduce a certain behaviour, often even the way an issue is framed can impact whether or not an attitude is to change. When appeals are made, they may be framed in a way which forces the recipient or audience to think about the issue in relation to another attitude, value, or goal. For framing to be successful an individual should already have existing knowledge on the topic (Wood, 2000). In their book, Maio and Haddock (2010) summarised the available theoretical models which aim to help explain attitude change. One of the theories they reviewed mentions the importance of having an incentive to promote attitudes in persuasive messages. This can be either by who is giving the message, what the message is about or who is the intended audience of that particular message. Petty *et al.* (1997) found that positive messages were more persuasive when the audience was in a good mood rather than a sad one. Conversely, negative messages were more convincing if the participants were in a bad mood. Maio and Haddock (2010) reported similar findings.

Persuasion can happen anywhere and can be targeted to specific audiences. However research conducted by Ballantyne and Packer (2005) suggested that learning in informal settings could also promote attitude change regarding the environment among students. They went on to state that individuals update their knowledge and understanding of environmental issues and challenges through the media, free-choice learning experiences along with the internet. Ballantyne and Packer (2005) explained that free-choice learning experiences could include activities such as encounters with nature, school field trips, exhibitions, and sustainable tourism. The message from this research seems to be that individuals or in this case students can pick an area of sustainability which appeals to them, either because it is something they can incorporate into their lifestyle, or because it has emotionally moved them, rather than the topic being dictated by curriculum.

The review conducted by Petty *et al.* (1997) indicated that message memory is a major factor when attempting to predict attitudes. That is, if someone is asked to give their evaluation of a message they heard a considerable time before, they will have to rely on their recollection of that message in order to make an evaluation as to whether the message was valid or pertinent to them.

4.2.2 Attitude and Behaviour

It is important to address this topic as it is commonly thought that attitudes will predict behaviour (Maio and Haddock, 2010). From the early 1930s up until 1970 it was concluded that attitudes were a weak indicator for predicting behaviour (Murray, 2011). In the last 40 years, the conclusion has become more optimistic with the general consensus being that attitudes can predict behaviour in some conditions more than others (Maio and Haddock, 2010). Shepherd *et al.* (2009) focused on values in their work, as the authors stated that they accept that values precede attitudes and behaviours. Murray (2011, p. 124) too made a distinction between attitudes, values and beliefs, as he said that "beliefs are fundamentally important because they have a profound influence on what an individual says and does...whatever we believe about ourselves will have a strong influence on what we do now and how we are in the future". Murray (2011) also added that changing beliefs was about changing one's life as well as enhancing the quality of it.

> "... apparent discrepancies between attitudes and behaviour may reflect the presence of multiple context-dependent attitudes toward social targets. In a similar vein, respondents have been found to hold different attitudes with respect to high and low relevance versions of the same attitudinal issue"(Ajzen, 2001; p.29).

Maio and Haddock (2010) reviewed whether some types of beliefs are more important than others. They discuss findings which indicate that when cognitive and emotional reactions conflict with one another, it is in fact the emotional reaction which will drive behaviour.

Kollmus and Agyeman (2002) described pro-environmental behaviour as behaviour which knowingly aims to minimise the negative impact an individual's actions have on the natural and BUE. Attitudes and temperament can lead to individual barriers for those that are trying to be more environmentally friendly. They posited that to become more

environmental, people must concern themselves with the wider community rather than just focusing solely on themselves. The authors offered what they called a "valid argument" in arguing that environmental knowledge was in fact a subcategory of environmental awareness and that emotional involvement is what shapes environmental awareness and environmental attitudes.

Ross and Tomlinson (2011) introduced the notion of negabehaviours which they defined as being the behaviour of not performing a specific undesirable action. This was in the hope that it would promote sustainability by either avoiding unsustainable actions or replacing them. Berenguer, Corraliza and Martín (2005) noted that pro-environmental behaviour depends heavily on a specific attitude or on direct experience with nature. They argued therefore that it was important to develop intervention models in education to raise awareness and take into account the needs and habits of those who use the environment.

Schultz *et al.* (2004) wrote that the kinds of environmental attitudes individuals develop are related to the point of how connected a person believes they are to a part of the natural environment. Schultz *et al.* (2004) and Dunlap *et al.* (2000) stated that a person's evironmental worldview is 'primitive', suggesting that a sense of connectedness to nature may not be a conscious one. It could also mean that it is not a belief that is thought of frequently. Overall, the authors found that low connectedness was related to egotistical concerns about the environment and high connectedness with nature related to biospheric or pro-environmental concerns. Therefore, those that display egotistical concerns about the environment would be worried about how the weather may may have an impact on their appearance rather than those who exhibit pro-environmental concerns such as how airplanes are depleating the ozone layer and thus may choose not to fly. This is corroborated by Barr and Gilg (2006) who found that those who did not report interest in environmental behaviour mainly held the attitude that humans govern over nature and that technology will not degrade the environment.

The UK government and their Sustainable Development strategy (DEFRA, 2005, p. 25) acknowledges that "information alone does not lead to behaviour change" neither do intentions for the most part as Maio and Haddock (2010) remind us. This may be due to

other commitments, or merely forgetting. However, if an individual outlines a strategy of when, where and how they plan on doing something, this significantly increases their chances of performing the behaviour. Knussen et al. (2004) found that past recycling behaviour tended to predict future behaviour. The authors concluded that attitudes which have developed through direct experience are more dependable predictors of future behaviour than attitudes which are based on very little reflection, or indirect experience. For example, if an individual wants to consume less electricity, they would have to say when they would try to consume less electricity. That is, they could do it at the end of the day before they go to bed by checking that electronic equipment is not left on stand by and that any lights are turned off.

Based on this discussion alone, it is easy to see why attitudes do not immediately represent a change in behaviour. This can be due to social pressures or inherent states within the individual for example.

4.2.3 Theory of Planned Behaviour

The theory of planned behaviour (TPB) (Ajzen, 1991) is an extension to the theory of reasoned action (Ajzen and Fishbein, 1980; Maio and Haddock, 2010). It hypothesised that intentions are influenced by attitudes, subjective norms and perceived control (Tonglet, Phillips and Read, 2004). A central assumption in the TPB is that attitudes causally impact behaviours through the intentions the individual has to perform certain behaviours (Manetti, Pierro, and Livi, 2004). The stronger an individual's intention is to do something, the execution of it is more likely to occur. This is because intentions are assumed to capture motivational factors which affect behaviour. It is indicative of the amount of effort the individual is willing to put into carrying out the behaviour (Ajzen, 1991).

Before behaviour has even occurred, the person's thought process will have dictated whether or not the action is to happen. An individual's initial evaluation of an object or situation will indicate to them whether performing that behaviour is good or bad (Maio and Haddock, 2010). The attitude then links into subjective norms.

Subjective norms are social pressures the individual senses. These can also determine whether the behaviour will be carried out (Teo and Loosemore, 2001; Tonglet *et al.*, 2004). That is because if the social circle of the individual view a certain behaviour as positive, the individual will be more likely to perform that action (Maio and Haddock,

2010). Additionally, if the person has the ability to choose whether or not to carry out the behaviour voluntarily will impact upon whether the behaviour is carried out.

Another element which is dependent upon the individual's cognition is their perceived behavioural control. This refers to the person's judgement about the complexity of acting out a certain behaviour. Often past experiences and anticipated impediments play a role as to whether the behaviour is ultimately carried out (Teo and Loosemore, 2001).

Factors external to the model, such as demographics, past experience and personality may also influence behaviour, but in an indirect manner (Ajzen, 1991; Davis and Morgan, 2008). There are of course other factors which relate to the behaviour but what may affect it such as money, time, the cooperation of others and ability (Ajzen, 1991). The combination of choice (or intention) and resources symbolises the individual's actual control over behaviour.

Work has been conducted on TPB and ecology, with the best results predicting behaviours such as general ecological behaviour and household recycling (Davis, Foxall and Pallister, 2002; Mannetti *et al.*, 2004; Davis and Morgan, 2008).

4.2.3.1 Criticisms of the Theory of Planned Behaviour

Although there is much evidence that suggests that the TPB does indeed predict behaviour, its shortcomings must be acknowledged. If the theory is essentially complete, then there would be no additional factors aside from attitudes, subjective norms and perceived behavioural control which would impact on a person's behaviour. However, there are certain factors such as morality, personal need for satisfaction, individual differences in self-efficacy and anticipated negative self-conscious emotion which are able to contribute to the prediction of behaviour (Maio and Haddock, 2010).

While there is a lengthy history for the TPB, and it has served as a framework for many researchers conducting work on attitudes (Knussen *et al.*, 2004; Manetti *et al.*, 2004; Tonglet *et al.*, 2004; Maio and Haddock, 2010), TPB has not unlocked the reason as to why people behave in a certain way and therefore should not be considered the be all and end all where attitudes are concerned.

4.3 Emergence of Personality Theory

Before the emergence of personality theories, the assumption that a person's intelligence was directly linked to their academic performance, prevailed in educational settings. Since then there has been a shift in thought from intelligence alone predicting educational success to certain personality traits influencing academic performance, especially in higher education (Furnham *et al.,* 2003). Furnham *et al.*(2003) found that the accuracy of personality inventories is likely to increase the predictive power of academic performance while cognitive ability declines as a predictor at university level.

Personality is comprised of five traits which are conscientiousness, openness to experience, agreeableness, neuroticism, and extraversion (Swami, Chamorro-Premuzic, Sneglar and Furnham, 2010). Tickle, Heatherton and Wittenberg (2001) stated that at a theoretical level most personality models include characteristics and dispositions which are fairly continuous thus implying that personality traits are fairly stable over time. Tickle *et al.* (2001) also found empirical evidence in their review of personality models that there is stability within the five factors of personality over time.

Conscientiousness, extraversion and neuroticism have been found to predict academic performance (Furnham *et al.,* 2003). Conscientiousness is characterized by dutifulness, achievement striving, responsibility and order which positively correlate with academic performance (Todd, McIlroy and Bunting, 2009). Extraverts are typically thought of as people who are excitable (Boeve-de Pauw, Donche and Van Petegem, 2010), sociable (Furnham *et al.,* 2003) and individuals who enjoy human companion. Extraversion correlated negatively with performance as extraverts are likely to spend more time being social rather than introverts who spend more time studying.

Likewise, neuroticism (a state of constant worry and anxiety) correlated negatively with academic performance as anxious individuals may not be able to cope with the pressure of examinations (Furnham *et al.,* 2003; Boeve-de Pauw *et al.,* 2010). Another term that is used to describe the opposite of neuroticism is emotional stability which refers to individuals who do not experience constant feelings of distress and worry. Hirsh (2010) also found that individuals who scored high on the neuroticism scale tended to have higher levels of environmental concern. Hirsh suggested that people scoring high on neurotisicm are generally worried about negative outcomes therefore concern for the environment could be a reflection of anxiety regarding the consequences of

environmental damage. It could be that people who are continuously experiencing anxious states are able to sense anxiousness in others. Highly emotionally stable individuals may benefit from teaching which provides facts of the environmental damage that is being done, while also emphasising that what can be done to reverse this damage is important. If one is too anxious about the current state of things, they will be in no shape to cope and formulate manageable strategies to attempt to solve environmental problems in the future.

The remaining two personality traits which have not been linked with academic performance are agreeableness which is associated with helpfulness (Todd *et al.,* 2009), empathy, trust, altruism (Widiger and Trull, 1997) and compliance; while openness to experience is a tendency for a person to be open to ideas, creative and imaginative (Hirsh and Dolderman, 2007; Todd *et al.,* 2009). It is interesting that openness to experience was not associated with academic performance as Todd *et al.* (2009) noted that it was a good predictor of English, mathematics and science among secondary school children yet as a trait it is linked to intellectual and cognitive ability.

4.3.1 Personality and Environment

Research conducted by Hirsh and Dolderman (2007) found that personality traits such as agreeableness and openness to experience predicted environmentally positive behaviours. An explanation as to why these traits were more likely to be related to environmentalism was that agreeableness is a good predictor of empathy; therefore people who are highly agreeable are able take others as well as themselves into consideration. Individuals who are very open to experience may appreciate the environment if nature serves as a source of inspiration, for example.

Boeve-de Pauw *et al.* (2010) advocated that personality traits are able to explain levels of environmental concern to an extent, and should therefore be included into further studies which aim to gain a better understanding of individual differences and their impact on environmental concern.

Additionally, individuals who are extraverted and agreeable may be more accepting of environmental messages and may be likely to express these views to others. An individual may have the personality traits associated with environmental concern, but it may be social pressures which are stopping them from acting upon these values. Therefore, social learning may help promote the sharing of ideas about ways to minimise harm to the

environment by engaging social groups in such discussions (Wenger, 2000). If conditions are adequate, it may even lead to sustainable behaviours. If individuals are provided with adequate information about the environmental outcomes that human activities have on the planet, it may prompt people to be more likely to conserve resources, or minimise resource use, rather than to deplete resources; they may opt to pollute less or promote preservation rather than development (Dunlap and Jones, 2002). This suggests that environmental concern can arise from personality and information about environmental problems.

Although openness to experience and agreeableness were not associated with academic success, Hirsh and Dolderman (2007) found these two traits to predict pro-environmental values. The characteristics of agreeableness and openness are likely to be linked with environmentally favourable views as they are associated with empathy towards others and being open to new ideas and experiences (Hirsh, 2010). Individuals who score highly on these traits are more likely to form personal connections with nature which are likely to increase their intention for wanting to protect it (Hirsh, 2010).

4.4 Emotional Intelligence

Another psychological construct which can assist in profiling who is more likely to become more environmentally conscious is emotional intelligence (EI). This construct identifies how aware individuals are of their emotional state and that of others. The concept emerged from the search for a set of measurable capabilities which combined with traditional intelligence, may predict academic and life success (Fox and Spector, 2000; Saklofske *et al.*, 2003). Todd *et al.* (2009) lent support to this statement as they too said that emotional intelligence had a firm place in higher education because of associations with academic performance. Reis and Roth (2010) also found emotions to mediate students' decision-making as well as their school performance.

The Trait Meta-Mood scale was developed to provide an indicator of individual differences in mood regulation; these scores are believed to reflect stable differences among individuals (Fitness and Curtis, 2005). EI focuses on intelligent behaviour in natural settings, and unlike traditional or academic intelligence, can be used to solve problems which the individual deems are important to their emotions, plans, needs and well-being (Fox and Spector, 2000). It is expected that matching psychological profiles to adequate

educational interventions will enable BUE students to extend their concern for others into concern for the environment.

As with traditional intelligence and how much one knows, emotions are now measured in a similar manner. That is, how aware an individual is of their own emotions and those of others (Saklofske, Austin and Minski, 2003). The concept of emotional intelligence was first proposed by Goleman (1996) and the framework was later refined by Salovey and Mayer (1990) and Mayer and Salovey (1997).

Salovey and Mayer (1990) and Mayer and Salovey (1997) presented the notion of emotional intelligence as a set of skills that make an individual able to perceive, understand, use and regulate emotions in efficient and appropriate ways (as cited in Wranik, Barrett and Salovey, 2007; p. 394). EI can be categorized into four aspects, or branches, which explain the levels of emotional processing (Mayer, Salovey, Caruso and Sitarenios, 2001; McEnrue, Groves and Shen, 2009):

- Perception of emotion
- Using emotion to facilitate thought
- Understanding emotion or emotional knowledge
- Managing emotion

Perceiving emotions demands that a person can perceive the emotional state of others with ease in most cases through vocal cues, facial expressions and body movements. Emotions can facilitate thought if the individual is able to use emotional information to pay attention to the environment around them, to resolve problems, guide momentary judgements and possibly to predict future behaviour and outcomes. Understanding emotion is a branch that develops with age and experience as research has found it to be incremental (Wranik *et al.,* 2007). The individual must be able to use emotional terminology in ways to analyse emotions so that the emotive trends and possible consequences can be understood. The fourth branch involves the ability to remain aware of events that are related to emotions even if they are not pleasant, along with the ability to solve problems that are emotionally loaded, effectively (Wranik *et al.,* 2007; p. 394). In section 4.2, Paul Murray's (2011) work identified four attitudes which support sustainability which were caring, compassion, openness and respect. As caring and

compassion are related to understanding the feelings of others and empathising with them, it seems reasonable that emotional intelligence is used within this research in order to see if a conceptualised measure of emotion correlates with sustainability attitudes.

Wranik *et al.* (2007; p. 393) argue that EI "provides fertile scientific grounds for understanding how people shape their emotional episodes to a specific situation, for a desired purpose, within a particular context". The notion of EI could be extended into the environmental domain as it ultimately supports life, thus individuals who are emotionally intelligent may feel more compelled to make an effort to be sustainable in their day-to-day activities. They may even appoint 'sentimental value' to the environment, thus feeling compelled to be more mindful. In conjunction with the Five Factor Model, measuring both may lead to a more revealing answer as how to best target attitude change.

Assessing these constructs in an educational setting may enable a more successful integration of sustainability amongst future construction professionals. This would work parallel to the efforts which the government and professional bodies are expecting from practising professionals. Therefore, once students graduate, they are able to enter the workforce without requiring an introduction in sustainability once they gain a position in industry. It is believed that BUE students would have a relatively high ecological world view and that their scores on agreeableness, conscientiousness as well as openness to experience would have a relationship with EI and their ecological world view.

4.5 Psychologically Profiling through Environmental Education

Environmental education seeks to change attitudes in the hope that behavior would change as a result. Therefore educating young people to adopt a creative mindset by which to alleviate ecological burdens in the future is paramount in bringing sustainable development to the forefront. Reis and Roth (2010, p. 71) conducted research on how incorporating emotional discourse could help further environmental education pedagogy. They found that emotive narratives were able to instill environmental consciousness into students but could also help educators find "teaching identity claims". Pappas (2012) also considered the use of emotions in achieving positive social change as he mentioned that it would be the emotional, intellectual, change and social awareness skills which would be important.

4.5.1 Transformative Learning Theory

Transformative learning is a theory which has been studied for over 30 years (Taylor, 2007) in educational psychology. Mezirow (2003) defined transformative learning as learning which changes problematic frames of reference into ones which are more reflective, inclusive and emotionally able to change (Moore, 2005c; Dirkx, Mezirow and Cranton, 2006). The focus of the theory in most cases has been to understand adult learning but it has also been used in higher education as it is "abstract and idealized, grounded in the nature of human communication" (Dirkx *et al.,* 2006; Taylor, 2007; p.173). Aspects of the theory are rooted into developmental stages but most of the theory focuses on the understanding of the process of using a previous notion to devise a new or revised intepretation of meaning of an individual's experience in order to direct future action. Moore (2005c) argued that transformative learning corresponds to a constructivist paradigm as individuals construct knowledge through their experiences.

An overview on transformative learning perspectives was conducted by Dirkx (1998) which found that there were four different views endorsed by four authors. Regardless which of these four perspectives one subscribes to, a central commonality of them all is that of the ability of individuals to reflect, critically reflect, and critically self-reflect to come up with meaning from their experiences (Dirkx, 1988; Mezirow, 2003). In a later publication (Dirkx *et al.,* 2006), a discussion between the positions of both Dirkx and Mezirow was held, with Mezirow considering a more rational process to transformative learning and Dirkx opting for a more subjective understanding.

In 1998, Taylor (as cited in Taylor, 2007) conducted a review of transformational learning publications and confirmed the importance of critical reflection and the role of a disorienting dilemma as a catalyst for change. Transformative learning aims to change frames of reference through critical reflection of both points of view and habits. By critically reflecting on biases and assumptions, transformative learning can help change worldviews and relocate understandings (Moore, 2005c). Mezirow (2003) mentioned that to participate fully and freely in critical-dialectial-discourse, an individual has to possess some level of emotional intelligence in order to appreciate alternative beliefs. As old assumptions and ways of interpreting experience are reflected upon and change begins to occur, an individual may find that they grieve for their former self and demonstrate feelings of confusion and even frustration at the new self (Moore 2005c).

While transformative learning uses different methods to change an individual's perspective, the content which transformational educators teach is no different from what non-transformational educators teach (Dirkx, 1998). Transformative learning can be periodic or augmentative and can involve objective or task-oriented as well as subjective (self-reflective) reframing. In most cases the support from others is needed in order to fulfill subjective reframing (Dirkx *et al.,* 2006). Therefore elements such as group work and having a reflective element to it may help promote transformational learning. Moore (2005c) pointed out that new models of interdisciplinary education promote teamwork exercises. However, she continued by stating that these aims are difficult to implement in current curricula as they focus on marking the individual, hence making the implementation of transformative learning more difficult. Moore noted that academics have freedom in both teaching and research, yet very few engage in different methods of teaching, nor do they emphasise the intended learning outcome of social change.

4.6 Summary of Literature Review Findings

The conclusions which can be drawn from the literature review are:

- Attitudes are a representation of a person's evaluation of an object or situation. The attitudes a person possesses predisposes them to behave in a certain way.

- Attitudes are shaped over time by a person's social circle, cultural upbringing or organisational culture as well as direct experience with the attitude object.

- Even if an attitude has changed, the associated behaviour that accompanies that attitude may not be practiced. Therefore it is incorrect to think that changing attitudes will change behaviour.

- Psychological constructs such as personality and emotional intelligence have been established by previous research to have an impact on the way an individual performs in educational settings.

- Transformational learning theory would appear to be a valuable approach by which to help students gain knowledge, question and readdress their beliefs and change their behaviour.

- Psychological constructs show promise in helping to understand the ways individuals learn, behave and empathise with others. This may be beneficial in promoting sustainability attitudes among future construction professionals.

- The literature regarding transformational learning seemed to suggest that emotional intelligence is important and that it should be measured in this study to determine whether it too can have some sort of legacy by which to better understand how sustainability can be appreciated by individuals.

5. Methodology

After the literature identified gaps in knowledge, a review of appropriate methodologies for the proposed research was carried out. For over a century quantitative and qualitatitive research paradigms have been in discordance with one another, leading to both methodololgies being represented by extremists or purists (Burke Johnson and Onwuegbuzie, 2004). In a traditional sense, when talking about research methodologies, qualitative and quantitative paradigms are considered the only ways to conduct research. More recently however, a third paradigm appeared in the last 50 years (Creswell, 2009) which is being dubbed the third research paradigm. The following sections will detail the theoretical approaches which are available as well as the ethos of each method and come to a conclusion on which is the most fitting methodology for the project in question.

5.1 Theoretical Approaches

These three methods all have their own theoretical approach as to how to conduct research. Quantitative research methods adopt sceintific naturalism and post-positivist knowledge claims (Creswell, 2009; David and Sutton, 2011) which mean that already existing knowledge and theories can influence what is being studied and that everyithing is a result of prior causes. Scientific naturalism has an objectivist ontology by which it is believed that the world exists independently of our knowledge (David and Sutton, 2011). Similarly, realism is also associated with quantitative research theory because it is the approach used to study the natural and physical world (David and Sutton, 2011). This theoretical approach includes a deductive aspect by which logical conclusions are generated from testing hypotheses (Amaratunga, Baldry, Sarshar and Newton, 2002; David and Sutton, 2011).

The theoretical approaches associated with qualitative research methods are constructivism and interpretivist (Amaratunga *et al.,* 2002; Burke Johnson and Onwuegbuzie, 2004). These allow for theories to be created through detailed exploration of what the evidence is conveying (induction) rather than wanting to test hypotheses through the generalisation of facts (deduction) (Amaratunga *et al.,* 2002). In this research approach it is believed that people construct their social reality through interaction with each other (Creswell, 2009; David and Sutton, 2011).

Mixed methods are commonly associated with pragmatic knowledge claims which means that knowledge, theory and practice are linked to one another (Creswell, 2009). Teddlie

and Tashakkori (2009) described mixed methodology as a research cycle involving inductive-deductive by which qualitative data gives evidence as to the way the phenomena is understood or how generalisations deduced from quantitative data in order to answer the research question. Burke Johnson and Onwuegbuzie (2004) suggested that the empirical and practical consequences should be considered when decicing what action should be taken in an attempt to understand real-world phenomena.

5.2 Quantitative Methods

Quantitative research is the research method with the longest standing history of use (Amaratunga *et al.,* 2002). It is motivated by post-positivist knowledge which is concerned with the current state of knowledge and theory and is often confirmatory in nature (Creswell, 2009). This form of data, data collection and data analysis values numerical measurement, deduction, objectivism or realism and generalisability (David and Sutton, 2011). All of which are still very dominant in academia.

A quantitative report will often have a set structure which includes an introduction, literature review, outline of the methodology, results and discussion sections. Amaratunga *et al.* (2002) recommended this type of methodology to examine behavioural components in BUE research as the methods of data collection include surveys, statistics and official reports.

Quantiative data is interested in testing hypotheses and generalising theories (Amaratunga et al., 2002; Burke Johnson and Onwuegbuzie, 2004) often through close-ended surveys, and experiments (Creswell, 2009) and has an abundance of defined research designs which can be implemented for analysis (Teddlie and Tashakkori, 2009).

The strengths of this type of research are that it allows for large sample sizes to be obtained relatively easily and cost effectively and provides statistical proof, it allows for findings to be replicated by other researchers for comparative purposes and finally that objective methods of analysis are carried out. Quantitative data is able to deal with much of information from large participant samples and can also be analysed fairly quickly with the use of statistical software (Burke Johnson and Onwuegbuzie, 2004).

Weaknesses of quantitative data are that response rates may be low because form filling and collecting may be deemed too time consuming by both the participant and researcher. Quantitiative data is often a static representation of a certain concept and

may therefore not be generalisable after a certain amount of time, or even applicable to different cohorts (Amaratunga et al., 2002). The most notable weakness in quantitative data is that it cannot explain *why* certain things occur.

5.3 Qualitative Methods

Qualitative research "refers to forms of data, data collection and data analysis that give priority to one or more of the following: meanings over numerical mesurement, induction over deduction, constructionism, or phenomenology (attention to small-group interaction) over objectivism or realism (attention to social structures and constraints), and depth over generalisability" (David and Sutton, 2011, p. 629). It explores the meanings that individuals or groups give to their experiences (Burke Johnson and Onwuegbuzie, 2004). This mode of inquiry takes on a constructivist and participatory approach to knowledge as the researcher makes an interpretation of the meaning of the data (Creswell, 2009) instead of testing whether the hypotheses were met statistically. Under the qualitative philosophy, Amaratunga *et al.* (2002, p. 18) discussed phenomenological enquiry because it uses a "naturalistic approach to inductively and holistically understand human experience in context-specific settings". The authors further added that the aim of qualitative research in the BUE under phenomenological guidelines would be to develop theories through explanatory techniques rather than creating generalisations.

Qualitative data is gathered from the participants' setting, often through individual or group interviews, observations or archives (David and Sutton, 2011). Interviews can be structured, semi-structured or unstructured in nature (Burnard, 1991). Qualitative methods are often preconceived to be unscientific, invalid and not reliable because there are no set rules as to how to go about conducting this type of research (Morse, Barrett, Mayan, Olson and Spiers, 2002).

An inductive analytic tool commonly used in qualitative analysis is the use of thematic networks. Thematic networks explain the understanding of an issue by making connections between the statements that people make and the meaning they are trying to impart through conversation, or discourse (Attride-Stirling, 2001). Burnard (1991) and Attride-Stirling (2001)proposed a systematic extraction method which includes pulling out:

1. key words immediately found in text [basic themes]

2. this is then followed by grouping basic themes which summarise abstract principles [organising themes]
3. after the organising themes are found, they too are regrouped to form [global themes] which in turn are the umbrella terms for the overall content that the interview covered.

Thematic networks are used to analyse discourse by identifying the most prominent themes from the transcribed interview and representing these themes visually in spider diagrams or web maps for example. Various forms of qualitative analysis include (Burnard, 1991; Amaratunga *et al.*, 2002):

- Grounded theory
- Phenomenology
- Discourse analysis
- Content analysis
- Phenomenography
- Ethnography

The relevance of these forms of qualitative analysis were assessed to see which one would be the most suitable for the purposes of this study. Grounded theory is typically used for theory development (David and Sutton, 2011)and was not adopted because the current study wanted to gain understanding about attitude change, rather than formulate a theory. A more appropriate qualitative form of analysis was phenomenology which is used to understand the experience of the world (Giorgi, 1999; Mann, Dall' Alba, Radcliff, 2007; David and Sutton, 2011). Ultimately, the reason why this approach was not chosen was because the experience of the researcher was not the focus of the study which is central to the aspect of phenomenology. Discourse analysis is a form of textual analysis which focuses on the meaning of textual data (David and Sutton, 2011). Similar to discourse analysis, content analysis is a technique used to code textual data. It too is used to count the number of occurrences a certain code has within the text. For this reason, both siscourse and content analysis were deemed inappropriate in the analysis of the current study because they measure the occurrence of certain units of meaning which was not the intent of this study. Phenomenography was identified as the best form of qualitative analysis because it is similar to phenomenology in the sense that it studies

how something is experiences, but does not take the experience of the researcher into account. This chosen method will be described in depth in section 5.5.3. Ethnography was the final type of qualitative approach which was considered. It is typically associated with anthropological fieldwork, normally requiring the researcher to go and live with the community under study. Comparable to phenomenology, this method was not chosen because the experience of the researcher was not the focus of the work.

Qualitative methods have become increasingly popular in the social sciences as they enable deeper understanding of the dynamics of social phenomena (Attride-Stirling, 2001; Burke Johnson and Onwuegbuzie, 2004). However, on-going debate about whether qualitative research is to be considered solid empirical research is still predominant because there is seemingly no way to ensure rigor, or validity within the methods used (Morse *et al.,* 2002). While there is a general understanding that the type of data which is collected through qualitative methods is different from quantitative methods, it should be obvious that different criteria for assessing the validity of the work conducted in a specific paradigm should be adopted. Morse *et al.* (2002) denoted what terms are associated with rigor in qualitative terms which are: transferability, confirmability, dependability and credibility.

To address the issue of reliability and validity, triangulation can be used as a way of looking at the same topic from different angles. David and Sutton (2011; p. 637) defined triangulation as " approaching the same topic from a number of different approaches. Triangulation may involve the use of more than one researcher or research team, more than one round of data collection, different types of data collection, or different theoreical frameworks". Kitto, Chester and Grbich (2008) noted that a commonly used concept in qualitative research is the use of inter-rater reliability. This is a form of researcher triangulation by which several researchers are involved in analysing the data, therefore understanding all the possible interpretations there can be for the object being researched. A related validation technique is respondent validation where the participants are given the chance to view and amend their interview transcripts, although Kitto *et al.* (2008) deem it best as a process by which to reduce error.

A weakness of qualitative methods is that the data is often very difficult to find and replicate (David and Sutton, 2011) thus making it difficult to test hypotheses and theories

(Burke Johnson and Onwuegbuzie, 2004). Collecting and analysing data is quite time-consuming when compared to the time it takes to collect and analyse quantitative data (Burke Johnson and Onwuegbuzie, 2004).

Written reports following the qualitative paradigm are often less structured than quantitative ones because the researcher can adopt more of a narrative approach to conveying the importance and meaning of the data (Burke Johnson and Onwuegbuzie, 2004). As a basic guide however, Kitto *et al.* (2008) feel that the researchers need to provide a clear description of the forms of analysis which they used, describe the process and discuss what the major conclusions of the analytical process were in relation to the findings. The reason for doing so would serve two purposes which are to ensure quality for the author, as well as to allow a reader to make an evaluation on the research based on the analytic quality.

5.4 Mixed methods

Mixed methods are a combination of both quantitative and qualitative methods (Teddlie and Tashakkori, 2009). "Also called multi-method. Research design using more than one data collection technique. This may or may not involve the mixing of qualitative and quantitative data" (David and Sutton, 2011, p. 623). It is the newest form of research practice which is being recognized as a third research paradigm (Burke Johnson, Onwuegbuzie and Turner, 2007; Greene, 2008). Mixed methods research emerged in the early to mid 20th century in areas of behavioural, human and social sciences (Burke Johnson *et al.*, 2007) and represents a pragmatic approach to knowledge (Creswell, 2009).

Mixed methods research addresses questions which other methodologies are not able to explore (Tashakkori and Teddlie, 2003); therefore the results represent different views on the same matter which provide the researcher with a more comprehensive account of the phenomena under study (Burke Johnson *et al.*, 2007).

This type of methodology involves an inductive-deductive research cycle that may be seen to move from facts and observations to inductive and general inference such as theories, or conceptual frameworks through to deductive inference to predictions of most notably *a priori* hypotheses (Teddlie and Tashakkori, 2009). Teddlie and Tashakkori (2009) argue that mixed methods provide an alternate to quantitative and qualitative research by promoting the use of whichever methodological tools are required to answer the research question. Therefore multi-method research is a way of choosing the strengths of

both quantitative and qualitative methods to view the phenomena from various perspectives (Sale, Lohfeld, and Brazil, 2002).

Within mixed method practice there are two ways of conducting research which are:

Parallel mixed designs
Sequential mixed designs

Parallel mixed designs collect both quantitative and qualitative data simultaneously; in contrast, sequential mixed designs are adopted to collect data in phases (Teddlie and Tashakkori, 2009). Östlund, Kidd, Wengström, and Rowa-Dewar (2011) argued that when two methodologies are mixed in one study, one methodology will gain precedence over the other. They did however claim that sequential mixed methods are far less difficult to conduct as one method informs the following. Creswell (2009) noted that the structure of a mixed method report may possibly reflect the initial modes of inquiry that were used. Thus if the first stage of data collection was quantitative in nature followed by qualitative data, the style of the report may be written in a standard quantitative publication. Conversely, if qualitative data was gathered first, the report may be written in free-form (Creswell, 2009).

Criticisms of mixed methods research involves debate on whether "the end product is more than the sum of the individual quantitative and qualitative parts" (Bryman, 2007; p. 8). Bryman (2007) used the example of including quantitative data after initially collecting qualitative data as a way of possibly trying to "embellish" the quantitative findings so that testing hypotheses relies on both types of data to be answered. Burke Johnson and Onwuegbuzie (2004) suggest that mixed methods require even more time dedicated to them than the previous two paradigms as two types of methodology are being implemented into the same line of inquiry. Not only that but the researcher needs to be aware of both methodologies to be able to apply them suitably.

To ensure that the researcher engages with the entire set of collected data - be it quantitative or qualitative, Sale *et al.* (2002) suggested that the researcher distinguishes what findings came from which research method. The reason for this is that it would indicate the level of influence made by each method separately to the overall findings. This would also assist in showing that both research methods were used to look at the

same topic from a different perspective; thus indicating that triangulation was applied (David and Sutton, 2011).

As can be seen in section 5.3 above, triangulation can also be used in mixed methods research, possibly to a larger extent than in qualitative methods. Denzin (1978) expressed it as a "combination of methodologies in the study of the same phenomenon" (as cited in Burke Johnson *et al.,* 2007, p. 114). Denzin (1978) distinguished triangulation into four types which were:

- Data triangulation which involved the use of various sources in the study
- Investigator triangulation referring to the involvement of many researchers on the same project
- Theory triangulation in which multiple theories and perspectives are used to interpret results
- Methodological triangulation involving the use of various methods to study the research problem

It was also identified in the review conducted by Burke Johnson *et al.* (2007) that there could be two different ways of applying triangulation. Using both qualitative and quantitative approaches is referred to as between-methods triangulation. Whereas choosing to use more than one method from either the qualitative or quantitative paradigm is called within-methods triangulation. Denzin (1978 as cited in Burke Johnson *et al.,* 2007) concluded that use of within-methods triangulation would be more limited in scope because only one research paradigm is being used, therefore regardless of the research design, weaknesses within the paradigm itself would show through. Based on this conclusion, Denzin recommended using between-method triangulation because mixing methods, data and researchers would be more likely to lead to an explanation of social phenomena because the shortcomings of each method would cancel out bias on the overall inferenence of the said phenomena.

5.5 Proposed Methodology

The proposed methodology for this project will be to use a sequential mixed methods approach (Teddlie, and Tashakkori, 2009). To address the research topic thoroughly, this

approach will initially rely on three survey designs followed by semi-structured interviews with academics (Creswell, 2009). A third survey design will then be administered and qualitative data will be gathered from the final year students who take part in the Joint Project module as they reflect on the project they have completed. An experimental condition will be incorporated before the fourth survey is carried out as certain programmes will receive sessions relating to sustainability. Once the fourth survey is completed the scores of those who had a session will be compared with those who did not, to see if there were any differences in attitudes.

Final year BUE students were eligible to participate in the study as it was vital to try to measure the attitudes of those who are closest to completing their tertiary education and moving on to the construction sector. Due to the large number of students who take part in the Joint project each year, it was deemed to be the best way by which to recruit the same participants to complete the questionnaires. If these educational interventions are successful, they could then be embedded into the first two years of BUE programmes in LJMU.

"...the bottom line is that research approaches should be mixed in ways that offer the best opportunities for answering important research questions" (Burke Johnson and Onwuegbuzie, 2004, p.16). Figure 3 in chapter 1 illustrated the methodological overview of all four phases which are outlined below:

5.5.1 Phase 1

The first phase of this project was to gain an idea as to the level of environmental concern students reported. The methodology for this phase was purely quantitative. After analysis, a stage of questionnaire development followed in order to create a purpose-specific questionnaire to capture the attitudes of BUE students regarding sustainability practices within construction.

Further details of the scale development and validity testing are discussed in section 6.

5.5.2 Phase 2

After the initial validation of the Sustainability Attitudes Scale was conducted, the first round of longitudinal data was collected from final year BUE students during their Joint Project in 2011. Students were given a questionnaire pack which measured their attitudes before the start of the project and completed a personality and emotional intelligence

questionnaire. The Sustainability Attitudes Scale was then administered to the students again after the end of the project. Again the data collection for this phase is completely quantitative and serves as benchmark values for the following year's data collection.

Phase 2 is detailed fully in chapter 7.

5.5.3 Phase 3

Following the analysis of 2011 joint project data, phase three consisted of interviewing module and programme leaders as well as designing educational interventions that could be implemented into the final year curriculum for BUE students. Programme and module leaders were contacted via email (Appendix 6). Interviews were recorded by the researcher and sent off to be transcribed by a third party. The interviews were then analysed using phenomenography.

Used since the 1980's, phenomenography has been a research approach that describes people's experiences; these have covered elements such as the experience of teaching and learning as well as the ways of experiencing the learned content (Mann *et al.,* 2007). Experience is defined as non-dualistic because internal relationships exist between the participant and world (Hasselgren and Beach, 1997; Giorgi, 1999; Mann *et al.,* 2007). Mann *et al.* (2007) added that phenomenography gives a non-dualist ontology as the focus is on the world as it is experienced. It therefore does not take a positivist or objective approach which is free of human interpretation yet it does not focus on a subjectivist approach either. Hasselgren and Beach (1997) summarised the history of phenomenography as it emerged in Gothenburg as a method which described qualitative differences in the ways in which a phenomenon is experienced, understood or conceptualised. The reason why this particular form of qualitative analysis was chosen is because it was 'designed' to investigate learning among university students, specifically forms of deep and surface learning, making it ideal for the context in which the current study is being explored (Mann *et al.,* 2007).

In this phase, it was important to probe the educators about their experiences of teaching sustainability in their modules as well as how prominent sustainability information is throughout the undergraduate BUE programmes. Asking the lecturers about their experiences of teaching may shed some light about the way they experience student learning, similar to what Bruce and Gerber (1995) did. Loughland, Reid and Potcz (2002) cited Payne (1998, p. 20) stating that:

"Until environment education and researchers give clear expression to what is entailed in being a present day learner in environmental education, there is a probability that the range of academic and teacher-driven curriculum theories of environmental education will be relatively ineffective in terms of learner needs, interests and understandings."

Marton (2007) described a theory of learning which was based on phenomenography in which teachers thought critically about how they present teaching materials and what they have to do to make sure that students can easily learn from what is presented to them.

This third phase relied heavily on a qualitative research approach as phenomenography was used to find themes which could help with the creation of educational interventions at later stages of the research. Educational interventions were devised with the guidance of the module leaders and the content within the interventions was made to be as relevant to the course content as possible. In semester one (2011) the educational interventions were implemented into one-off sessions for the Construction Management, Architectural Technology and Real Estate students. Rationales for why these three programmes received educational interventions and what the interventions consisted of will be discussed in Chapter 9. The educational interventions were meant to feed into the joint project in which a new cohort of students would be taking part, in January 2012. The LJMU BUE curriculum underwent changes during this time, therefore the researcher was able to create the questions that the students were meant to reflect upon after the 2-week project.

With this in mind, phase 4 was the exploration of the 2012 student cohort's attitudes and learning through the Joint Project as it was hoped that these would resemble what the programme and module leaders outlined in their interviews.

5.5.4 Phase 4

After the implementation of educational interventions towards the end of semester one, the second round of longitudinal data was collected at the beginning of semester two (2012) at the start and end of the Joint Project (similar to phase two). This phase took the methodological approach of having quantiative data supplemented by qualitative data in the form of student reflections.

As the final year students began their Joint Project they were briefed on what they were required to do as well as asked to complete the first set of questionnaires which included some personal information such as their student identification number (for tracking purposes), demographic information, Sustainability Attitude Scale (SAS), Five Factor Model (FFM) and Trait Meta Mood Scale (TMMS) questionnaires. All students were fully informed on the nature of the study and were asked to sign consent forms agreeing to take part.

The students were left to carry on with the project after being given the guidelines. Two weeks later the project finished; students held presentations in front of a panel of experts to discuss their plans. After this the students completed the SAS questionnaire only and were asked to provide their student identification number again to be able to match up their scores to the first round of data collection.

A final aspect of the group project was for the students to write reflective essays about their learning experiences about undertaking the project. Students were asked to reflect on aspects such as what competencies they felt they gained from taking part in the joint project as well as if they felt more confident in understanding and assessing sustainability information following the group project. The reflective essays were written about a week after the project ended giving students time to reflect over the entire process.

Student reflections were analysed using phenomenography (Hasselgren and Beach, 1997) as hopefully the students will be able to reflect on the learning process they undertook while participating in the group project and be able to pinpoint at what time during the project their attitudes changed or when at least they experienced a change in perspective.

Although the questionnaire presented to the students was the same as in the first round of longitudinal study, there were certain changes to the methodological design of phase 4 compared to phase 2. For example, the 2011 cohort did not have educational interventions aside from the Joint Project, nor were they contacted afterwards to provide qualitative data about the experience. On the other hand, the 2012 cohort were exposed to educational interventions in semester one and asked for qualitative data in the form of a reflective essay two weeks after the Joint Project ended.

5.6 Materials

Sets of questionnaires were used at the different phases. Where possible the details of the questionnaires that were used are described in the following sections. At other times, interview schedules will be discussed where appropriate.

5.6.1 New Ecological Paradigm

This scale aimed to measure an individual's ecological worldview - the extent to which respondents consider the world from an ecological perspective (Dunlap, 2008) based on pertinent ecological problems. With time however, environmental problems have evolved into more complex ones such as global warming, ozone depletion, deforestation and loss of biodiversity which are not immediately observable in some instances, but the effects are starting to impact the earth. This led to Dunlap, Van Liere, Mertig and Jones (2000) to revise the original scale to suit the concerns of the present, rather than measuring out-dated environmental notions.

The revised scale has stronger psychometric properties and better theoretical grounding making the NEP the most widely used scale that measures environmental concern in the world (Dunlap, 2008). The NEP contains five hypothesised aspects which encompass ecological worldview and which statement numbers it measures in brackets:

-anti-anthropocentrism [2, 7 ,12]
-the fragility of nature's balance [3, 8, 13]
-rejection of exemptionalism [4, 9, 14]
-the possibility of an eco-crisis [5, 10, 15]
-the reality of limits to growth [1, 6, 11]

The scale contains 15-items and uses a 5-point Likert scale which range from 5- Strongly agree to 1- Strongly disagree (Appendix 2). The lowest score an individual could get is 15 points, the highest being 75 with a mid-point of 45. Agreeing with the odd numbered questions signifies a positive attitude toward the NEP whereas disagreeing with the even numbered statements means pro-NEP attitudes. Dunlap *et al. (*2000) found Cronbach's alpa (α) to be .83.

5.6.2 Five Factor Model of Personality

The five factor model (FFM) was created by Goldberg (1992); Goldberg , Johnson, Eber *et al.* (2006). It is a 50-item scale which measures individuals on five broad personality traits

with 10 questions pertaining to each dimension (Appendix 2and 4). The five personality dimensions and their respective statement numbers are Extraversion (1-10), Agreeableness (11-20), Conscientiousness (21-30), Neuroticism (31-40). An individual is said to be emotionally stable when they do not display signs of constant anxiety and worry, but whenever their scores (as measured on the five factor model of personality) are less than 30, the term neuroticism can be used to draw attention to the worried and anxious state of respondents. The fifth personality is Openness to Experience (41-50). Response options are based on a 5-point Likert scale ranging from 1- Very Inaccurate to 5-Very Accurate while the mid-point is 3-Neither Inaccurate nor Accurate. Twenty-four of the statements are reverse scored. Statement numbers 6, 7, 8, 9, 10, 17, 18, 19, 20, 27, 28, 29, 30, 33, 34, 35, 36, 37, 38, 39, 40, 48, 49, 50 are to be reversed. The range of scores will vary from 10-50 in each of the subscales with the midpoint being 30.

Cronbach's alpha for the five factors is α .87 for Extraversion, α .82 for Agreeableness, α . 79 for Conscientiousness, α . 86 for Neuroticism and α .84 for Openness to Experience. This suggests that the items adequately capture the qualities expressed in personality thus making it a highly reliable tool for measurement. Previous research has also suggested that personality is a fairly stable trait in adults (Tickle *et al.,* 2001), therefore there would only be a need to collect this information once from participants.

5.6.3 Emotional Intelligence

Emotional Intelligence is measured by the Trait Meta Mood Scale (TMMS) created by Salovey and Mayer (1990) and Mayer and Salovey (1997) which measures the set of skills that make an individual able to perceive, understand, use and regulate emotions in efficient and appropriate ways. That scale consists of 30 items which ask about how an individual handles their emotions (Appendix 2 and 4). Scoring the scale occurs with a 5-point Likert scale with 5 representing Strong Agreement with the statement and 1 representing Strong Disagreement a mid-point of 3 indicates uncertainty toward the statement. Emotions are categorized into three subscales which are Clarity, Repair and Attention of emotions. Questions 2, 3, 4, 7, 10, 12, 17, 18, 21, 23, 24, 27, and 29 assess Attention, statements 5, 6, 11, 14, 15, 16, 20, 22, 25, 28, 30 measure Clarity and questions 1, 8, 9, 13, 19, 26 assess Repair of emotions. TTMS can be divided into sub-scales or all the scores can be added together to get an indication of an individual's overall emotional intelligence. For the purposes of this study, the overall emotional intelligence score will

be used where 30 signifies that an individual needs to work on their emotions, 90 meaning that they have a handle on their emotions and 150 meaning that an individual has excellent understanding of their own and others' emotions.

Score ranges will vary from 30-150 with the midpoint being 90. Half of the statements are reverse scored, these being statement numbers 2, 3, 4, 5, 9, 11, 14, 16, 17, 18, 19, 22, 23, 27, 29. Saklofske *et al.* (2003) reported the reliability of the overall scale to be Cronbach's α .89.

5.6.4 Sustainability Attitude Scale

The creation of this questionnaire will be discussed in chapter 8.2. From Chapter 9 onwards the SAS will replace the use of the NEP scale and will be used to quantify final year student attitudes towards sustainability in construction practices.

5.6.5 Interview schedules

Chapter 8.2 discusses in detail the list of questions that was used to conduct interviews with both module and programme leaders. The list was compiled from several articles and issues which had been identified through the literature review (Taylor, 2007; Jones, Trier and Richards, 2008; Wright, 2010). Most of the questions were adapted from work done within universities on attempting to embed sustainability information into the curriculum of undergraduate degrees or specific university figures' conceptions about what sustainability is. Other questions reflected on transformational learning theories while others related more generally to environmental education.

5.7 Methods of Data Analysis

The following section will describe the methods of qualitative and quantitative data analysis which will be used throughout this research.

5.7.1 Phenomenography

Phenomenography was the chosen qualitative method which was used in chapters 8 and 10. Its origins lay in investigating learning among university students, although it has also been applied to understanding the experience of teaching; both of which are precisely what the current research intends to explore (Hasselgren and Beach, 1997; Mann *et al.*, 2007).

In line with the work of Hasselgren and Beach (1997), Giorgi (1999) and Mann *et al.* (2007) the way this phenomenographic analysis was carried out in chapter 8 began by

conducting interviews with module and programme leaders who were chosen based on table 24 in chapter 8. These interviews were transcribed verbatim by a third party who specialised in transcription. The transcriptions were then checked by the researcher to make sure that the audio recording coincided with what was written (Appendix 8). In chapter 10, student reflective essays were analysed using the phenomenographic process outlined below.

Phenomenography is not to be mistaken with a similar research approach which is phenomenology. Giorgi (1999) distinguishes that while both approaches research experience, their methods in doing so differ. The main way in which the approaches vary are that phenomenology requires the researcher to investigate their own experience, whereas phenomenographers study the experience of others. It is this difference which is crucial to the current study as while the researcher is involved in implementing educational interventions, it is the learning outcome, and the experience of attitude formation and change within the final year students which is of interest to the researcher: "Phenomenography takes a second order approach, as it is the experiences of others rather than the researcher, that are the base of the investigation" (Mann *et al.,* 2007, p. 7).

Rather than using qualitative analysis software packages such as NVivo, the analysis was done by hand. The reason for this was that NVivo did not provide the results which were hoped as it only isolated the questions from the interview transcripts (David and Sutton, 2011). Not only that, but the terminology which is used in the software is different from the traditional terms used in describing the qualitative analysis process (Burnard, 1991; Attride-Stirling, 2001; David and Sutton, 2011).

The manual analytical process began by reading the transcriptions several times to become familiar with their content and to think of the transcripts as a whole set (Mann *et al.,* 2007). Open, inductive coding (David and Sutton, 2011) was used in which key words and phrases were highlighted from every transcript and made a note of on paper. Once notes had been created for each interview transcript, the notecards were grouped together where similar individual meanings were mentioned and the similarities within and differences between groups being clarified (Mann *et al.,* 2007). These essentially form the organisational themes which Attride-Stirling (2001) mentioned. A description is

then written for each category which emerges using quotes from the trasncripts to support the description.

Mann *et al.* (2007) emphasise that the first attempt of forming categories will not be final and is likely to change but it will provide the researcher with a different way by which to see the data and allow for further categories to be developed.

Once the final categories have been identified, they should be organised into a hierarchy of increased comprehensiveness. It its this hierarchical representation which is referred to researchers as the outcome space (Loughland *et al.,* 2002; Mann *et al.,* 2007).

In order to ascertain whether the categories which the researcher came up with seemed valid, the differences were discussed with others for their thoughts on the logic behind the categories. The overall cohesiveness of these groupings and implications were also discussed with others demonstrating that the analysis of qualitative data was triangulated (Kitto *et al.,* 2008).

5.7.2 T-tests

T-tests are an inferential statistical test used to analyse parametric data. There are two versions which are the independent t-test which is used for independent groups' designs (Laerd Statistics, 2012) and the paired t-test which is used for related designs (Brace, Kemp and Sneglar, 2006; Laerd Statistics, 2012).

Independent t-tests are sometimes called student's t-test or two- sample t-tests. This test determines whether the means of two independent groups are statistically significant. In order to perform this statistical test, a dependent variable should be interval or ratio data (David and Sutton, 2011), while the independent variable must be categorical (David and Sutton, 2011; Laerd Statistics, 2012). Examples of categorical variables include male/female and old/young for example (Brace *et al.,* 2006). The independent t-test would be appropriate when trying to determine whether the mean scores of students who received an educational intervention before the start of the joint project had statistically significant scores as compared to those who did not receive the intervention.

Paired t-tests on the other hand are used to compare the means of two related groups to determine whether there is any difference between them. Paired t-tests are often called dependent t-test as well as paired-samples t-test. Conducting paired t-tests is an example of 'within subjects' or 'repeated measures' tests as the same participants are tested more

than once (David and Sutton, 2011). The assumptions this data requires are that a dependent variable is measured at either interval or ratio scale. The independent variable should be categorical and only have two levels. Quite frequently, paired t-tests are used on pre- and post-experimental research designs (David and Sutton, 2011; Laerd Statistics, 2012).

For the main purposes of this study, paired t-tests will be used because a repeated measures design was applied. This means that data was collected from each participant in all stages of the study (Brace *et al.*, 2006).

Paired and independent t-tests were conducted in chapter 10 when the individual item analysis was carried out for 2011 and 2012 data.

5.7.3 Analysis of Variance (ANOVA)

Analysis of variance (ANOVA) is an inferential statistical test used to analyse data that have more than two experimental conditions and with more than one factor (Brace *et al.*, 2006; David and Sutton, 2011). Section 5.7.2 described the use of t-test when there is one factor. ANOVA is therefore useful when a study has more variables that need to be explored at once, rather than having to conduct multiple t-tests (Brace *et al.*, 2006). In order to use ANOVA certain conditions need to be met. These are that the data is normally distributed, the variances between data are equal and that the dependent variable consists of either ratio or interval level data (Brace *et al.*, 2006). However, in the absence of "nonparametric equivalents for two-or-more-factor designs", ANOVA can be used (Brace *et al.*, 2006, p. 368).

ANOVA was used to conduct analysis in the pilot study in chapter six and in chapter ten for individual item analysis of 2011 and 2012 data.

5.7.4 Non-parametric Equivalents

Non-parametric data can describe data that is measured in nominal or ordinal levels. It can also signify that data did not meet the assumptions required to conduct inferential statistics or used to describe the statistical techniques used to analyse non-parametric data (Brace *et al.*, 2006; David and Sutton, 2011).

Despite most of the data collected being measured at ratio and interval levels, the data in this research was not normally distributed therefore parametric tests were not suitable to

conduct analysis. The non-parametric equivalents of the t-tests were used instead because they do not rely on assumptions that the data is normally distributed.

5.7.4.1 Wilcoxon Matched-Pairs Signed-Ranks Test

Section 5.7.2 described the parametric paired t-test. Due to problems with the data collected, the non-parametric equivalent had to be used which is the Wilcoxon matched-pairs signed-ranks test (Brace *et al.,* 2006).

The Wilcoxon test ranks the data and the analysis is performed on these ranks. Rather than reporting means and standard deviations as descriptive statistics, the median and range are reported because these are distribution free and do not assume normal distribution (Brace *et al.,* 2006). Similar to the paired t-test, there should be one dependent variable that has been measured at ordinal, ratio or interval level as well as one independent variable which comprises of one group or matched pairs groups (Laerd Statistics, 2012).

The analyses conducted in chapter 7 and 10 on 2011 and 2012 data relied on the use of Wilcoxon matched-paired signed-ranks test.

5.7.4.2 Mann-Whitney U Test

Section 5.7.2 also explained the independent t-test. To test whether the experimental condition had an effect on the students' SAS scores the ranked scores of students who had a sustainability session were compared with those of students who did not have a session. Due to similar limitations as described in section 5.7.4.1 above, the Mann-Whitney test had to be used in chapters 7 and 10 instead (Brace *et al.,* 2006) of the parametric equivalent.

5.7.5 Effect Size

The reason for measuring effect size is to quantify the magnitude of an effect (Brace *et al.,* 2006). Effect size was calculated in chapter 10 after paired and independent t-tests as well as ANOVA was performed on the individual item analysis to see whether the associations between psychological constructs and scores on the SAS were strong, moderate or weak.

Cohen's *d* is a standardised way of reporting effect size, although there are a few formulas by which it can be calculated. The first which will be detailed is the formula to

calculate Partial Eta-squared (η^2) which is to be used to quantify the effect of a one-way ANOVA:

$$\eta^2 = \frac{SSbetween}{SStotal}$$

SS between stands for the sum of squares between the groups, *SS total* then is the total sum of squares which is also part of the SPSS output.

To determine whether the effect size was large or small, these guidelines can be followed when eta-squared is calculated:

η^2=.01 small effect

η^2=.09 medium effect

η^2=.25 large effect

It is worth noting that eta-squared provides an indication of the proportion of variance that is caused by the treatment condition that variables are exposed to. For example, η^2=.25 would suggest that 25% of the variance in one variable was due to another variable. Therefore, it is more of a descriptive statistic than an inferential one.

Cohen's *d* is the standardised measure of effect size for t-tests. It provides a measure of the extent of how much two means differ in terms of standard deviations (Brace *et al.,* 2006).

Thalheimer and Cooks (2002) published a simplified version of how and when to use different variants of Cohen's *d* formula, but for the purposes of this research, the formula that was used is as follows:

$$d = \frac{\bar{x}_2 - \bar{x}_1}{\bar{x}\text{StandardDeviation}}$$

Cohen (1988, 1992), Thalheimer and Cooks (2002) as well as Brace *et al.* (2006) are in agreement on the thresholds for what constitutes a large or small effect size when Cohen's *d* has been calculated:

d=.20 small effect

d=.50 medium effect

d=.80 and above large effect

Cohen related the guidelines for η^2 to those of *d*. This was done by association because mathematically, Fisher's eta-squared is the same as Pearson's *r* (Levine and Hullet, 2002). Therefore Cohen (1988) was able to convert *r* into *d* and so was able to relate eta-squared values to those of *d:*

d=.20 small effect	η^2=.01 small effect
d=.50 medium effect	η^2=.09 medium effect
d=.80 and above large effect	η^2=.25 large effect

Another formula for calculating the effect size of t-tests is (Rosenthal, 1991):

$$r^2=\frac{t^2}{t^2+df}$$

Where r^2 is the coefficient of determination, *t* is the value gained from performing a t-test which is then squared. The denominator is then the squared *t*-value added to the degrees of freedom.

6. Phase 1-Pilot Study

Phase one of the research was to conduct a pilot study once the gaps in the knowledge had been identified through the literature review. It was vital to gain a current 'snapshot' of the environmental concern BUE students reported in order to understand what would be a good starting point from where to direct the research. In order to accomplish this, the history of environmental concern must be touched upon briefly.

6.1 Introduction

Environmental attitudes have been a topic of interest to researchers for 40 years (Dunlap *et al.,* 2000; Torgler and García-Valiñas, 2007). Due to this fact, several research endeavours have been undertaken to measure environmental attitudes or behaviours (Corral-Verdugo, 1997; Corraliza and Berenguer, 2000; Davis, Green, and Reed, 2009; Shepherd *et al.,* 2009). A useful measuring tool for doing this is the New Ecological Paradigm (NEP) which emerged because of policy changes the American government made in the 1970s due to mounting concerns about air and water pollution, resource conservation and loss of aesthetic values (Dunlap *et al.,* 2000).

The scale aimed to measure an individual's ecological worldview - the extent to which respondents consider the world from an ecological perspective (Dunlap, 2008) or as Schultz *et al.* (2004) defined it as being a person's belief about humankind's relationship with the environment, based on pertinent ecological problems. The NEP is useful in that that it can be seen to uncover "primitive beliefs" people have about the environment which sustains them. These primitive beliefs can influence attitudes and beliefs with regards to more specific environmental problems (Dunlap *et al.,* 2000, p. 427). Therefore, the extent to which individuals perceive environmental concern to be a threat will influence the types of efforts put forth to solve or at least attempt to contribute to a solution (Dunlap and Jones, 2002).

The grounds from which the NEP were created, fit with the objective of this study, which was to gain a snapshot of the general understanding construction students had regarding environmental damage. Although the content in the questionnaire is generic, it was hoped it would indicate if any of the five personality subscales or emotional intelligence interacted or in some way influenced these scores.

Boeve- de Pauw *et al.* (2010) conducted a study relating to young peoples' environmental concern and personality and found that adolescents who were organised and goal-oriented were more likely to have an ecocentric world view, meaning that they viewed human activity and environmental preservation as a delicate balance. On the other hand, students who were more selfish and easily irritated displayed a less ecocentric view, meaning that they did not regard environmental issues as important to them.

Hirsh's (2010) work followed on from Hirsh and Dolderman (2007) in which Openness to experience, Agreeableness, Conscientiousness, and Neuroticism seemed to relate highly with environmental concern. Hirsh explained that Openness and Agreeableness would be related to concern for the environment because Openness is associated with increased intellectual aptitude (Todd *et al.,* 2009) therefore an individiual would be flexible with their thoughts rather than have a narrow and often conservative view on environmental protection. Agreeableness on the other hand is related to empathy, therefore those who are less empathetic would not pay so much attention to the prosperity of others. Hirsh (2010) mused that the worry which individuals high in Neuroticism experienced could motivate them to preserve the ecology because of their aversion to negative effects. Swami *et al.* (2010) had similar findings. Conscientousness relates to environmental concern in the way that individuals will follow rules and social norms and thus are more likely to take adequate steps to protect the environment.

6.1.1 Hypotheses

The hypotheses for the pilot study were that there would be relationships between conscientiousness, openness to experience, agreeableness, emotional intelligence and ecological worldview.

6.1.2 Data Sampling and Descriptive Statistics

The pilot study recruited participants from the school of BUE (HNC, HND, undergraduate, postgraduate students). To make potential participants aware of the study, an email invitation was sent out to the entire LJMU BUE student body. The email contained a link to an online survey (Bristol Online Survey) where the students were to give their answers. The questionnaire was compiled from three separate measures which were the Five Factor Model (Goldberg, 1992) the Trait Meta-Mood Scale (Salovey and Mayer, 1990) as

well as the New Ecological Paradigm (Dunlap *et al.*, 2000) measuring ecological worldview (Appendix 4).

The methodological design of this study was to only collect quantitative data. Despite sending several electronic invitations to potential participants, a sample of ninety-nine BUE students (82 male, 17 female) with a mean age of 28.20 years (S.D= 10.93) took part in an online questionnaire. It could be that because the questionnaire was fully anonymous and there was no incentive offered to the students for completing, many of them decided not to take part. Alternatively this could have been because the survey was fairly lengthy. In instances where the students had left answers blank, Missing Values Analysis (MVA) was used to calculate and insert values where there were none so as to not reduce further the already small sample size.

6.1.3 Results

The results indicated that the cohort had a slightly better than average mean on ecological worldview compared to the scale midpoint. Students were moderately emotionally intelligent, moderately extraverted, highly agreeable, conscientious, open to experience and emotionally stable. These results are detailed in table 5.

Scale	Scale Mid-point	Mean	Standard Deviation
New Ecological Paradigm	45	50.78	10.50
Emotional Intelligence	90	103.93	13.01
Extraversion	30	33.79	7.52
Agreeableness	30	39.41	5.91
Conscientiousness	30	35.03	7.31
Emotional Stability	30	30.95	8.10
Openness to Experience	30	36.71	4.95

Table 5. Descriptive statistics for each measurement scale (self-study).

The reliability of each of the constructs was very high as NEP had an alpha coefficient of α=.84, emotional intelligence had a reliability of α=.80, extraversion was α=.87, agreeableness α=.84, conscientiousness α=.86, emotional stability had a coefficient of α=.88, openness to experience had the lowest reliability of α=.75.

Correlations revealed that there were no relationships between agreeableness, conscientiousness, openness to experience, emotional intelligence and ecological world

view as hypothesised; extraversion (p<.05), agreeableness and openness to experience (p<.001) showed positive relationships with emotional intelligence (all two-tailed). Results are summarised in Table 6 below.

Scale	NEP	Emotional Intelligence
Extraversion	-.22*	.36**
Agreeableness		.39**
Openness to Experience		.27**

*p< 0.05 **p<.001

Table 6. Correlation chart indicating which psychological constructs were associated with the NEP (self-study).

Analysis of Variance was carried out to see whether any of the psychological constructs had differences in means in ecological worldview. The five personality factors were unable to identify any differences, however, emotional intelligence did $F(57, 41)=1.923$, $p<.05$ partial $\eta^2=.73$. Referring back to section 3.6, there do not seem to be any additional levels of effect size, therefore the researcher will assume that this too had a large effect size.

To further examine whether personality traits or emotional intelligence scores could predict environmental concern scores, a multiple hierarchical regression was run. In line with previous literature, the first model included age, gender (Larsen, 1995) and agreeableness and openness to experience (Hirsh and Dolderman, 2007) as independent variables. In the second model, neuroticism and conscientiousness were included based on findings from (Hirsh, 2010). The third and final model had extraversion and emotional intelligence as variables. Although the sample size was small, a formula ($N > 50 + 8m$ where m is the number of independent variables) devised by Tabachnick & Fidell (2007) indicated that sample size requirements were met, therefore $99 > 50 + 8*6 = 98$. The results indicated that all three models were non-significant, therefore neither personality traits nor emotional intelligence were able to predict environmental worldview scores.

6.1.4 Conclusions

The hypotheses outlined in the pilot study were rejected; however interesting results emerged which illuminated a different perspective of the study. Extraversion correlated with ecological world view negatively, which can be interpreted that extraverted individuals may be more preoccupied with being sociable amongst their peers than to

concern themselves with environmental issues, these results are similar to those that Furnham *et al.* (2003) found with regards to educational performance.

Hirsh and Dolderman (2007) and Swami *et al.* (2010) found that agreeableness was associated with empathy. The results in this study confirmed this. The data demostrated positive relationships between agreeableness, openeess to experience, extraversion and emotional intelligence were found; even though these associations were weak. The correlation between agreeableness and emotional intelligence was to be expected because an individual is able to take others into consideration. It is interesting that emotional stability had a positive relationship with emotional intelligence as well.

Extraverts may be more aware of the emotional state of others because they seek and enjoy the company of others. To find relationships between a few personality traits and emotional intelligence, as well as the significant result of the ANOVA between environmental worldview and emotional intelligence, justified the claim made by Wranik *et al.* (2007) that emotional intelligence is an area worthy of study.

The question then remains, how can this area be used to explore how to best extend concern for others, into concern for the environment through education? Based on the relationships between emotional intelligence and extraversion, it may make sense to have extraverted individuals attend group sessions or tutorials to discuss and exchange information about environmental issues. In this way the students would be playing to their strengths whilst building knowledge which may bridge the gap between being sociable and being concerned about the environment.

The main limitation of the pilot study was the sample size as it made the possibility of running more elaborate statistical tests impossible. The small sample size may have prevented similar results to be found such as the ones that Hirsh (2010) reported in his work. The results which emerged were not those that were hypothesised, further analysis is therefore required to explore if other variables which were not included in this study contribute to the relationship between ecological worldview and psychological factors. As data was collected at one point in time, the results may not be generalisable to a wider population and only represent an 'of the moment' state (Amaratunga *et al.,* 2002). As a pilot study, a methodological constraint such as this one is not a hindrance for moving the research forward because a static representation is needed to create a solid base from which to continue.

6.1.5 The next step to Researching Environmental Attitudes

As outlined in section 5.6.1, the NEP consists of five sub-scales which capture elements of environmental issues. Table 8 below shows the descriptive statistics for these subscales.The mean scores for the five sub-scales of the NEP are fairly similar aside from limit to growth score which was lower at ($\bar{x}$=8.65). Perhaps this had the lowest score because people cannot see that 'space' is running out or that resources are being depleted. The mean for anti-anthropocentrism seems to suggest that particpants felt that evaluating facts based on human expectations should not be done. Participants tended to agree with the fragility of nature's balance subscale, maybe due to all the messages surrounding environmental issues in media or government policies. This cohort believe that they are not above other species with whom we share the planet. The possiblility of an eco-crisis may reflect some degree of knowledge or personal beliefs on the matter as these effects cannot be seen yet, similar with the limits to growth and ecological balance subscale.

Sub-scale	Mean	Standard Deviation
Limit to Growth	8.65	2.84
Anti-anthropocentrism	10.38	2.94
Nature's Balance	10.80	2.73
Rejection of Exemptionalism	10.51	2.30
Eco-crisis	10.48	3.34

Table 7. Means and standard deviations of NEP subscales (self-study).

While the statements in the NEP served the purpose to give an initial idea of what BUE students' attitudes toward the environment are, the statements are too generic and do not address construction related practices. An additional literature review was conducted into best practice publications as well as adapting some of the questions from the NEP which the author found to be very relevant to the next stage of the research.

6.2.Questionnaire Development

With over 40 years worth of environmental attitude literature, certain factors have been identified as likely indicators of whether someone has positive or negative environmental attitudes. Anderson, Lee, Pryce and Taal (2010) looked at what factors affect environmental attitudes in the English and Welsh. They believe that education is an important driver of environmental awareness as it has more freedom than the government to promote innovation and change to concepts such as environmental issues.

This sentiment is shared by Torgler and García-Valiñas (2007) as higher levels of education lead to a stronger likelihood for wanting to protect the environment. The aim of this aspect of the study was to devise a measurement tool which would be specific to the area of the BUE.

The starting point for a questionnaire measuring sustainability attitudes in construction was the theoretical rationale behind it. Illustrated in section 2.2 is Larsen's (2009) Dimensions of Sustainability which served as the framework behind the the Sustainability Attitudes Scale (SAS). It seemed logical to have environmental, economic and social areas as subscales which would capture participants' views on each domain individually while still allowing the entire scale's scores to be used holistically (i.e. total score) to gauge attitudes towards sustainability in construction practices (Kokkarinen and Cotgrave, 2011).

Following section 4.1's pilot study (Kokkarinen and Cotgrave, 2010a) which used the New Ecological Paradigm (Dunlap *et al.,* 2000), certain statements from that questionnaire were taken and modified to reflect aspects of construction. Additional content for statements was collected from government publications (OGC, 2007; HMG, 2008) and recommendations made by professional bodies such as the Chartered Institute of Building (CIOB, 2001 and 2010).

A list of statements was made as the literature was reviewed. Statements fell into one of three categories vital to sustainability which were environmental, economic or societal issues. The statements were then looked at and grouped into their appropriate section from which the original set of 42 statements was reduced down to 24.

After the 24 items were selected and formatted into a questionnaire, it was sent to a panel of experts to assess the content, relevance and clarity of the statements. Six experts provided feedback and necessary amendments were made. It also became clear that an additional statement needed to be included in the questionnaire making it a 25-item scale which was about the thorough inspection of land before development or redevelopment.

Findings from the pilot study using the NEP suggested that students were not able to acknowledge the limits of growth because it is an abstract concept. To address this issue

in the research, statement numbers 1 and 10 are directly adapted from Dunlap *et al.* (2000) NEP scale. These statements relate to the environmental sub-scale of the SAS. Specifically statement number 10 addresses the depletion and waste of resources by clearly directing the respondents' imagination to landfills and skips on construction sites by using the concept of spatial awareness. Statements regarding the good of the community are used instead of focusing particularly on anti-anthropocentric ideas as the New Ecological Paradigm did. Similarly, exemptionalism was not measured in the Sustainable Attitudes Scale, yet statement 21 is again inspired by the New Ecological Paradigm. Another concept which was modified from Dunlap *et al.* (2000) was that of the fragility of nature's balance. Statement numbers 7, 10, and 24 address this as they mention how certain practices can help preserve nature, rather than degrade it further. The origin of other statements is a reflection of the literature review in terms of using legislation as an incentive for change, cost-benefit analysis and from the United Nations definition of sustainable development (WCED, 1987).

1. There will be sufficient natural resources if they are used prudently.
2. Legislation is the only way to make the industry change its ways.
3. The effectiveness of construction work does not have to diminish even if substantial changes are made.
4. It is important to adopt a sustainable approach to choosing materials.
5. Communities cannot benefit from what the built environment does.
6. The construction industry wastes money on procuring materials that do not get used.
7. It is important to know where and how materials are sourced so that the less environmentally harmful choice is made.
8. Thorough inspection of land, which is to be (re)developed, needs to be carried out to ensure the well-being of communities.
9. It would be good practice to evaluate the cost of refurbishment against new build.
10. Minimising water, noise and spatial pollution should be a goal in any activity.
11. Current generations have the obligation to protect the environment for the benefit of future generations.
12. Companies reporting their sustainability plans as well as their accomplishments have a competitive advantage over other companies.
13. Construction practices could use significantly less embodied energy.
14. The industry should inform the wider community of the effects construction work has on the environment.
15. It is often easier to choose the non-environmentally friendly option; either due to cost, availability or lack of knowledge.
16. In previous years, the construction industry has posed a threat to the environment.
17. Resources could be saved by increased awareness.
18. Acting sustainably is only worthwhile if it reduces costs.
19. The use of renewable energy as well as recycled materials should become more prominent in areas where facilities exist.
20. The built environment has the potential to benefit communities through the infrastructure it provides.
21. Technological advancements will ensure that the construction industry will not degrade the environment.
22. The environmental impact that the built environment has is largely exaggerated.
23. Poor planning and management are the main cause of bad practice.
24. Cutting down waste can have financial benefits attached to it in the long run.
25. The construction industry does enough to protect the environment.

Table 8. Full list of statements of the SAS (Self-study)

Three of the statements have an opposing one to check whether participants were engaging with the material or whether they were just 'ticking boxes'. These were statement numbers 5/20, 6/24, and 16/25. The order in which the questions appreared was shuffled around so that respondents would not 'guess' which subscale they were answering. Therefore every third question belonged to the same sub-scale. This is outlined in table 9 below.

Subscale	Statement numbers	Minimum Score	Mid-point	Maximum Score
Environmental	1,4,7,10,13,16,19,22,25	9	36	63
Society	2,5,8,11,14,17,20,23	8	32	56
Economic	3,6,9,12,15,18,21,24	8	32	56
Total SAS score	1-25	25	100	175

Table 9. Allocation of SAS statements into sub-scales (Self-study)

6.2.1.First SAS Validation Attempt

Shepherd *et al.* (2009) created a questionnaire which looked at sustainable values and noted that using student samples or convenience sampling was permissible when looking at psychological phenomena. This argument is used predominantly in the creation of SAS as the overall purpose of it is to measure student attitudes toward sustainability in the BUE at university level while exploring whether there is enough scope for it to be applied in professional settings.

Once amendments were made, the scale was formatted into a 5-point Likert Scale where '1: Strongly Disagree' and '5: Strongly Agree'. The scale was opportunistically distributed to students during lectures and they were briefly told about the purpose of the study and informed that participation was voluntary. One hundred and seventy-six questionnaires were sent out. A total of 125 (104 male and 21 female) students completed the questionnaire with a response rate of 71% and the mean age of the cohort was 26.5 years (S.D=6.5). Some participants left missing data which was replaced using the Missing Values Analysis function on SPSS version 17.

An important element of psychometrically valid measures is the internal reliability of it. For a scale to be deemed reliable, Chronbach's alpha (α) should be .7 or above (Hoxley, 2000; Brace *et al.,* 2006). While Hair and Anderson (2010) agree with Brace *et al. (*2006), they noted that Cronbach levels of .6 are acceptable when exploratory research is carried out. The reliability for this questionnaire was α=.58. Further analysis revealed that the sample size was far too small to perform factor analysis which would have indicated wehther the three dimensions of sustainability were the only underlying factors in the SAS (Hoxley, 2000; Brace *et al.,* 2006). Too many participants had chosen '3: Neither Agree nor Disagree' as their answer for a majority of the statements which is a likely contributor for Chronbach's alpha being so low. The 5-point Likert scale therefore failed to show individual differences.

Given the various sources which produce literature about promoting sustainability such as government reports and professional bodies, the need to collate all of these ideas and condense them into one manageable tool is vital. Government goals are a significant driver for environmental behaviour because they are to be complied with. However, sustainability is expected to become a significant part of the construction industry's mentality. As was the case with the work of Shepherd *et al.* (2009), this questionnaire was developed for the BUE as a small step in attempting to increase understanding on the complex notion of sustainability.

To overcome the limitations caused by the 5-point scoring system, the scale should be extended to a 7-point Likert scale including options such as '1: Very Strongly Disagree' and '7: Very Strongly Agree' shifting the midpoint to 4. In order to avoid too many individuals ticking the middle option, participants should be primed before they complete the questionnaire by saying that it is important that their attitude towards the statements show directionality either veering toward more positive or negative scores. As the initial validation process was not successful due to various limitations, a second validation should be undertaken after the scale is amended to see whether Cronbach's alpha reaches acceptable levels.

7. Phase 2-Longitudinal Data (2011)

7.1. First 2011 Data Collection

While the second validaton of the SAS was being conducted the first set of longitudinal data was gathered. This included administering the five factor model of personality and emotional intelligence questionnaire along with the SAS. The aims of this chapter are to establish whether the data collection was able to indicate a relationship between SAS and psychological constructs, to establish whether the SAS is internally consistent as well as investigate whether the joint project was able to change student attitudes.

It was expected that participants would have higher scores at the end of the project as opposed to the start of it.

As mentioned in section 4.5.1, transformative learning can be periodic or augmentative and can involve accomplishing an objective or task. Moore (2005c) would call this kind of group work collaborative learning as it assumes that students from every discipline will have something to contribute towards the process of meeting the design brief. In essence, the purpose of the Joint Project is to give the students the experience of working in a practical setting, putting the knowledge they have gained from their course to use.

Students were asked to participate in this research during the first day of the Joint Project. The students were administered a questionnaire pack inclusive of a debreifing sheet and consent form. Firstly the participants completed their demographic data. They then proceeded to complete the SAS, five factor model of personality and finally the emotional intelligence scale (see Appendix 4). As this was a before-and- after data collection design, participants were asked to disclose their student identification number so that their scores could be compared at time 1 and time 2. Collected data was only looked at by the researcher and securely stored. The data will be disposed of adequately in accordance with the recommendations from the research ethics committee.

Before the Joint Project started (time 1), the sample size was 302 with a gender breakdown of 263 males and 39 females with a mean age of 23 (SD=3.92). The overall mean score for the SAS was 123.96 (S.D=10.81). The response rate was 100%.

Subscale	Mean	Standard Deviation
Environment	41.36	4.69
Society	43.85	5.38
Economic	38.75	4.15
Total SAS score	123.96	10.81

Table 10. Means and standard deviations (before- data) n=302 (self-study)

Table 10 indicates the descriptive information from the first round of data collection which indicates that all three subscales and the total SAS score are above the midpoints mentioned in table 9 in section 6.2.

Scale	Mean	Standard Deviation
Extraversion	34.97	7.24
Agreeableness	37.98	6.42
Conscientiousness	34.33	7.14
Emotional Stability	34.33	7.14
Openness to Experience	35.59	5.61
Emotional Intelligence	104.21	11.52

Table 11. Time 1 data collection for personality and emotional intelligence (Self-study)

Descriptive statistics in table 11 indicate that the cohort had a good understanding of their own emotions and those of others, were moderately open to experience, agreeable and extraverted, with average levels of conscientiousness, and emotional stability being reported.

7.1.2 Second SAS Validation Attempt

The recommendations made in chapter four during the first validation attempt of the SAS scale were followed in order to improve the scale (Kokkarinen and Cotgrave, 2011). Thus the rating system was changed to a 7-point Likert scale. The answer options ranged from '1: Very Strongly Disagree' to '7: Very Strongly Agree'. Before the students were told to begin completing the questionnaire, the researcher read the instructions out loud and urged participants to avoid using the midpoint (4) as their answer, unless they were not sure what their attitude to that statement was. Instead, participants were urged to indicate their agreement or disagreement with the statement.

Cronbach's alpha was $\alpha = .64$ at time 1, representing that the questionnaire met acceptable exploratory reliability levels. When looking at the reliability values for environment were $\alpha = .26$, social was $\alpha = .62$ and economic subscale was $\alpha = .14$. Ultimately

indicating that two of the subscales in the second validation attempt were still not reaching the recommended .6 or .7 level (Brace *et al.*,2006; Hair and Anderson, 2010).

7.1.3 Time Two Follow-up Data Collection

Two weeks after the first set of longitudinal data was collected, the second SAS was administered to the same cohort. The reason for only administering the SAS is because the two psychological constructs are fairly stable over time (Tickle *et a.,* 2001) therefore a two-week period would not have changed their personality or attentiveness to emotions. The intention was to measure whether their attitudes towards sustainability issues had changed within the course of the joint project.

After the Joint project time ended (T2), the sample size reduced to 203 with a gender composition of 174 males and 29 females with a mean age of 22.79 (SD= 3.87). The response rate at time 2 was 67%. Cronbach's alpha did increase significantly to α=.80 at T2 rendering it an acceptable level confirming that the items within the SAS are internally consistent. The subscales improved considerably from T1 as the alpha coefficient for environment was α=.42, economic α= .41, yet it was again society α=.77 which had a high enough coefficient to be measured alone. The mean scores for the entire SAS was 122.01 with a standard deviation of 14.90 showing moderate variance in responses.

Subscale	Mean	Standard Deviation
Environment	40.86	5.56
Society	42.35	6.81
Economic	38.80	5.10
Total SAS score	122.01	14.90

Table 12. Descriptive statistics for data collected after the joint project was complete (n=203) (Self-study)

The table above again demonstrates that the cohort scored above the midpoints of the SAS.

7.1.4 Analysis of Repeated Measures Data

As the number of participants fluctuated during time 1 and 2, this section of the analysis focuses on the participants that completed both questionnaires. A total of 184 participants completed the questionnaire packs at both time 1 and 2 rendering a response rate of 61%. One hundred and fifty-eight of them were male, while 26 were female. Their average age was 22.79 years (SD= 3.85).

Subscale	Mean	Standard Deviation	Subscale	Mean	Standard Deviation
T1Environment	44.30	5.13	T2Environmental	40.80	5.56
T1 Social	40.41	4.89	T2Social	42.24	6.87
T1Economic	39.93	4.62	T2Economic	38.76	5.17
T1SAS	124.64	11.86	T2SAS	121.81	15.13

Table 13. Means and standard deviations for repeated measures data (Self-study)

The results in table 13 show that within this reduced sample, some of the mean scores on the SAS increased while others decreased as compared to the larger samples obtained at T1 and T2.

Scale	Mean	Standard Deviation
Emotional Intelligence	105.21	11.10
Extraversion	35.50	7.23
Agreeableness	38.51	6.21
Conscientiousness	36.20	6.60
Emotional Stability	34.61	7.32
Openness to Experience	35.40	5.40

Table 14. Descriptive statistics of Psychological traits of repeated measures cohort (Self-study)

If the scores of the above table are to be compared to the mean scores from table 11 in section 7.1.3, it can be seen that the repeated measures sample reported slightly higher levels of emotional intelligence. This reduced cohort also had slightly higher scores on extraversion, agreeableness, conscientousness, and openness to experience than the initial sample of 302 participants. Looking at these results suggests that possibly this smaller cohort of participants who completed both sets of questionnaires are more dilligent and hardworking (as suggested by the agreeableness personality trait Widiger and Trull, 1997; Todd *et al.,* 2009), as virtually all of the scores increased slightly from time 1 considering that 118 participants were excluded from the repeated measures data.

As the study is looking at the relationship between psychological traits and sustainability attitudes, it is of interest to see whether the instruments correlate to justify the reason for them being measured together. Other aims for the repeated measure data were to see whether attitudes changed as a result of the group project (T1 vs. T2) and whether there were any statistical differences among those who completed the study at both T1 and T2. The final aim was to assess whether the reliability of the Sustainability Attitudes Scale (SAS) is acceptable.

Correlations were run among the three subscales of the SAS at both T1 and T2 as shown in Table 15 as well as with the FFM (Tables 16 and 17) and TMMS as seen in Tables 18 and 19.

	Environment (T1)	Society (T1)	Economy (T1)	Environment (T2)	Society (T2)	Economy (T2)
Environment (T1)	—	.517**	.462**			
Society (T1)	.517**	—	.469**		.149*	
Economy (T1)	.462**	.469**	—		.165*	
Environment (T2)				—	.615**	.589**
Society (T2)		.149*	.165*	.615**	—	.611**
Economy (T2)				.589**	.611**	—

** p< .01 *p<.05

Table 15. Correlations between T1 and T2 subscales (Self-study)

The table of correlations above shows that the subscales at T1 correlate moderately well with each other, but T1 subscales correlate weakly with T2. The same can be seen for T2.

	T1Env	T1Soc	T1Econ	Extra	Agree	Consc	EmoSt	Open
T1Env	—	.517**	.462**			.195**		.171*
T1Soc	.517**	—	.469**	.160*	.239**	.231**	.173*	.191**
T1Econ	.462**	.469**	—			.243**	.197**	
Extra		.160*		—	.261**	.176*	.239**	.397**
Agree		.239**		.261**	—		.151*	.156*
Consc	.195*	.231**	.243**	.176*		—		.287**
EmoSt		.173*	.197**	.239**	.151*		—	
Open	.171*	.191**		.397**	.165*	.287**		—

** p<.01 *p<.05

Table 16. Relationships between personality (FFM) and T1 data (Self-study)

The five personality traits correlate weakly with T1 subscales. Although the weak association with SAS subscales means it is worthwhile to explore further.

	T2Env	T2Soc	T2Econ	Extra	Agree	Consc	EmoSt	Open
T2Env	—	.615**	.589**		.156*			
T2Soc	.615**	—	.611**		.245**			
T2Econ	.589**	.611**	—					
Extra				—	.261**	.176*	.239**	.397**
Agree	.156*	.245**		.261**	—		.151*	.156*
Consc				.176*		—		.287**
EmoSt				.239**	.151*		—	
Open				.397**	.156*	.287**		—

**p<.01 *p<.05

Table 17. Correlations between T2 and FFM (Self-study)

Agreeableness was the only personality trait which correlated weakly, if at all with T2 subscales. Interestingly, even the other personality traits correlated weakly with one another.

	T1Env	T1Soc	T1Econ	TMMS
T1Env	—	.517**	.462**	
T1Soc	.517**	—	.469**	.173*
T1Econ	.462**	.469**	—	
TMMS		.173*		—

**p< .01 *p<.05

Table18. Correlations between T1 and Emotional Intelligence (Self-study)

Emotional Intelligence correlates very weakly with the Society subscale of the SAS and did not correlate at all with the other two subscales.

	T2Env	T2Soc	T2Econ	TMMS
T2Env	—	.615**	.589**	
T2Soc	.615**	—	.611**	.170*
T2Econ	.589**	.611**	—	
TMMS		.170*		—

**p< .01 *p<.05

Table 19. Correlations between Emotional Intelligence and T2 data (Self-study)

As with the T1 data, emotional intelligence only correlated weakly with the society subscale. On the whole, emotional intelligence did not correlate with the SAS. This may indicate that the Society subscale relates to emotional intelligence on its own rather than as a sustainability scale on the whole.

Although the correlations between the SAS, FFM and TMMS were weak, they still indicate that these measures are associated. It may be possible that the reduced sample size is responsible for these weak associations. If a larger repeated measures sample is attained

in future studies, it should be examined whether that cohort demonstrates stronger relationships between the scales to help suggest whether the SAS can be used in association with personality scales.

In order to achieve two of the aims stated above, the objective of the analysis was to compare the means of the SAS scores at T1 and T2 and to run paired samples t-tests to assess whether there were statistically significant results between those individuals who completed the study at T1 and T2.

The repeated measures data was not normally distributed, therefore the median and range values were used as measures of central tendency and dispersion. This was done instead of reporting the means and standard deviations from the above tables because they do not assume normal distribution (Brace *et al.*, 2006). The median and ranges can be seen in table 20. As the differences between scores at T1 and T2 were of interest and the data was not normally distributed, the non-parametic equivalent of the paired t-test was used which is the Wilcoxon matched-pairs signed-ranks test.

Subscale	Median	Range
T1Environment	45	40
T1 Social	41	34
T1Economic	40	31
T1SAS	126	104
T2Environmental	41.50	34
T2Social	43	41
T2Economic	39	32
T2SAS	123	87

Table 20. Median and range for repeated measures data (Self-study)

To detemine whether there was a statistical change in attitudes among those who completed the study at T1 and T2, a Wilcoxon test was conducted. There was a statistically significant decrease in overall SAS scores in T1 (median=126, range=104) and T2 (median=123, range=87) (z=2.197, N-Ties=174, p=.014, one-tailed). It was expected that scores would increase at T2, therefore this test was conducted at the one-tailed level.

The SAS was designed to capture sustainability attitudes, the higher the overall score (or sub-scale score), the more positive the attitude. In the repeated measures instance, it seems as though the two week project **lowered** their initial attitudes towards

sustainability. To see how much participants differed in the three sub-scales scores, further Wilcoxon tests were conducted.

The results for the Environmental subscale indicated a statistically significant decrease in scores at T2 (median= 41.50, range=34) compared to T1 (median=45, range=40) (z=7.018, N-Ties=176, p=.001, two-tailed).

Attitudes regarding Society aspects increased after the study as the median was 43 (range= 41) at T2 and at T1 the median was 41 (range=34) (*z*=4.015, N-Ties=176, p=.001, two-tailed).

Finally the Economy subscale of the SAS also had a significant decrease in scores at T2 (median=39, range=32) and scores at T1 (median=40, range=31) (z=2.561, N-Ties=167, p=.01, two-tailed).

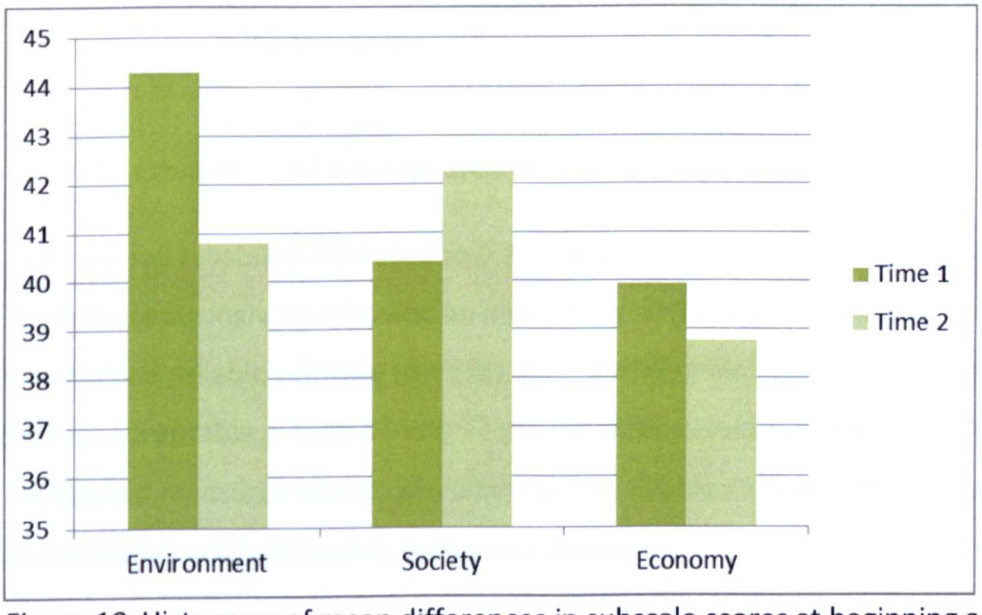


Figure 10. Histogram of mean differences in subscale scores at beginning and end of study (Self-study)

The biggest change in scores was in the Environment sub-scale. It could be that students shifted their perspective from being 'motivated' by environmental aspects of sustainability to a more community oriented approach as indicated by the significant increase in Society sub-scale scores. It might also be that during their two week project, students read more about the societal benefits sustainable construction could yield as opposed to thinking about sustainability from a strictly environmental or economic standpoint.

The final aim of checking the reliability of the SAS scale at T1 and T2 was achieved by calculating Cronbach's alpha (α). In terms of the reliability of the Sustainabilty Attitudes Scale, the repeated measures cohort alpha values were higher at T1 than those of the very first round of data collection where the sample size was 302 (α=.64).

	Time 1 (α= .72)
Environment	.42
Society	.51
Economy	.37

Table 21. Cronbach's α from repeated measures sample T1 (Self-study)

Overall, Cronbach's α at T1 (when only repeated measures data was considered) was was 0.72. The breakdown for each of the subscales at T1 indicate that individually, the reliability of the subscales was rather low, with Society having the highest α value of 0.51.

	Time 2 (α= .81)
Environment	.44
Society	.78
Economy	.44

Table 22. Cronbach's α from repeated measures sample T2 (Self-study)

At T2 overall reliability increased to 0.81 suggesting that the items correlated together much more strongly and showed an increase in all three subscales, only Society was a stand-alone reliable subscale (α=0.78). As a starting point, the overall reliabilities of the SAS are acceptable at both T1 and T2 yet the scale should be subjected to longer periods in between measurements to see whether the α value changes and to establish the Sustainability Attitude Scale's test-retest reliability.

Crobach's alpha for the remainder of the scales used were as follows:

Psychological Construct	Cronbach's alpha (α)
Extraversion	.86
Agreeableness	.83
Conscientiousness	.82
Emotional Stability	.83
Openness to Experience	.76
Emotional Intelligence	.75

Table 23. Cronbach's alpha for Personality and Emotional Intelligence.

If these reliability values are compared with those of the pilot study in section 6.1.3 there is very little discrepancy in the data. The only alpha coefficient which is considerably

lower in this data set when compared to the pilot study was Emotional intelligence which had a value of α=.80.

7.2 Summary of Findings

To summarise, all of the aims were achieved within this chapter:

- It was established that there was some association with the psychological constructs and SAS suggesting that there is some justification for studying these together.
- Reliability levels were calculated using Cronbach's alpha which indicated that the SAS is meeting adequate levels of internal reliability (Brace *et al.*,2006; Hair and Anderson, 2010).
- It was expected that scores on the SAS would be higher after the end of the project as opposed to the start. This was not the case when looking at the overall SAS, economic and environmental scores.
- The hypothesis was supported in the case of the social subscale though, as this was the only instance where scores significantly increased after the project had been completed.

8. Phase 3- LJMU Final Year Curriculum Structure and Teaching

8.1 Where to Start Promoting Change?

The findings of the second validation attempt indicated that before and after the Joint Project students scored their attitudes significantly lower in environmental and economic aspects of sustainability; whereas they had a significant increase regarding societal issues. It could be that this two week long project managed to alter the point of view by which students understand sustainable construction rather than change their attitudes. It may be useful to have students understand and internalise messages underlying the three domains of sustainability before the Joint Project takes place.

The findings described in section 7.1.4 suggests direction to the sort of educational interventions that could then be devised in the attempt to prime students before they undertake the Joint Project. Considering that Societal aspects were looked at favourably, perhaps messages talking about the benefits of sustainable communities should be mentioned, as well as how construction projects may help or hinder human well-being. It is vital that examples of sustainablity should be given in various contexts including local, national and international levels to show its complexity but also to engage students with aspects of sustainability closer to their own region.

For environmental messages then, students should be encouraged to look at areas which have been degraded by poor construction or industrialisation and how this has affected natural life as well as whether the area is habitable for humans. For example, sutdents could write in their own words how environmental issues are exacerbated by the construction industry.

Economic messages on sustainability could be covered in modules such as materials costing. Students should be made aware of the price of resources but also how to consider reusing these resources elsewhere such as bathing water used to irrigate plants and so on. Also the pay-back period should be discussed. If a sustainable system is invested in, how long will it take before that investment makes returns and is able to show a profit?

8.1.2 Exploring Avenues for Change

The identification of modules into which to introduce educational interventions was carried out through an exploration of the current Built Environment curriculum at LJMU in the final year (equivalent to Level 6) modules. The reason for focusing on the final year modules was due in part to time constraints but also because the Joint Project is only offered to final year students which had been identified as a powerful avenue to elicit a change in attitudes. In effect however, focusing on the final year students and their attudes can be considered a pilot run for incorporating educational interventions throughout the degree at years one and two (equivalent to levels 4 and 5), if proven effective. Another argument for focusing on final years can be directly related to the end of their educational careers (for a vast majority of the students at least) therefore they may be thinking more about the type of construction professional industry is looking to hire and attempt to conform to a sustainability-minded job applicant.

The nine programmes that are offered in the School of the Built Environment in LJMU are:

Architectural Technology
Building Services Engingeering
Building Services Enginerring and Project Management
Building Surveying
Civil Engineering
Construction Management
Quantity Surveying
Real Estate Management
Real Estate Management and Business

Course diagrams were used to find out which modules students of each programme had to study. These were used to identify which modules were subject-specific, and which ones had shared commonalities with other programmes. Module proformas further clarified the assessment method and intended learning outcomes making some modules more favourable for implementing educational interventions whilst ruling others out. Out of the 45 modules that are taught at Level 6; a total of eight modules were identified as potential educational intervention mediums. These did not include civil engineering modules as they do not participate in the Joint Project.

Advanced Architectural Design Project

Business Management

Construction Site Management

Development Projects

Maintenance and Facilities Mangement

Project Management and Professional Practice

Quantity Surveying Technology Project

Sustainable Property

Table 24 shows which modules are shared by multiple programmes and which ones are programme specific.

Programme > **Module v**	*Architectural* Technology	*Building* Services Engingeering	*Building* Services Engineering and Project Management	*Building* Surveying	*Construction* Management	*Quantity* Surveying	*Real Estate* Management	Real Estate Management and Business
Advanced Architectural Design	X							
Business Management			X		X			X
Construction Site Management		X	X		X			
Development Projects							X	X
Maintenance and Facilities Management				X	X			X
Project Management and Professional Practice	X			X				
Quantity Surveying Technology Project						X		
Sustainable Property							X	

Table 24. Programme (column) and module (row) grid for Level 6 modules where sustainability session could be incorporated (Self-study)

8.2 What Academics Think

After the potential modules to prime students had been identified, the next point of call was to interview the Module and Programme Leaders (Appendix 6). The reason for interviewing both types of leader was to obtain their views on sustainability and how it could or should be implemented into the overall programme and compare these.

The questions that were asked are listed in table 25 (Appendix 7).

	Question	Who was question addressed to?
1.	What does the term sustainable/sustainable development mean to you?	Module and Programme Leaders
1a.	What are the key issues facing module in the next few years?	Module Leaders only
2.	What role, if any, do you feel the module/programme in general should play in acheiving sustainability?	Module and Programme Leaders
3.	What, if any barriers do you see preventing the module/programme from engaging in sustainability initiatives?	Module and Programme Leaders
4.	Do you think there are external factors which prevent sustanability being more prominent in the module/programme? (i.e. Curriculum/ University Policy/Professional body accreditation)	Module and Programme Leaders
5.	Do you foresee different barriers and challenges in the future?	Module and Programme Leaders
6.	Do you think the module/programme could advertise the sustainability component more prominently?	Module and Programme Leaders
7.	In what ways would you want to promote/include sustainability education in the module/programme?	Module and Programme Leaders
8.	Are sustainable messages embedded into the teaching material or is sustainability mentioned separately from the core aspects of the module/programme?	Module and Programme Leaders
9.	Do you think the promotion of sustainability in the construction industry (once students graduate) will be more likely to happen if the students have a transformative experience through educational interventions/increased sustainability knowledge while at university?	Module and Programme Leaders
10.	Is it likely that students would become more engaged learners and possibly gain positive sustainability/environmental attitudes if they had a more empathetic/emotional attachment to the environment?	Module and Programme Leaders
11.	What competencies would you want students in the module/programme to gain with regards to acting sustainably in the construction industry? Personal lives?	Module and Programme Leaders

Table 25. Interview schedule for programme and module leaders (Self-study)

The interview schedule was a culmination of several articles and issues which had been identified through the literature review. Questions such as 1, 1a, 2, 3 and 5 were adapted

from Wright's (2010) work on university presidents' thoughts on sustainability. Question 4 was adapted from Jones *et al.* (2008) who looked at embedding sustainability into higher education undergraduate programmes. Question 9 related specifically to the concept of transformational learning (Taylor, 2007). Questions 6, 7, and 8 are concepts which the researcher wanted to probe the module and programme leaders about whereas questions 10 and 11 related to transformative learning and environmental education that the researcher wanted to explore further.

The process of performing phenomenography was described in section 5.7.1 and was chosen because its origins lay in investigating learning among university students, although it has also been applied to understanding the experience of teaching; both of which are precisely what the current research intends to explore (Hasselgren and Beach, 1997; Mann *et al.*, 2007).

Although phenomenography is meant to be the collective experience (Loughland *et al.*, 2002) of respondents as opposed to individual representations of a phenomenon this analysis will be broken down into the collective voice of both module and programme leaders separately because the very nature of programme and module leaders is different. A final section will analyse and elaborate on the collective experience of teaching sustainability to the final year students at LJMU. In this instance, the type of phenomenography used will be discursive phenomenography (Hasselgren and Beach, 1997) because it is concerned with mapping general conceptions of the world, or in this case, teaching. Although the interviews were transcribed verbatim, anecdotes have been made more concise to extract their meaning more easily.

8.2.1 What Module Leaders Think

Six module leaders were interviewed. They ran the Advanced Architectural Design Project, Construction Site Management, Development Projects, Maintenance and Facilities Management, Project Management and Professional Practice, and Quantity Surveying Technology Project modules.

8.2.2 About Sustainability, Sustainable and Sustainable Development

When asked what they thought of when they heard the terms sustainable, sustainability and sustainable development, the Brundtland report was cited because *"everybody is aware of"* it and made mention as to how it relates to meeting the needs of the present as well as future generations *"I refer to the Brundtland commission thinking that*

sustainable development is about meeting the needs of the present without compromising the needs of future generations". This notion of considering future generations was reiterated by others whilst not making specific reference to the Brundtland report as such.

Module leaders made mention of the use, and preservation of resources *"within the context of construction industry therefore it's got to do with resources used in the construction industry and therefore the resources have to take into consideration future generatiosn, not only from a resource perspective but more importantly from an environmental impact on future generations"* while also refering to the need to minimise and eliminate waste. A majority of the module leaders mentioned the importance of social aspects and sustainable communities and how this related to future generations. Few mentioned end-users and occupiers of buildings and how the field of real estate covers the physical building and the use of it.

Out of all six interviewees, only one mentioned their own personal unsustainable practices and being in conflict with the need to impart sustainable knowledge onto the students as a part of core knowledge. It was this same module leader that was the only one to state that economic, social and environmental aspects were all important factors when considering sustainability. What became very apparent from these various renditions of what sustainability meant to academics was that they saw it in different ways (Faber *et al.,* 2005; Mann *et al.,* 2007; Murray, 2011). This was mentioned by a module leader who felt *that "sustainability really is pretty much an undefined term it means a lot of different things as you know to different people..."*

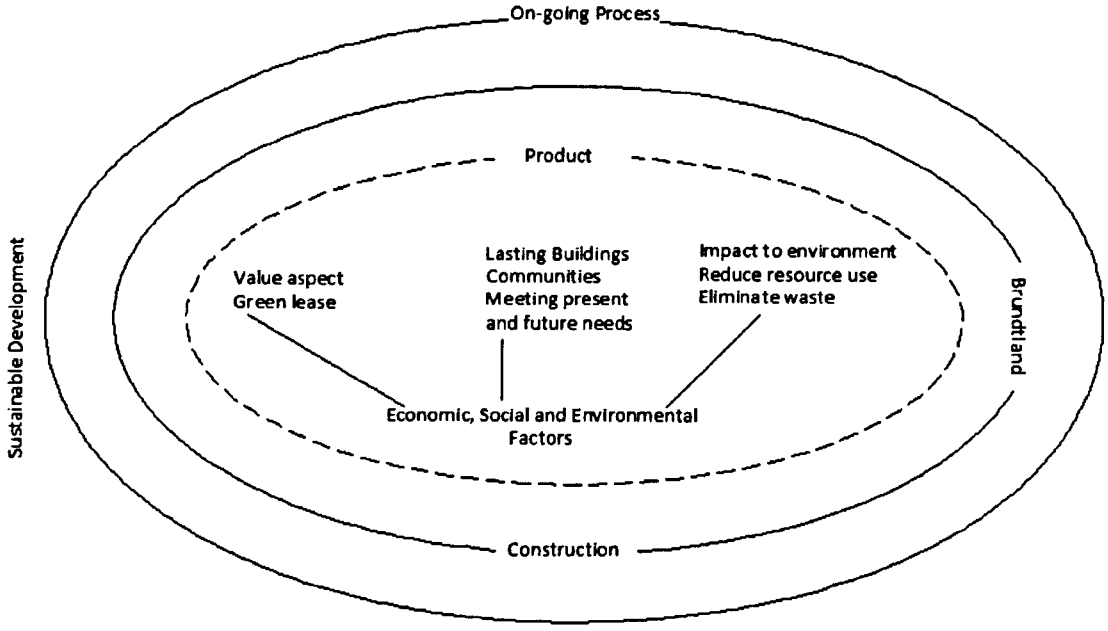


Figure 11. Module leaders' understanding of sustainability (Self-study)

The conceptual map of the module leaders' understanding of sustainability, and adjacent words, can be represented in an elliptical manner. This is because utterances made by the interviewees awareness surrounded the core topics of sustainability (Hasselgren and Beach, 1997). Although only one module leader mentioned economic, social and environmental aspects, the remaining module leaders gave examples of all of these areas to some extent which reinforced the fact that they were central to the way they saw and define sustainability themselves. On the whole, module leaders seemed to regard social and environmental aspects significant as these were uttered at various times. Environmental aspects were talked about as general impact on the environment, reducing the amount of waste as well as limiting the amount of energy used. Examples of social aspects involved the buildings themselves, as well as sustainable communities. Economic aspects were mentioned in relation to sustainable development linked in with value, and green leases. Most of the examples given related to construction or BUE practices as the module leaders chose to give examples relating to their fields.

8.2.3 Barriers Facing Module

Following their descriptions of what sustainability meant to them, the module leaders were asked if they thought their modules would face barriers in implementing sustainability. Only one module leader answered 'no'. The rest of the module leaders

believed that there would be barriers. These were listed to be:

1. the competition between sustainability information and the core information the module was meant to deliver
2. it was expressed that the emphasis placed on sustainability may be much more prominent than it actually is out in the construction industry
3. changes in legislation
4. meeting targets *"having to achieve certain levels of carbon reduction from codes...the barrier that there is at the moment is they don't think its achievable"*
5. economic factors: such as the recession and possible future recessions *"when the economy is in a good situation...they can take on factors such as sustainability a little bit more easily than when the economy is in not such a good situation"*
6. the knowledge and attitudes of both students *"how much information student have had when they arrive to undertake this project"* and practicing professionals: *"It could be that the younger people in the profession might be challenging the...more established...perceptions"*

8.2.4 Role of Module and Embedding of Sustainability Information

When asked what role they felt the the module had in achieving sustainability, four of the six module leaders said that it had a role and two respondents said that the module did not have a role. Of the four that said that the module had a role to play their justifications were as follows:

"...As well as lecturing here I'm a non-exec director of a construction business. Both of those, business and the industry really are still paying lip service to sustainability... if we could educate people a little bit more in Construction Management they would go out there and hopefully make a difference. ...A lot of the things that I teach in Construction Management are things that they need to know when they go out there, but also things that are modern thinking within contruction which have not yet been adopted by all companies. I try to explain to them... it's your industry so if you believe what I am saying and you understand what I am saying...then it's up to you to make a difference."

This module leader felt that it was important to impart personal experiences to the students to broaden their understanding of what is likely to happen in the construction industry.

"Thinking about introducing ... a new joint project within the QS section is to challenge the student with a sustainable development that will integrate not only sustainability but...an energy dimension and therefore challenging the student from the perspective of integrating alternative sources of energy in a development...therefore we try to find out how the student thinks about how to integrate alternative sources of energy in building."

This module leader also wanted to broaden the students' understanding of the types of aspects that the students should know when they conduct projects in their working life and to simulate the challenges that they are likely to face out in industry.

"Yeah it's just making sure that we have the time to become experts ourselves... It's a changing area [from the architectural point of view] *...that's such a major ask. We need to make sure that we instil that into students but at present at least we understand it well enough to be able to confidently teach."*

This particular academic felt that it was not only the module that had a role in achieving sustainability but the module leaders themselves as they have to be able to confidently and accurately teach the students the state of affairs at the time the module runs. If the academics themselves were not competent in the subject area this would lead to incorrect, or limited knoweldge being passed on to their students, thus hindering the successful implementation of sustainability practices in the industry.

Three of these module leaders mention the direct influence which the module and themselves as educators, have on imparting sustainability knowledge to students whereas the fourth one mentions the activities of the professional's role: *"Facilities Management is more about the operational aspects of the building's lifecycle...So it's prolonging its lifecycle... Facilities Managers are often left to pick up the pieces with a building, often when they are poorly designed, poorly constructed and they haven't taken into consideration how that will then operate in practice...".*

The other two module leaders were of the opinion that the module did not achieve sustainability because the module was designed to increase awareness of sustainable issues:

"I think its part of the...package of modules and at the end of the package of modules they should have a greater awareness on a range of factors... I don't think it [the module] *achieves sustainability, its going to achieve awareness however,which they can take into their professional career ".* This was agreed upon by the co-module leader who said: *"I would agree... I think it is a general awareness... one of the core themes running through the whole suite of programmes is...making sure we're current with industry. And if the students go out aware...that puts them...in a better position".*

Although these two module leaders seemingly disagree with the achievability of sustainability through the module, the sense of awareness and knowledge is still shared by at least five of the module leaders who mention certain things which they would want the students to be aware of and to be prepared for when they enter the construction industry as professionals.

When the interview turned to the module leaders' thoughts as to whether they felt the information regarding sustainability was embedded within the module or mentioned as a side note to the core skills, their answers revealed that only two out of the six respondents believed that it was embedded *"...the Architectural Technology is only new so I suppose its only really bedding in to start with...It's maybe the way it* [sustainability] *is taught in terms of we talk about it but I suppose to some extent I wonder whether we just talk about it as a bolt-on extra every class."* This module leader also expressed that it is extremely important that the students learn the basic core skills of their profession otherwise there is no point in teaching them to be sustainable professionals if they cannot produce the expected work itself. The module leader then raised the concern that *"there's a bit of an issue as to, where it should sit within the course".*

Professional bodies do little in helping to answer this question of where in the module sustainability information should be embedded. This is reflected by the QAA which stated what skills and knowledge Architectural Technology graduates should possess, however it gives very vague and generic guidance as to how this should be done: "The nature of the programme of study and content will reflect the character of the individual higher education institution and each is encouraged to explore innovative and stimulating methods of achieving the intended learning outcomes" (QAA, 2007, p. 8). Therefore in a programme that is meant to address topics such as design procedures, technology, procurement and contracts as well as professional practice, it is essentially up to the

programme and module leaders to negotiate the appropriateness of sustainabilty information into the teaching.

One module leader chose to answer the question more from an assessment point of view as opposed to what is directly in the module: *"the assessment is geared towards students creating what we call a request for proposal...and I've given sustainability a specific example within that about how they can maybe, you know, take these generic delivery of these services even further and bring in sustainable elements"* from this it is therefore unclear whether the module leader intends for the students to learn about sustainability aspects which are relevant to this assignment on their own or if there is some mention about it in the module lectures to introduce students to the subject before taking on any further reading in their own time.

The remaining module leaders believed that sustainability is mentioned as a side note to the core skills; one such example is *"... within Professional Practice* [module], *sustainability has not been something at the forefront of my mind when I've developed the content. ...maybe that's something that I've overlooked or maybe it's OK not to have it in there as much ...it's like an undertone to some of the key themes like organisational strategy...organisational culture...it may feed in a little but it's not as prominent."*

As the example from the QAA demonstrates, listing the skills and knowledge needed is easy, but suggesting how it should be implemented is not specified. This is therefore reflected in the mixed opinions and practices between module leaders, as with some modules sustainability is incorporated, whereas in others it is an additional topic that needs to be covered.

8.2.5 Advertisement

With regard to the prominent advertisement of sustainability which is embedded in BUE modules to both prospective students and current students, responses included: *"No I don't think we prominently* [advertise at open days]*...I would be confident as programme manager [and module leader] to say that we truly are...teaching sustainable design... because* LJMU *are very leading edge in terms of concrete design...we've got a high profile in the area... ".* Although this module leader was honest about the level of advertisement about sustainability to students, they were confident that it was strongly engrained in the modules and programmes, but not made blatantly obvious. Conversely only one

academic felt that it was not the module's duty to advertise sustainability: *"it needs to be in the programme".*

The remaining responses went on to explain how sustainability was included to meet learning outcomes and general teaching content:

"The way the module is developed in terms of learning outcomes and learning objectives, sustainability fits in with the concern for sustainable development project and environmental project."

"Well the module's got a learning outcome which is quite explicit."

"I think it's an element within the module, it's not the key driver..."

"I think in the FM module we are looking at it more because we're looking at the whole lifecycle of the building...in the Professional practice module, not so much, but at least there are elements relating to sustainability."

These quotes would then suggest that there is a limited amount of sustainabilty being advertised to prospective students and that there may be indirect advertising of sustainability to current students, as specified by the learning outcomes for the modules.

8.2.6 Transformational Experience and Emotional Attachment

When module leaders were asked whether they thought a transformational learning experience would be essential in changing students' attitudes towards sustainability, five of the module leaders answered yes. One module leader did not answer. Those that answered offered responses which suggested that academics were speculating that a transformational experience might be a good forerunner to embracing sustainability *"it would obviously have more of an impact if you suddenly changed your perceptions about sustainability, it may have a bigger impact but that's a tricky one to answer really"* others were more adamant that transformational experiences were beneficial: *"I'm absolutely positive because I've already seen it happen in a number of initiatives for the last couple of years. Just individual initiatives from staff and students who are looking for challenges in terms of their overall research project and their dissertation".*

Some remained realistic however, saying that transformational experiences would be different for everyone, and might only occur within small numbers of students *"even if it's*

just a small number you know that a small number is replicated on RICS courses across the country...".

Dirkx (1998) stated that transformative educators do not teach content that is much different from instrumentally-oriented educators, they simply use different teaching strategies and have a different goal in mind. Therefore it isn't so much what is being taught to the students, but justifying what it is that is being said to them: *"you've got to explain to people why you are saying what you are saying and you have to have facts so they can actually see what ... you're talking about...if you give them those examples then normally it gels... ".*

The reason why the module leaders might not have been able to answer this question with complete certainty could be because students may not be upfront with all their lecturers about changes in their perspectives towards sustainability. The sheer number of students per module leader is very high therefore students may feel that they can deal with the transformational experience on their own. Moore (2005c) wrote that the aim of transformational learning is to change one's assumptions and ways of interpreting experience by critical self-reflection. Such a process can lead students to 'grieve' for their old self and be confused and possibly even exasperated by the new self. Academics should therefore create a learning environment which encourages self reflection so that the students can be empowered to change their attitudes (Moore 2005c).

Two module leaders said that students having an emotional attachment to nature would not be more likely to consider sustainability issues than those who didn't have this attachment to nature: *"Don't personally see how that would make a difference."* The remaining four module leaders were unsure of its impact and alluded that the content, delivery of material and organisational culture were more influential factors than personality:

"I think in either case it's the way that the material is delivered to them and the application of the material so in both cases if they can see tangible application of these theories and concepts of sustainability...if they see that it's engrained within codes of conducts or...big professional strategies...then you know they can see the benefits of that"

"...trying different ways of learning should develop different attitudes...it's going to ...depend a lot on individuals"

"We would hope that they become engaged by the way that the module is delivered and gain a greater awareness."

"Yeah, yeah I do...having BREEAM excellent rating or outstanding will influence their marketability...So whether or not the student has got a personal interest... but actually from a practicing point of view they haveve no option...that will be the way of life - irrelevant of what their personal opinion is".

One module leader believed that teaching students about sustainable issues earlier on would influence students' attachment to the environment: *"you can go back earlier in teaching or training programmes for kids. The more they're in contact with nature...the more aware they will be of what's going on around different places...of the world".*

8.2.7 Competencies

Module leaders reported that knowledge and awareness were the competencies that they most wanted the students to take away from the modules which they teach. The knowledge they wanted the students to have, ranged from understanding current legislation *"...knowledge of the key targets, key legislation within the industry",* technologies, design principles, drivers that influence construction *"the state of technology at the minute and design at the minute to be able to meet these targets"* and monetary implications of applying sustainability into construction practices*: "One thing we need to make sure is that we can show the industry that operating sustainably can still make a profit and that sustainability doesn't come as an extra cost, because in the end the most important factor is how much money they are going to make."*

When asked if the module leaders wanted the students to develop sustainable competencies in their personal lives, only one person responded*: "I don't think it our role to impact their personal lives...I think we should be professional."* Perhaps the reason for this opinion was that as it is a professional degree, module leaders should be encouraging professional competencies. Another reason could be that because the construction industry in the UK alone produces 30-50% of all waste (Raynsford, 1999; Alkhaddar *et al.,* 2012) it would be more important as a higher education institution to pass on professional skills rather than personal ones.

8.3 What Programme Leaders Think

Five programme leaders were interviewed. They oversaw the undergraduate Building Services Engineering, Building Surveying, Construction Management, Quantity Surveying, Real Estate Management [and Business] programmes.

8.3.1 About Sustainability and Sustainable Development

Generally programme leaders expressed their understanding of the definition of sustainability through three categories, these were theoretical, operational and knowledge definitions. Theoretical definitions of sustainability were expressed by citing the Brudtland report *"the Brundtland definition is so familiar that it is probably the first thought when SD* [sustainable development] *is mentioned"* and mentioning the safeguarding of resources for future generations: *"safeguarding existing resources and making the best use of our existing resources... for the future"*. One programme leader went further by stating that sustainability was an umbrella term for anything related to environmental protection.

Operational definitions of sustainability were mentioned as opportunities to have economic benefits either through the creation of new industries, access to new markets or lucrative assets *"longevity of not just the construction or the techniques or the processes means a sustainable asset which will endure through its occupation, its development, and ability to have an economic return..."*. Other ways in which sustainabiliy was defined by programme leaders was by *"looking at sustainable procurements and how we get our buildings. So I'm looking at it from the raw material to the end user, so it's looking at sustainability over its lifecycle, not just a design aspect"*.

Knowledge definitions of sustainability were only mentioned by a programme leader who hoped that people would use current knowledge to make good decisions *"to ensure that decisions for today are made in a proper way that do not jeopardize the aspect of survival for the future generations"*.

8.3.2 Barriers Facing Programme

Similarly to the module leaders, only one programme leader felt there would be no barriers. The types of barriers that were articulated ranged from funding issues *"I don't think anybody external would want us not to inform students...funding...could be a barrier"*, to equipment and the challenges that the students will have to deal with in their

professional lives such as protecting the environment while making a profit *"Building Surveying students have to understand that their decisions have a commercial effect as well as an environmental one. So that's always the barrier in the challenge between the two."* Progamme leaders felt that student understanding could be a barrier as *"at the moment sustainability is just seen as a marketing tool and therefore the barrier with our students is making them see the link that sustainability has for enhanced asset value and improved growth in rentals and capital".*

Only one module leader felt that there would be no barriers facing the programme: *"No I don't think so to be honest".*

8.3.3 Role of Programme and Embedding of Sustainability Information

All five of the module leaders unanimously agreed that the programme did have a role in achieving sustainability. Their reasoning for this was that the students should be able to learn from competent lecturers, yet this can become difficult when lecturers teach various topics rather than know one area extremely well:

"I think we are the interface between the student and the industry. The student needs to be informed about developments in technologies and new technologies, so when discussing the new technologies and talking about legislation, we need to be on top of our game. And so for me one of the big problems would be making sure that we have the time to do the research...we're all spread and our knowledge is broad rather than deep but we want students to leave here with the right skills and the appropriate and up to date knowledge."

It was deemed important that the programme imparts the students with the understanding of the implications construction processes have as well as what needs to be considered with the upkeep of existing buildings.

"So when you consider that for as long as they are part and parcel of the consumption chain you will need to ensure that they are aware of the implications of poor decisions... especially uptake of raw resources as opposed to protecting the raw resources".

"I think the Real Estate side has a very big part to play because I don't think we fully appreciate what sustainability means...we don't realise that a building can be built sustainable, but not remain sustainable and therefore it's our job, in the Real Estate side and particularly for Real Estate education to make them understand that sustainability is

about how we use, how we occupy, how we manage and how we regulate our property once it's built...So therefore sustainability must start in buildings which are already here and it's how we use, how we occupy and how we maintain those buildings which is going to create the sustainability which is going to keep the BREEAM excellent, which is going to keep the LEED score".

"Building Surveyors are concerned largely with existing buildings. Existing buildings already have an embodied energy and the use, maintenance and conservation of existing buildings is environmentally sustainable as opposed to the alternative which is the demolition of old existing buildings and their replacement with new buildings".

One programme leader felt that the role of the programme was to impart *"theoretical and practical implications of sustainable development. The programme should aim to become a leader in these areas".*

Regarding whether programme leaders felt sustainability information was embedded into the programme or was a side note, four out of the five programme leaders thought that it was embedded but sentiments arose that it did not necessarily have to be everywhere:

"You're going to have to be careful to be able to embed sustainability into everything. There are certain things where it would be obvious, there are certain things where it won't be...as a tutor you are going to have to play the role of the motivator, showing them the way...it may not be obvious and should not be obvious in every subject."

Another programme leader said that they had both specific and broad knowledge so that the students could get appreciation for information in both ways.

"Obviously in Real Estate Management it isn't done in a relevant context because it's done with a bespoke sustainability module. I would say with Estate Management Business yes it is touched upon much in a much more relevant because it's in construction, it's in planning. In both courses it's also referred to as side issues...So I think they get both really."

In general terms, others felt that sustainability should *"be mentioned, it's part of every module... I think now it's much better because everyone has a lecture on sustainable aspects of whatever it is."*

Two other programme leaders expressed that sustainability as a theme was ever present in the programmes, and that it was most definitely embedded. *"Instead of using the word*

embedded it might be more appropraite to say that it runs through all the programmes at different levels".

"The idea is to embed sustainability into the core curriculum so that when...students are considering various construction techniques they would always take into account feasibility and sustainability."

8.3.4 Advertisement

In terms of advertising the sustainability element which is present in the various courses that LJMU offers some academics said that it was not as apparent or emphasised in undergraduate courses as it was in masters courses *"...so in the undergraduate it isn't, in the masters it is?"*

Another said that advertisement was more prominent in some courses than *others "so for the Real Estate Business it's not really pushed to them as much...Real Estate Management there is a bespoke module all about sustainability".*

One programme leader said that it was very prominent in the final year courses *"it really is a core theme at level six."* This was supported by another academic who felt that students and the general public are interested in sustainability topics; therefore advertisement should reflect this.

8.3.5 Transformational Experience and Emotional Attachment

Three of the programme leaders felt that transformational learning experiences would lead to a change in attitude by the students.The way in which programme leaders mentioned that transformational learning could occur by taking students to site visits *"...if you give a student an idea, lets say we take them to BRE and they see how these houses are operating...you sow the seeds, those seeds will eventually get back into industry..." "is important...the students are going to visit the BRE Innovations Centre at Watford. Looking specifically at..the promotion and trying to give the students some sort of experience in sustainability. In other words, trying to broaden their knowledge of this particular matter".* Programme leaders said that practising professionals sometimes come in and talk to students about sustainability from a practical perspective *"we try to bring in people from industry to help them understand and to see the application of a theory in Waste Management, in planning, in things like that".*

One academic rightly stated that students will experience transformational learning from different experiences and that it may not necessarily be up to the educator to dictate what will be a trasnformational learning experience: *"I think a transformational*

experience is very personal to the individual and I think people will come out of it with different experiences and therefore what you think is a transformational experience for the class is actually only related to one person...".

The remaining two said that a transformational learning experience would not make a difference to students attitudes regarding sustainability.

When asked about a students emotional attachment to the environment and whether that would affect their likelihood to consider sustainability, four programme leaders said yes as *"there are many people who are very environmentally aware who would readily adopt sustainability measures but there are others who could be persuaded to adopt various sustainability initiatives if one could prove these would add, for example, commercial benefits or financial viability"* one programme leader was unsure saying: *"well I think it depends on the person because some people are not going to be influenced by what we say. If they're not interested in the environment it doesn't really matter what we say. It's down to personalities...it would impact on some but not all".*

Additional comments made about the kind of influence a student's emotions would have on learning about sustainability were: *"I think yes they are more receptive to taking on board the concepts and the workings of sustainability practices. They are the converted and they will take on sustainability through education will carry that on throughout their education." "Interest plays a very important role...If you are interested in something you go and learn about it."*

8.3.6 Competencies

The programme leaders' answers seemed to fall into two groups: knowledge and understanding and personal skills. Being able to understand and be aware of current legislation, technology, and economic implications were mentioned by programme leaders. Personal skills that were expressed included leadership and *"the ability to communicate and communicate effectively and that goes from orally and written communication and it's also the ability to analyse information, to question information so that you can arrive at a reason to the conclusion... you have to have an enquiring mind, you have to look into things and decide you know, what the benefits, what the weakness is... . ... have the confidence to deal with people... they've got to be a team player... to be that rounded person."*

One programme leader went into detail more about the personal competencies they wished students to go away with which were the *"use of technology and PV panels, solar panels, ground source/air source heat pumps...rainwater recycling's another one...obviously cutting down on unnecessary travel."* In terms of professional competencies all that was said was *"I don't know of any other competencies specifically in sustainability other than studying for a degree in terms of...any specific other qualifications of programmes that build on sustainability".* Despite this discrepancy of stating personal rather than professional competencies as the rest of the programme leaders, it is implied that the students should possess knowledge of these technologies which is still in line contextually with what the rest have said.

8.4 Phenomenographic Analysis of LJMU Academics

8.4.1 What LJMU Academics consider Sustainable, Sustainability and Sustainable Development to be

The following sections will describe the categories and their relations to one another which is known as the outcome space of the research (Loughland *et al.,* 2002; Mann *et al.,* 2007). Combining the groups from both the module and programme leaders gives the following diagram which represents LJMU academics' understanding of what sustainability is (Kokkarinen and Cotgrave, 2012):

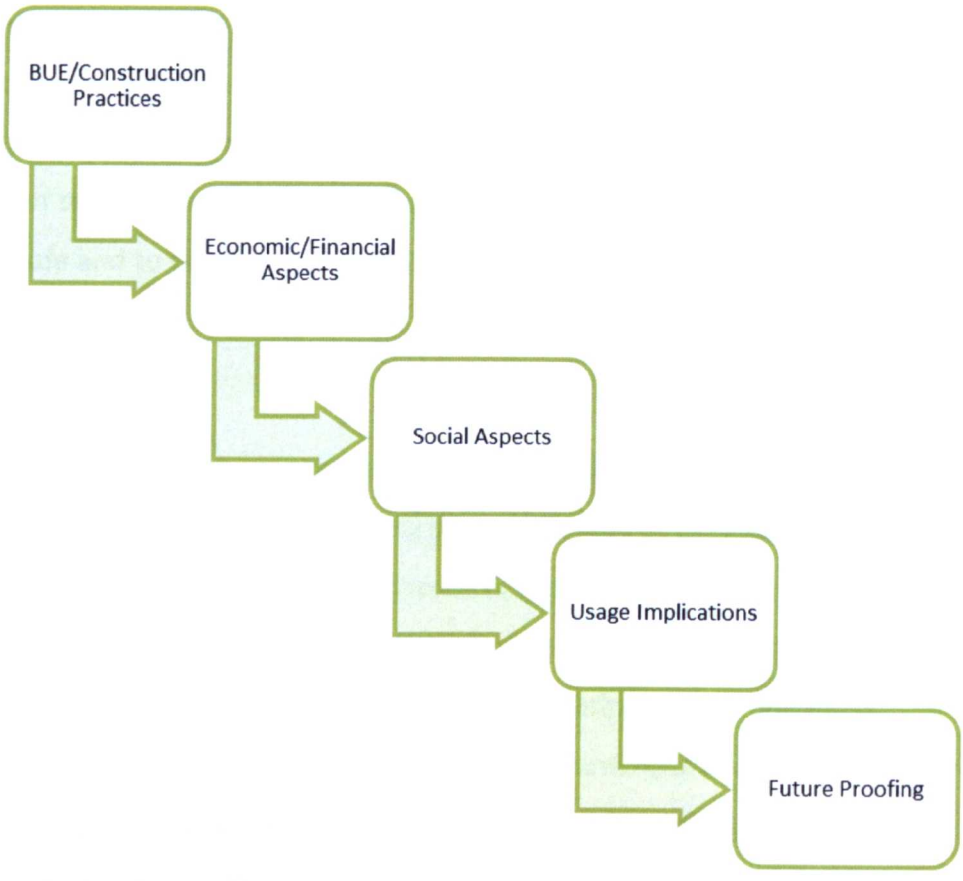


Figure 12. The Hierarchy of categories relating to Academics' perception of sustainability.

Built Environment and Construction Practices:

The context within which the interviewed participants understood sustainability was through construction practices and wider BUE aspects. This is not surprising because the interviewees all lecture on BUE courses. This topic was the one uttered the most times and could be interpreted that the knowledge they impart to the students is based on these principles *" it means inception of an idea, and planning it and building it and then maintaining it... building will last and be pleasant for people to use". "...means longevity of not just the construction or the techniques of the processes. It means a sustainable asset which will endure through its occupation".*

Economic and Financial Aspects:

Respondents expressed their beliefs that sustainability would lead to improved assets either by gaining access to new economies or develop new industries. *"Asset... ability to have an economic return for a long period of time".*

Social Aspects:

Social aspects were regarded as important because most of what the construction industry produces are buildings that are to be occupied by people. Therefore there needs to be enough of them such as *"sustainable communities"* by which the area where the building is, is safe and to be able to construct long lasting buildings which are pleasant to use.

Usage Implications:

Central to sustainability are three aspects: economic, environmental and social. This concept was reiterated in the understanding of interviewees as they gave examples of what their respective BUE field could experience as sustainable. Such things included minimising the use of resources, or saving them for future generations. It was implied that sustainability was an umbrella term for anything relating to environmental protection. However when further immersing into the transcripts this implication about resource use, energy consumption related to economic and social aspects as well. *"Safeguarding our existing resources and making the best use of our existing natural resources for the future". "Has longevity in relation to economic and functional use".*

Future Proofing:

The fifth category which emerged from the interviews was that of future proofing. The Brundtland report was mentioned which seeks to ensure that present and future generations have their needs met. This was also expressed by other respondents but they did not call it by the report's name. Terms such as 'longevity' resonates with this category as it was mentioned several times that buildings should last a long time. An implicit concern became evident from the interview transcripts as the amount of knowledge to be able to make appropriate decisions was expressed. With more information sustainability would improve values and parameters.

The hierarchy of these categories firstly reflects that all of the interviewees think about sustainability in terms of their primary role- as BUE practitioners/educators. From the time that they have learned the core skills of their given topic areas, they have picked up sustainability knowledge and have internalized it in a way which could be practised in their fields. Category 2 in summary is that LJMU lecturers see sustainability as a possibility to enhance the financial or economic status of the construction industry either by entering new markers or adding value to property. Category 3 relates to the social aspects

as they are a product of sustainability being achieved as whatever is constructed, such as buildings or offices, needs to benefit its occupants and society at large. They should serve a purpose. Environmental aspects were mentioned in a specific way: resource use (Category 4). The fifth category as how lecturers understand sustainability can be summarised as future proofing. Buildings that are constructed need to reflect sustainable know-how. Knowledge must be used to make the correct decision for the relatively immediate benefit of present generations but also endure for the use and benefit of future generations.

The inspiration for work conducted by Mann *et al.* (2007) was that there is no commonly agreed understanding of what sustainable design means. They argued that a reason for that was that people's understanding is influenced by their own background, work experience, previous training and their views on political and economic aspects. This sentiment is shared with the current analysis of what LJMU academics experienced sustainable development and its adjacent terms to be.

8.4.2 Barriers Faced

Module leaders uttered more possible barriers such as the possible culture shock students may experience between education and industry as sustainability may be emphasized more in academia than in the industry. An explanation as to why module leaders could have come up with more barriers is because they teach specific areas, whereas programme leaders oversee the entire course, therefore may only see barriers in a broad sense. Despite these differences, knowledge seemed to be a potential barrier. *"How much information students have had when they arrive to undertake this project"* and where will students' sustainability knowledge fit in professional practice: *"It could be that the younger people in the profession might be challenging the...more established...perceptions."*

On the whole however, economic factors were considered quite a barrier amongst all academics. These included funding, understanding financial return and its associations with sustainability and environmental protection. *"At the moment sustainability is just seen as a marketing tool and therefore the barrier with our students is making them see the link that sustainability has for enhanced asset value and improved growth in rentals and capital." "Building Surveying students have to understand that their decisions have a*

commercial effect as well as an environmental one. So that's always the barrier in the challenge between the two." These two main barriers are illustrated below.

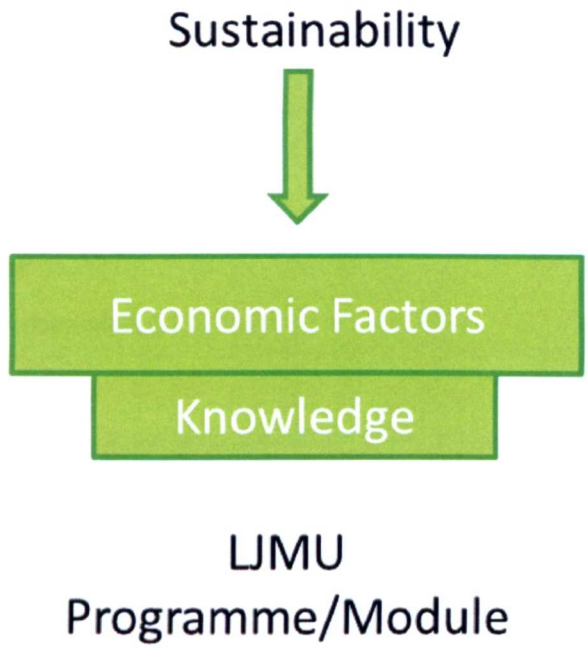


Figure 13. The two main barriers facing LJMU programmes and modules regarding the incorporation of sustainability.

8.4.3 Role in Achieving Sustainability and Embedding Information

On the whole, a majority of the eleven respondents said that the programme or module as a whole had a part to play in achieving sustainability while only two of the respondents disagreed, citing that the role is to promote awareness. More than half of the respondents believed that sustainability information was embedded into the programme or module, whereas four expressed that often the information was mentioned as a side note, not specifically linking it in concretely with core skills.

"...A lot of the things that I teach in Construction Management, I am teaching them things that a) they need to know when they go out there but also things that are modern thinking within construction which are not thought by all...companies, not used by all companies and trying to explain to them...it's your, it will be your industry so if you believe what I am saying and you understand what I am saying...then make a difference."

In their literature review Mann *et al.* (2007) also found that sustainable education at university level was seen as an add-on to engineering courses. Therefore the reason why

academics were asked about whether they thought sustainability information was embedded into the modules and programmes or if it was mentioned as a side note alongside the core skills was because the researcher wanted to compare the efforts of LJMU with the Australian universities which are in the process of embedding sustainability information into their engineering courses.

8.4.4 Advertisement

Advertisement of sustainability was a topic that divided the interviewees. Out of the eleven academics that were asked, five believed that the sustainability component is advertised prominently to both prospective and current students while the remaining six said that it was not advertised simply for the reason that it is challenging to do so: *"I don't know how you would do that...within the construction course you cannot promote sustainability alone and leave out the other core elements."*

On a modular level academics were quite adamant that sustainability was an integral part of the module: *" in terms of learning outcomes and learning objectives, then it'll fit within the concern for sustainable development project and environmental project." "Well the module's got a learning outcome which is quite explicit." "I think it's an element within the module, it's not the key driver..."* It is possible that rather than making it clear that sustainability is a part of the courses and modules that are taught, academics want to promote the variety of skills that the students will learn, therefore sustainability, even if not specifically cited, is a part of those skills.

8.4.5 Transformational Experience and Emotional Attachment

Eight out of eleven academics felt that a transformational experience would promote student learning, while two said no and one did not answer. *"I'm absolutely positive because I've already seen it happen in a number of initiatives for the last couple of years. Just individual initiatives from staff and students who are looking for challenges in terms of their overall research project and their dissertation".*

Although only one academic mentioned a clear example of transformational experiences happening to students because they had seen it first hand, others described the kinds of

methods they were using in order to promote transformational experiences such as taking them on site visits and guest lectures from practising professionals.

"We try to bring in people from industry to help them understand and to see the application of a theory in waste management, in planning, in things like that".

"Yes, yes that is important...the students are going to visit the BRE Innovations Centre at Watford. Looking specifically at the promotion and trying to give the students some sort of experience in sustainability. In other words, trying to broaden their knowledge of this particular matter".

"...if you give a student an idea, let's say we take them to BRE and they see how these houses are operating...you sow the seeds, those seeds will eventually get back into industry..."

"I'm sure the students will respond in different ways... But even if it's just a small number you know that small number is replicated on RICS courses across the country..."

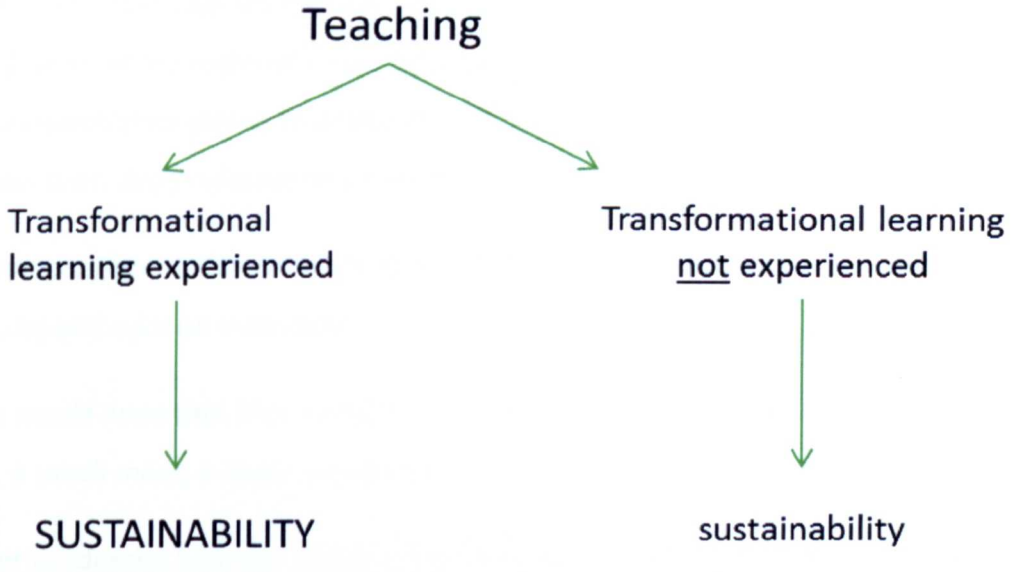


Figure 14. Diagramatic representation of how sustainability may be viewed following a transformational learning experience

Figure 14 above represents how students who experience transformational learning may view sustainability as more important than those who did not experience transformational learning because they have only gained more awareness rather than experiencing a shift in perspective.

The usefulness of an emotional attachment to nature was one that the academics saw in one of three ways; teaching material, professional constraints and interest. Four academics said that an emotional attachment would make students more likely to engage with sustainability information. Two said no and five said maybe.

Of those academics who viewed that an emotional attachment to nature would be the result of interest saw it in opposing ways. Some believe it would not *"make a difference"* possibly because students have to achieve a certain level of knowledge outlined in the learning outcomes which are reflected in student marks. On the other hand then, academics felt that both the emotional attachment and *"interest plays a very important role...If you are interested in something you go and learn from it"* therefore it being not so much about what the lecturers teach, but what the student wants to find out.

Academics that were unsure about students' emotional attachment having an effect hoped that the material and methods of teaching would engage them, rather than personal traits:

"I think in either case it's the way that the material is delivered to them and the application of the material so in both cases if they can see tangible application of these theories and concepts of sustainability...if they see that it's engrained within codes of conducts or...big professional strategies...then you know they can see the benefits of that."

"...trying different ways of learning should develop different attitudes...it's going to ...depend a lot on individuals"

"We would hope that they become engaged in a way that the module's delivered...have this, a much more, a greater awareness."

Other academics believed that it would be professional constraints that impact the acknowledgement and practice of sustainability rather than students' own attitudes towards it.

"Yeah, yeah I do...having BREEAM 'excellent' rating or 'outstanding' whatever will influence their marketability...So whether or not the student has got a personal interest... but actually from a practicing point of view they've no option...that will be the way of life you know and really irrelevant what their personal opinion..."

"Well I've no actual evidence... I would imagine so but I mean there are many people that's very environmentally friendly that would easily adopt sustainability measures but there are other people that you could persuade to adopt various sustainability initiatives if one could prove they'd add for example commercial benefits or it became financially viable."

8.4.6 Competencies

Overall, the analysis produced three general competence categories academics wished their students would acquire. These were knowledge/awareness, personal skills and money/economic factors (Kokkarinen and Cotgrave, 2012). The knowledge/awareness category is quite a broad one as is covers the knowledge and awareness students should have *regarding "current directives, legislation, restrictions, developments in...construction technology. I would like them to be as well informed as they possibly can be..."*. This category also related to *"practical understanding of renewables"*.

The personal skills condensed from the academics expressing that they would wish that students challenge information that is presented to them, to have an enquiring mind, possess leadership and to be confident whilst both communicating and dealing with others. *"...go out there being reasonably competent to say to look at a particular project and say 'Oh yeah I remember that's the way it's done, but there is also a different way so why?' and challenge it really."* Another quality which the academics wished would emerge is adaptability as *" ...students should be able to have fundamental regulations and rules of how things work. ...to be able to see 'this is what the client wants, this is what we can do' other than being so rigid. But they have to be rigid first to get their fundamentals then they need to actually be able to adapt". "the ability to communicate and communicate effectively both orally and in written communication... you have to have an enquiring mind ... have the confidence to deal with people... they've got to be a team player".*

Lastly, the money/economic factors competence category appears to be a central one as through knowledge and understanding accumulated from formal education as well as future interactions with colleagues and clients may help reap financial benefits *"operating sustainably... can still make profit...it doesn't come at an extra cost. So as long as we say 'This course of action is not necessarily going to increase our overall cost' because at the end of the day it all boils down to how much money you are going to make". "Having the*

competency to understand enough about the sustainable issues in construction, where we waste money now and how we can over come that." "Within the understanding of economic viability, the sort of sustainable economic issues."

As was mentioned in the individual analyses of both the module and programme leaders, there were few responses regarding the students' personal competences. "*I don't think it's our role to impact their personal lives...I think we should be professional.*" Throughout the entire analysis it was the quote above, and that of a programme leader which addressed personal lives. The latter saying that it isn't an academic's role to create personal competencies, while the former saying that in one's personal life the "*use of technology and PV panels, solar panels, ground source/air source heat pumps...rainwater recycling's another one...obviously cutting down on unnecessary travels*" could be implemented. Although these are opposing opinions on the same matter, they both still relate to construction practices, albeit one on a smaller rather than industrial scale. These statements link back to the categories of description of academics' understanding of sustainability as the competencies relate directly to the construction skills students will need to use once they become practitioners.

This chapter has mentioned the work of other researchers who have also conducted phenomenographic analysis when exploring sustainability education. Reid and Petocz (2006) also published work specifically relating to academics' understanding of sustainability and how to integrate it into their lesson plans. Their research however focused on academics who were not from the environmental science disciplines and even one of their conclusions was that their conceptions and experiences of sustainability differed greatly from the conceptions and experiences which lecturers who are familiar with sustainability have expressed. Their work is nonetheless valid as Reid and Petocz (2006) attempted to broaden the sustainability agenda throughout various disciplines in the hopes of achieving a sustainable curriculum.

The interviews with LJMU academics gave an opportunity to discuss, particularly with the module leaders, how best to implement the educational priming sessions into the existing learning outcomes. These priming sessions were envisaged to lend the project an experimental dimension to see whether students in certain modules would be able to assimilate and make links presented in a sustainability oriented session to the overall aim of the Joint project.

9. Choosing Educational Interventions

9.1 Overview of Educational Interventions

When reviewing existing literature regarding what is done in education to promote learning and skill development a considerable number of publications promote transformational learning (Jones *et al.*, 2008; Fortuin and Bush, 2010; Mochizuki and Fadeeva, 2010) in their courses. Taylor (2007, p. 174) added that a good learning process "needs to give greater attention to: the role of context, the varying nature of the catalysts of transformative learning, the increased role of other ways of knowing, the importance of relationships and an overall broadening of the definitional outcome of a perspective transformation". Students would be able to deeply reflect on the information which they accumulate throughout the course to be able to make appropriate sustainable choices. Examples from various subject areas are discussed to show the educational variation that takes place. It must be noted of course that some are more indicative than prescriptive which is largely due to the skill set that the students are required to have in their future professions.

In terms of the synopses below, some of the authors seemed to suggest that hands-on experience is the best way to teach. Entwistle and Tomlinson (2007) judge that universities do not offer enough chances for students to experience collaborative, team-based learning activities. The Joint Project which Liverpool John Moores offers in semester 2 of each academic year is one such opportunity in which students are able to collaborate with final year students in different programmes and take part in team-based learning activities. Therefore measuring students' attitudes while they are involved in a group project seems ideal. To get more of a hands-on approach the students could of course choose to go on a sandwich course for 12 months where they work in an organisation. This second option is also available to LJMU students but it is entirely up to the students if they are interested in participating and may be less likely to happen if the economic climate is not good.

Marton (2007) made reference to the education of medical students which shows that it is important to compare and contrast the various educational methods which are used to educate future professionals in any field.

Kerby, Shukur and Shalhoub (2011) assessed what professional anatomists thought was

the best method of teaching medical students. In their assessment it was found out that professionals felt dissection was the preferred method of teaching whilst other methods were proposed by the medical students themselves. Although dissection is a very relevant method to practice for future medics, a similar sort of technique should be found for construction students- one that is fit for purpose. One could conduct research by asking construction professionals what they think is an effective skill or expierience students should have and see if students felt that was appropriate.

Branch and Paranjape (2002) posited that feedback and personal reflection are also vital parts of the learning process in medical settings, but this can be generalised to many, if not all, learning situations. Getting feedback from peers or superiors would enable a student to build their skills up and adjust their behaviours and performance accordingly. Learners should also take time to reflect on feedback given to them and monitor their own performance or skill sets as well as to be able to psychologically grow as an individual. Another option would be to ask current students in construction programmes whether they felt that the feedback that they are given on coursework and field work was enough for them to improve upon at a later date.

Kerfoot, DeWolf, Masser, Church and Federman (2007) researched the effect of spaced education in urology students. Specifically in areas such as medicine, topics that are learned should be retained and understood in depth as opposed to merely memorising facts. Therefore the educational process itself would need to be customised so that deep learning could be achieved. Kerfoot *et al.* (2007) therefore used principles of the spacing effect to see whether introducing urology students to something and repeating the information over time resulted in improved learning. What they found out was that spaced education did show an improvement in students' learning but important questions such as what is the optimal spacing time remain. Pedagogical approaches such as this could easily be adapted to construction related subjects at tertiary education level but a main barrier for achieving this could be the time constraints the programmes are under to cover all areas that professional bodies have set out.

Andrews, Biles and Taylor (2009) looked at the effectiveness of scenario-based learning. Not only does scenario-based learning promote the development of other skills such as communication, leadership and team work, it also encourages deep learning to occur as knowledge is consolidated through repeated and progressive exercises. This again goes

back to the notion of transformational learning as students are encouraged to reflect on their own performance, progress and identify their own training needs. Activities such as this could be easily tailored to fit the needs of construction students to not only equip them with the knowledge but also the appropriate skills set that they will require upon entering the construction industry.

While this first section has reviewed the teaching methods that are available to medical students, the following will evaluate environmental education and education for sustainable development in university curricula. Sahlberg and Oldroyd (2010) aim to promote environmental education by teaching students to "think outside the box" to endorse the convergence of economic development in conjunction with notions of environmental preservation. The authors posit that it is not enough to simply teach students about environmental issues; they need to be taught soft skills such as leadership, communucation and presentation skills so as to strengthen their worth in terms of *social capital* (as discussed in chapter 2.1.5.1).

Murray and Murray (2007) promoted a form of learning which is centred upon enquiry rather than the outcome called Enquiry Based Learning (EBL). The aim of EBL workshops are to enourage those enrolled on career-based programmes to identify and reflect upon their own core values and relate these to the broader sustainability agenda. Initiatives such as EBL may also help students develop their literacy skills so that future construction professionals are able to engage with sustainable development from all three sustainability aspects.

Mochizuki and Fadeeva (2010) argue that by creating sustainable development competences, students are able to experience transformative learning. UNESCO characterised education for sustainable development as not what should be taught but what should be learned. Therefore student engagement with the real world could be deepened by collaborating with faculty members and outside stakeholders of the university.

Jones *et al.* (2008) view sustainability teaching as a way to teach people how to cope with the ecological crisis as opposed to solving the problem. The authors suggested that a transdisciplinary approach to learning and teaching supports the four pillars of education which are:

Learning to know

Learning to do

Learning to live together

Learning to be

These four pillars to education seem to enforce the idea of deep learning (Alkhaddar *et al.,* 2012) as well as the transformative learning process that Moore (2005c) and Mochizuki and Fadeeva (2010) expressed. These would also lead to the opportunity for students to gain career skills and, plausibly, employability, much like the competences Mochizuki and Fadeeva (2010) discussed in their work.

The work of Fortuin and Bush (2010) suggests that sustainable development solutions require boundary crossing skills along with domain specific knowledge and communicative/social skills, which is similar to what Murray and Murray (2007) argued. The way in which Fortuin and Bush forsee the promotion of sustainability literacy is by students having to work with other students in different disciplines as well as professionals in various fields, specifically in the form of fieldwork to bridge the gap between classroom knowledge and practical application. The authors also want to allow for self reflective learning to take place which falls in line with the aims of transformational learning (Jones *et al.,* 2008; Mochizuki and Fadeeva, 2010).

Based on the review of these works, it would be beneficial if the implemented educational interventions promote transformational learning as the literature suggests this would help them change student values and eventually their behaviours (Jones *et al.,* 2008; Andrews *et al.,* 2009; Mochizuki and Fadeeva, 2010; Fortuin and Bush, 2010). The chosen method of delivering the educational priming sustainability session will be discussed in the section below.

9.2. Administering Change

The researcher met with a member of the educational services department to get an idea of what kind of teaching methods could be implemented as educational interventions. A meeting was also held with a member of staff who ran a postgraduate programme to see if any of the instruction methods could be adapted for use in the undergraduate sessions (Appendices 9 and 10).

Programme> Module v	Architectural Technology	Construction Management	Real Estate Management
Advanced Architectural Design	X		
Business Management		X	
Sustainable Property			X

Table 26. Grid of the three programmes and modules which were selected to have sustainability session and be 'primed' (Self-study)

Table 24 in Chapter eight gave an overview of Liverpool John Moores final year curriculum where modules were identified for each programme in which a potential sustainability session could be held. Some programmes shared modules which would have given those students the most exposure to sustainability messages through the intervention sessions but, due to time constraints, the researcher chose three programmes and their respective modules to hold a sustainability session tailored to the teaching aims of that module. These are presented in table 26.

The modules which received a priming session were Business Management, Advanced Architectural Design, and Sustainable Property which were held toward the end of semester one in 2011. The justification for targeting these programmes was that Architectural Technology has a strong push from their professional body (CIAT) to learn about sustainability. Construction Management students are experiencing a sustainability push internally from the school of the BUE and lastly Real Estate Management was chosen because it seems to be the most sceptical or least likely profession to accept change or that sustainability is useful in their industry as quoted by one of the programme leaders in section 8.3.2: *"I think from a real estate profession that might be a slight barrier because there is a lot of scepticism in the real estate side in the general practice side. A lot, a lot of people are very sceptical about what sustainability is, how it impacts on property, what the future is with it."*

Pappas (2012) stated that it is not necessary or even appropriate for every discipline to cover all aspects of sustainability. Therefore, what Pappas suggested, which was also endorsed by Wright (2010), is that the university curriculum should incorporate sustainability throughout so that students gain an appreciation and basic knowledge. Specific disciplines could then provide students with the tools their profession needs to

push sustainability forward. Pappas (2012) also urged that every endeavor is made to understand the contribution towards sustainability each discipline has as well as the influence which each perspective has on other disciplines. This consideration was followed by the researcher as the material which was presented in the sessions was created with the module leader's guidance on what would be relevant to the overall teaching aims and objectives of that specific module. The sub-headings below detail the type of material which was presented in each of the three sessions.

9.2.1 Business Management

Students enrolled on the Construction Management as well as Real Estate Management and Business programme undertake a module called Business Management in their final year. The aim of the module is to make students aware of major principles and techniques of effective management as well as to broaden students' appreciation of the complexities of modern business, in particular, factors affecting current and future business practices (LJMU, 2010).

Upon inspecting the LJMU (2010) module handbook, there was no mention of sustainability or sustainable development in the module. Therefore this module was chosen as one where an educational priming session would be implemented. The rationale behind this was that the basis of sustainability is based on three factors: environmental, societal and economic. Thus students could be told about economic sustainability as it would engage them in an aspect of sustainability that would be context specific to this particular module.

The module leader was contacted about possibly allowing a session to be held. Without disrupting the flow of the already set teaching timetable of the module. Discussions regarding the type of information that would be presented and what, if any sort of in-class task would be set out were held.

The content that was included in the session related to introducing elements such as the Triple Bottom Line (TBL) and Corporpate Social Responsibilyt (CSR), and case study examples of companies implementing sustainability into their business strategies. Students were told about the benefits of incorporating sustainability into a business as well as asked to consider if they knew of any additional examples of how sustainability is or could potentially be incorporated into a business (Appendix 11).

9.2.2 Advanced Architectural Design Projects

Students enrolled in the Architectural Technology programme are involved with the Advanced Architectural Design Projects module. The aims for this module are firstly to enable students to work on realistic projects and develop a range of professional skills in the context of sustainable building design (LJMU, 2011a). Secondly, the aim of the module is to develop the students' ability to be able to design whilst bearing in mind environmental, technical and financial constraints.

As with the Business Management module, the module leader was consulted about the material and information that would be presented to the students as well as what sort of activity would be appropriate for students at this level. In this case, the students were to consider elements of sustainable design covering topics such as materials and design solutions. They were asked to read a handout and evaluate a few case studies and assess whether the sustainable solutions they boasted about were regarded as such by the students. This excersie generated a group discussion about the various aspects that sustainability can cover including certain construction processes, choosing materials, using natural light in the design to maximise sunlight in the building and how that can benefit the end-users in terms of productivity. Where appropriate, the module leader would elaborate on points made by the researcher to further consolidate and draw links between general concepts of sustainability with the more relevant aspects for the architectural students (Appendices 12 and 13).

9.2.3 Sustainable Property

The final sustainability session was held in the sustainable property module which is undertaken by Real Estate Managers. The module covers a wide range of topics which encourage strategic and detailed thinking about sustainable property (LJMU, 2011b).

The importance of context specific learning was once again stressed as the session involved a presentation which informed students about the economic, environmental and societal aspects that waste management can have on the property industry. The presentation was followed by an in-class activity which was to read related reports regarding the role of property professionals and sustainability followed by a group discussion (Appendix 14 a-c).

All three sessions were intended to prime a handful of the students who will be participating in the Joint Project and then comparing their results to those who did not receive an educational intervention.

10. Phase 4- Joint Project 2012

Mann *et al.* (2007) emphasised in their work that curriculum should be designed so that students are able to experience professional practice in their own way. The researchers go on to suggest that students should experience solving a problem holistically. Others such as Jones *et al.* (2008); Fortuin and Bush (2010) and Salhberg and Oldroyd (2010) were of the opinion that interdisciplinary work which also forces students to develop and use soft skills is important. This suggestion is followed in the case of the final year BUE students at LJMU as the essence of the Joint Project which they undertake at the beginning of Semester 2 involves them designing or redeveloping an area of Liverpool city centre in a group of students from a range of study programmes. It requires students to look at the project from a design aspect, choosing materials, building techniques, costing, procurement and presentation of the design to a panel of professionals.

The second round of quantitative data collection began a year after the first 'validation' attempt for the SAS was conducted (Chapter 7). A new cohort of final year BUE and fifth year architecture students were given the same questionnaire pack as the previous cohort, including demographic questions, Sustainability Attitudes Scale, Five Factor model of personality as well as the Trait Meta Mood Scale. Students were asked to complete the questionnaire pack before they were briefed on the project itself. After this first round of data was collected students were meant to carry on with the project until they finished two weeks later. It was during their group presentations that the 'after' data was collected.

10.1 Before-Data Collection Process (Time1)

A total of 248 students (including postgraduate architects) were enrolled in this module. At time 1 (T1) 223 students completed the questionnaire pack resulting in a completion rate of 89% (Appendix 4). However, there were 10 participants who had to be removed from the analysis because they had left a majority of the questionnaire unanswered. Therefore the sample size was 213. There were instances where participants had left a few answers blank; these were mathematically calculated and 'filled in' by applying Missing Values Analysis EM algorithm using SPSS version 18. This ensured that there was a full data set which was statistically analysed.

Scale	Mean	Standard Deviation
SAS	124.54	10.02
Environment	41.49	3.97
Society	44.50	4.99
Economic	38.55	4.09
Emotional Intelligence	106.25	11.64
Extraversion	34.70	6.54
Agreeableness	38.73	6.06
Conscientiousness	35.25	6.33
Emotional Stability	34.06	6.76
Openness to Experience	35.15	5.11

Table 27. Descriptive statistics for data collected at Time 1 n=213 (Self-study)

Table 27 presents the means and standard deviations which were measured in the first round of data collection. The cohort scored well above the mid points (as discussed in section 6.2) .

Validity of the questionnaire was also calculated using Cronbach's alpha. Table 28 presents the level of reliabiliy all the scales and subscales of the three questionnaires.

Scale	Cronbach's alpha (α)
Sustainability Attitude Scale	.65
Environmental	.19
Society	.62
Economic	.25
Extraversion	.85
Agreeableness	.83
Conscientiousness	.83
Neuroticism	.82
Openness to Experience	.75
Emotional Intelligence	.79

Table 28. Cronbach's alpha for the FFM, SAS (including subscales) and TMMS (Self-study)

As a whole, the SAS scale seems to have an acceptable reliability value of α=.65. Its two subscales, Environmental and Economic, have very low alpha coefficients, whereas Society subscale has a fairly good α value of .62. The coefficients for the five factors of personality all had good reliability as the scores ranged from .75 to .85. Emotional intelligence was also internally reliable at α=.79.

10.2 After-Data Collection Process (Time2)

Two weeks after the start of the Joint Project, the 213 students who had completed the first questionnaire were asked to complete the SAS questionnaire resulting in an 86% response rate (out of the potential 248 students who were enrolled on the module), fortunately, no further participants had to be removed from the data set.

Scale	Mean	Standard deviation
Overall SAS (Time 2)	121.62	15.84
Environmental	41.10	5.45
Society	42.24	7.11
Economic	38.28	5.71

Table 29. Descriptive statistics of the SAS and its subscales collected as 'after' data (Self-study)

The Wilcoxon Signed Ranks test was used because the data was not normally distributed. It is the non parametric equivalent of the paired samples t-test.

There was no significant difference between Environmental scores at time one and time two (z=-.693, N-ties=192, p=.488, two-tailed). The economic subscale did not experience significantly different scores between times one and two (z=-.747, N-ties=194, p=.455, two-tailed).

Social scores changed significantly (z=-3.69, N-ties=203, p<.001, two-tailed) also the overall SAS scores were significantly different at times one and two (z=-2.45, N-ties=204, p=.007, one-tailed). In both instances, the median values were higher before the joint project took place than after the project was completed.

The reliability of the SAS was calculated again in the second round of data collection.

Scale	Cronbach's alpha α
SAS (Time 2)	.83
Environment	.45
Society	.78
Economic	.54

Table 30. Cronbach's alpha values at Time 2 (Self-study)

Upon inspection of the alpha values it is clear that they had improved from what they were before the joint project was undertaken. Overall the internal reliability of the SAS was high as was the alpha values for the society subscale. Environmental and Economic subscale values improved greatly, but as stand alone subscales, their values were not high enough to be deemed internally reliable on their own.

10.2.1 Experimental Condition

Chapter 9 outlined the information which was covered in the sustainability sessions given to the construction management, real estate management and artchitectural technology students. It was expected those who had a session would score higher on the SAS.

When looking over median and ranges, the priming sessions held at the end of semester one seemed to be most successful on the real estate management students as they had the highest median score at T1 before the joint project took place. After the project, it was the architectural technology and fifth year architecture students who had the highest median. Following the group project, the real estate managers had the lowest median.

Programme	T1 Median	T1 Range	T2 Median	T2 Range
Construction Management	124.50	33	123	79
Real Estate Management	127.50	33	121.50	59
Quantity Surveying	124	80	122	80
Building Surveying	126	70	125	95
Architectural Technology	122	28	129	69
RIBA Part 2	126	29	129	58

Table 31. Table of median and range values of SAS for all six programmes which were involved in the joint project (Self-study)

To determine whether the means reported above were statistically significant, a Mann Whitney U test was conducted. This is the non-parametric equivalent of an independent t-test. The analysis revealed that there were no significant differences between those that had a sustainability intervention and those who did not, prior to the joint project. The results for the environmental subscale at T1 were (U=4832, Z=-.411, p=.34, one-tailed) and at T2: (U=4968, Z=-.88, p=.47, one-tailed).

The results for the society subscale at T1 were (U=4706.500, Z=-.71, p=.24, one-tailed) and at T2, (U=4477.500, Z=-1.25, p=.11, one-tailed).

Results for the economic subscale at T1 were (U=4776, Z=-.54, p=.29, one-tailed) and at T2, (U=4801, Z=-.48, p=.31, one-tailed).

Finally, the overall SAS scores for T1 between those who had an educational intervention and those who did not was (U=4822.500, Z=.43, p=.33, one-tailed) and at T2, (U=4811.500, Z=-.46, p=.32, one-tailed).

The hypothesis that those who had an educational intervention would score higher on the SAS was therefore not supported.

10.2.2 Individual Item Analysis

Reviewing the data from chapter 7 and sections 10.0-10.2 indicated that in both years, the data seemed to signpost a systematic downward shift in the means after the full data had been collected that is, the before- and after- data. This suggested that perhaps the overall means for the SAS as well as the overall means for the three subscales were not providing the answers which the researcher had anticipated. Therefore analysis was conducted at the micro-level (i.e. individual items). The following sub-sections will indicate how the items within each of the three subscales correlated with their counterparts at T2. This section will go through both 2011 and 2012 repeated measures data.

As the data was not normally distributed, other measures of dispersion were looked at such as skewness and kurtosis (Brace *et al.*, 2006), means and standard deviations were also included. David and Sutton (2011) mentioned that a way of measuring the reliability of a scale is to correlate the answers that were given and that anything over .8 is taken as indication that the question is reliable. This was easily done as the study relied upon a before-and- after design. However, David and Sutton (2011) point out that the correlation may be more indicative of respondents' memory rather than the questionnaire itself.

Loewenthal (2001) however argued that any items which inter-correlate above the .2 level could be considered for further statistical tests such as the t-test and ANOVA.

The individual items of the SAS were correlated with their equivalent statement at T2. The following sections will revisit the data from 2011 as well as 2012 and discuss the main findings of the individual item analysis. It was deemed sufficient that the overall SAS would not be analysed individually as all of the statements fell under one of the three subscales. The data will be presented in the following way: means and standard deviations, correlations, skewness and kurtotic statistics followed by t-tests and ANOVA. This section will first list 2011 data analysis by subscale and then continue on with 2012 in the same order.

For convenienve, the 25 items which comprise the SAS scale will be included for easier reference of the questions for the individual item analyses. Statements relating to the environmental, social and economic aspects of sustainability are listed below:

Environment	1	4	7	10	13	16	19	22	25
Society	2	5	8	11	14	17	20	23	
Economic	3	6	9	12	15	18	21	24	

Table 32. Identification of statement numbers that relate to SAS subscales (Self-study)

1. There will be sufficient natural resources if they are used prudently.
2. Legislation is the only way to make the industry change its ways.
3. The effectiveness of construction work does not have to diminish even if substantial changes are made.
4. It is important to adopt a sustainable approach to choosing materials.
5. Communities cannot benefit from what the built environment does.
6. The construction industry wastes money on procuring materials that do not get used.
7. It is important to know where and how materials are sourced so that the less environmentally harmful choice is made.
8. Thorough inspection of land, which is to be (re)developed, needs to be carried out to ensure the well-being of communities.
9. It would be good practice to evaluate the cost of refurbishment against new build.
10. Minimising water, noise and spatial pollution should be a goal in any activity.
11. Current generations have the obligation to protect the environment for the benefit of future generations.
12. Companies reporting their sustainability plans as well as their accomplishments have a competitive advantage over other companies.
13. Construction practices could use significantly less embodied energy.
14. The industry should inform the wider community of the effects construction work has on the environment.
15. It is often easier to choose the non-environmentally friendly option; either due to cost, availability or lack of knowledge.
16. In previous years, the construction industry has posed a threat to the environment.
17. Resources could be saved by increased awareness.
18. Acting sustainably is only worthwhile if it reduces costs.
19. The use of renewable energy as well as recycled materials should become more prominent in areas where facilities exist.
20. The built environment has the potential to benefit communities through the infrastructure it provides.
21. Technological advancements will ensure that the construction industry will not degrade the environment.
22. The environmental impact that the built environment has is largely exaggerated.
23. Poor planning and management are the main cause of bad practice.
24. Cutting down waste can have financial benefits attached to it in the long run.
25. The construction industry does enough to protect the environment.

Table 33. SAS statements listed for reference for the upcoming sections (Self-study)

10.2.3 Individual Item Analysis 2011 Data

10.2.3.1 Environmental Sub-scale

For the first subscale, four out of the nine statements which comprise this subscale correlated at .2 or higher.

Statement	Mean	Standard Deviation	Correlation	Skewness	Kurtosis
1	4.31	1.44	.25**	-.49	-.66
1(T2)	4.14	1.67		-.10	-1.13
7	5.63	1.50	.32**	-1.20	2.09
7(T2)	5.43	1.30		-1.24	1.56
22	3.28	1.50	.23**	.64	-.18
22(T2)	3.73	1.64		.24	-.89
25	3.32	1.62	.24**	.68	-.43
25(T2)	3.53	1.65		.24	-.92

** p<.001

Table 34. Descriptive statistics and inter-correlations for environment subscale (Self-study)

Looking at the standard deviations of these items indicates that they were capturing spread, as for a 7-point Likert scale, dispersion of 1.5 is favourable (Loewenthal, 2001). Paired t-tests were conducted which showed that only statement number 22 had significantly different means at time 1 and time 2. The mean difference was -.446 with the 95% confidence interval level ranging from -.703 to -.161, t(183)=-3.09, p<.05 (two-tailed). There was a small effect size of d=.29.

Table 7 in section 6.2 outlined what the midpoints of each of the subscales were. In this case, the midpoint for the environmental subscale is 36 and the means tended to be above this. Even after one standard deviation less leaves the means above the midpoint. The table below indicates what the means were. For the society and economic sub-scales, the midpoint was 32 which indicates that after one standard deviation less; economic factors are still above the midpoint and at least two standard deviations away for societal factors.

Correlations were conducted amongst the subscales and the psychological factors which were the five factors of personality (extraversion, agreeableness, conscientiousness, emotional stability and openness to experience) and emotional intelligence. Table 35 indicates which item numbers (at both times one and two) correlated significantly with the psychological factors.

Factor	1.	4.	7.	10.	13.	16.	19.	22.	25.
Emotional Intelligence		.193**	.218**	.182* .176*(T2)				-.253**	-.211** -.156*(T2)
Extraversion		.174*					.147*(T2)		
Agreeableness		.212** .146*(T2)	.192** .249**(T2)	.246**(T2)	.176*(T2)		.155*	-.154*	
Conscientiousness			.148	.191*	.207**			- .149* (T2)	
Emotional Stability					.164*				-.145*
Openness to Experience	.182*			.152*	.169*			-.164*(T2)	

** p<.001 *p<.05

Table 35. Correlations showing the relationships between the environmental subscale items and independent variables (Self-study)

Further analysis of the subscale data revealed that there were significant differences between responses given at T1 and T2 when one-way analysis of variance (ANOVA) was conducted on each statement number and psychological factor. Table 33 in section 10.2.2 has lists the statements of the SAS. Two questions from the SAS seemed to be quite 'popular' in the analysis as statement numbers seven and 10 seemed to be highlighted as the most significant among the psychological constructs.

For emotional intelligence, statement number twenty-five showed a significant difference $F(51, 132) = 1.523$, $p<.05$ at T1. Eta squared was $\eta^2=.37$ indicating a large effect size. Therefore 37% of the variance is accounted for by a participant's level of emotional intelligence. At T2 statement numbers 16 $F(51, 132) = 1.764$, $p<.005$ with a large effect size of $\eta^2=.41$ and statement 25 $F(51,132) = 1.508$, $p<.05$ were significant with a large effect size of $\eta^2=.37$. It is possible that the reason why statement numbers 16 and 25 (which were the opposing statements in the questionnaire) were significantly related to emotional intelligence was due to words such as 'protect' and 'threat'. These may have elicited an emotional response from the participants. This could be an indication that students were able to express or at least consider the state and well-being of the environment without being able to express verbally what is happening to it.

When ANOVA was performed on extraversion factor of personality, statement number 13 at T2 came up as significant with values of $F(31, 152) = 2.134$, $p<.001$. There was a large effect size of $\eta^2=.30$. Perhaps extraverted individuals would be more likely to discuss the implications of using less embodied energy in construction practices. Statement number 19 was also significant $F(31, 152) = 1.707$, $p<.05$ with a large effect of $\eta^2=.26$. Similar to statement thirteen, more sociable people might be more assertive and vocal (Furnham *et al.*, 2003; Boeve-de Pauw *et al.*, 2010) about their opinion of more extensive use of both recycled materials and renewable energy where possible. Both statement numbers thirteen and nineteen are related to one another as recycled materials would have lower embodied energy, and renewable energy would be more efficient to use as well. Thus extraverted individuals seem likely to talk about both of them.

At T1, there were no significant differences when ANOVA was conducted with Agreeableness being the independent variable. At T2 however, statement number seven $F(28, 155) = 2.051$, $p<.005$ with a large effect size of $\eta^2=.27$ was significant. It is not surprising that this statement was significant among agreeable individuals as it is to do

with knowing where and how materials have been sourced. People who score highly on agreeableness tend to want to be helpful (Todd *et al.,* 2009) and considerate towards the impact materials can have on the environment. Statement ten was also significant F(28, 155) = 1.890, p<.01 with a large effect size of η^2= .25. Agreeable individuals may have also felt strongly about this as another characteristic which is associated with this personality trait is compliance. It could therefore be inferred that agreeable individuals comply more readily than other personalities to minimise water, noise and pollution of the surrounding area in any construction activity. Statement thirteen was significant F(28, 155) =1.552, p<.05 with a medium effect size of η^2=.22. Consuming less embodied energy is another statement which the participants agreed with as it links in with characteristics of being helpful and considerate toward the environment. Lastly, item twenty-five was significant F(28, 155) = 1.680, p<.005 with a medium effect size of η^2=.23. It is likely that this last statement was significant because agreeable individuals tend to have a positive outlook on human nature. This positive belief may have extended to industries as well, hence why they believe that the construction industry is taking the relevant steps in protecting the environment.

Conscientiousness was the most significant independent variable for the ANOVA which indicated that at T1 statement numbers seven F(29, 154) = 1.847, p<.01 with a large effect size of η^2=.26. As conscientiousness is regarded as a trait where individuals are thorough and dutiful (Furnham *et al.,* 2003) it would be expected that they would see the importance of knowing how and where materials were sourced. Knowing such information would help conscientious individuals deliberate and plan where they would place the order for their materials (Todd *et al.,* 2009). With regards to statement thirteen which also came up as significant at F(29, 154)= 1.942, p<.005 with a large effect size of η^2=.28, this result is another example of how by implementing better planning and preparation, less embodied energy would be consumed during construction.

At T2 statement numbers four F(29, 154) = 1.569, p<.05 with a medium effect size η^2=.22 and ten F(29, 154) = 1.983, p<.005 which had a large effect size of η^2=.27 were significant. Statement number four which is about adopting a sustainable approach to choosing materials is in line with thorough and planning qualities that highly conscientious individuals possess. Lastly, the statement regarding the minimisation of pollution in any

activity resonates with what Furnham *et al.* (2003) called achievement striving, as being able to keep a record of what has been used and how it has diminished would fit into this. Overall, the findings for this personality trait can be thought of as likely behaviours highly conscientious individuals would engage in.

When emotional stability was the independent variable, statement number four was significant $F(34, 149) = 1.686$, $p<.05$ the effect size of this result was large at $\eta^2=.28$. It could be that those that were emotionally stable felt that as long as a sustainable approach is adopted regarding material selection there would be no reason to become anxious (Furnham *et al.*, 2003). Likewise statement sixteen $F(34,149) = 1.575$, $p<.05$ which also had a large effect size of $\eta^2=.26$ can be seen as a response that has been chosen by those who are not anxious as it concedes that in the past, construction practices may have been harmful to the environment. At T2, only statement seven $F(34, 149)= 1.671$, $p<.05$ was significant. Emotional stability was also able to predict 28% of the variance as eta-squared was $\eta^2=.28$. It is likely that this set of participants do not find it worrying where materials are sourced and that they believe they are sourced fairly. It could on the other hand indicate that knowing where materials have been sourced from may be a cause for concern if indeed materials have been sourced from a conflicted location. The statements which were significant with emotional stability may indicate areas with which respondents may become nervous or uneasy about as there still are many companies which will source materials from where it is cheap rather than considering cost-benefit analysis of locally sourced materials, which in a more sustainability conscious society may be distressing for some.

Finally, Openness to experience was also included in the ANOVA analysis as an independent variable. At T1, only question number seven was significant $F(26, 157)= 1.589$, $p<.05$ with a medium effect size of $\eta^2=.21$. An explanation as to why this statement was statistically significant is because openness is a trait which is associated with intellectual and cognitive ability (Todd *et al.*, 2009) and therefore being able to satisfy one's curiosity for where materials have come from may be important. At T2 statement ten was significant $F(26, 157) = 1.728$, $p<.05$ which had a medium effect of $\eta^2=.22$. Aiming to reduce pollution in construction processes may have been significant as openness is associated with an active imagination (Todd *et al.*, 2009) therefore those who are highly open to experience may have felt that a creative idea is needed to tackle this issue. Lastly,

statement sixteen was also significant F(26,157)= 1.834, p<.05 indicated a medium effect size of η^2=.23. It is possible that the knowledge and cognitive ability which individuals open to experience possess has allowed them to acknowledge that the construction industry has been harmful to the environment in the past but that it has made amendments to its practices.

Independent t-tests were conducted to see if there were gender differences between the nine statements of the environmental subscale. Only statement number ten (at T2) came up as significant as males scored ($\bar{x}$=5.38, SD=1.37) the average score for women was ($\bar{x}$=5.85, SD=.881) equal variance was not assumed because Levene's test of equality of variance was p<.05. The result for this t-test was that women had a significantly higher mean than men at t(182) = -1.676, p<.05 (two-tailed) with a mean difference of -.466 and a 95% confidence interval of -.877 to -.056. With a small effect size of *d*=.42.

An independent t-test was conducted to see if having completed a sandwich year made a difference on environmental statements. The t-test proved non-significant meaning that those who had completed a sandwich year did not have differing scores from those who had not had a year out in industry.

10.2.4 Society Sub-Scale

For the second subscale of Society, the relevant statement numbers were correlated with one another (table 33 in section 10.2.2). Only statement number two correlated above Loewenthal's (2001) recommended value.

Statement	Mean	Standard Deviation	Correlation	Skewness	Kurtosis
2	4.77	1.47	.31**	-.66	-.22
2(T2)	4.70	1.46		-.499	-.45

** p<.001

Table 36. Descriptive statistics and correlations for society sub scale (Self-study)

A paired t-test was conducted but was not significant.

Factor	2.	5.	8.	11.	14.	17.	20.	23.
Emotional Intelligence		-.253**		.187*		.272**	.249**	
							.195** (T2)	
Extraversion	.168*		.146*					
	.161*(T2)							
Agreeableness	.198**		.167*	.180*		.161*	.201**	
		.161*(T2)	.207**(T2)			.259**(T2)	.226**(T2)	.159*(T2)
Conscientiousness			.332**			.171*	.284**	
Emotional Stability				.146*			.162*	
Openness to Experience						.149*	.234**	.146*

** p<.001 *p<.05

Table 37. Correlations showing the relationships between the society subscale items and independent variables (Self-study)

Correlations were conducted amongst the subscales and the psychological factors which were the five factors of personality (extraversion, agreeableness, conscientiousness, emotional stability and openness to experience) and emotional intelligence. Table 37 above indicates which item numbers (at both times one and two) correlated significantly with the psychological factors.

Analysis of variance was conducted to discern whether there were differences in the means of answers given to each of the eight statements which comprise this subscale. One-way ANOVA indicated that levels of emotional intelligence did not have different scores on the social subscale at either T1 or T2.

Extraversion on the other hand had significantly different answers for statement numbers two $F(31, 152) = 1.612$, $P<.05$ were this finding having a medium effect size of $\eta^2=.24$. Perhaps the reason why this statement was significant was that extraverted people are talkative and thus the legislation being the only way to force construction companies to be sustainable seems like a talking point. Statement five was the only other significant result at T1 at $F(31, 152) = p<.01$ with a large effect size of $\eta^2=.28$. It could be that some of the participants have experienced first-hand that the BUE has not benefitted communities and have discussed it with the others it has affected, thus this statement may reflect that. At T2, only statement number eight was highly significant when ANOVA was conducted $F(31, 152) = 2.086$, $p<.005$ this finding too, had a large effect size $\eta^2=.31$. Similarly to statements two and five, extraverts may be inclined to discuss the thorough inspection of land in order to inform others of what is found or merely to exchange thoughts on the matter.
Based on these results it is possible that extraverts would be more forthcoming about voicing their opinion or sharing their knowledge about how the BUE may affect social aspects.

Agreeableness was a trait that seemed to be fairly strong indicator of which statements had the highest fluctuation of mean answers. At T1 statement number five $F(28, 155) = 1.585$, $p<.05$ had a medium effect of $\eta^2=.22$. It is likely that this statement resonated with those who scored lower on agreeableness as it is the opposite of what someone who would be agreeable would think as the statement indicates that communities cannot benefit from what the BUE does.
Statement eleven was significant $F(28, 155) = 1.569$, $p<.05$ with a medium effect of $\eta^2=.22$.

This answer is more indicative of someone who is highly agreeable as it is about current generations having an obligation to future ones regarding sustainability; therefore encompassing characteristics such as altruism (Widiger and Trull, 1997) and helpfulness (Todd *et al.,* 2009).

Statement twenty was the last significant factor at T1 $F(28, 155) = 1.960$, $p<.005$ which had a large effect of $\eta^2=.26$. Unlike statement number five, this statement is the positively worded one which has been responded to by those who are highly agreeable as it relates to behaviours which related to caring and compassion. At T2 the same statement number eight $F(28, 155) = 1.803$, $p<.05$ with a large effect size of $\eta^2=.25$ was significant. Thorough inspection of land should be conducted before the area is developed; doing so would have social benefits of health and well-being which is probably why this statement was highlighted as significant by agreeable individuals. Statements eleven $F(28,155) = 1.574$, $p<.05$ which had a medium effect size $\eta^2=.22$ and twenty $F(28, 155) =1.721$, $p<.05$ (large effect size of $\eta^2=.24$) were both significant at T2. This suggests that these are elements which agreeable people feel strongly about when it comes to social sustainability. Additionally, statement number seventeen was significant at this time as well $F(28, 155) = 1.845$, $p<.01$. This finding also had a large effect size of $\eta^2=.25$. Agreeable people seemed to agree that increased awareness and knowledge on behalf of society at large would mean that fewer resources would be used up in construction practices.

Conscientiousness was the next factor which was analysed using a one-way ANOVA. At T1 statement number eight which related to the thorough inspection of land was significant $F(29, 154) = 2.001$, $p<.005$ with a large effect size $\eta^2=.27$. Statement eleven was also significant $F(29, 154) = 1.920$, $p<.01$ and a large effect size of $\eta^2=.27$. Conscientious individuals must relate to this statement about current generations having an obligation to future generations to protect the environment because conscientiousness is characterised by dutifulness, planning and responsibility (Furnham *et al.,* 2003; Hirsh and Dolderman, 2007; Todd *et al.,* 2009) therefore this statement may be an indication that conscientious individuals would plan to protect the environment so that future generations could enjoy it as well. Item twenty was significant $F(29, 154) =1.803$, $p<.05$ which had a large effect size $\eta^2=.25$. The belief that the BUE will offer communities benefits may be a notion that conscientious individuals relate to because they are characterised by achievement striving, therefore they would believe that this is a target

the BUE should meet. Finally item twenty-three $F(29, 154) = 1.549$, $p<.05$, was significant (with a medium effect at $\eta^2=.23$). It is not surprising that this statement was significant for individuals who possess high levels of this specific personality trait as it would appear to indicate that those who score low on this trait will not have been thorough when plans were implemented and were not managing staff appropriately.

At T2, there were no changes in the means when conscientiousness was explored. As with the analysis of environmental aspects, these statements seem to reflect behaviours that conscientious individuals would act upon or would be more thorough in their execution of.

Emotional stability indicated differences in mean scores for three of the statements at T1 which were statements two $F(34, 149) = 1.524$, $p<.05$ (with a large effect size $\eta^2=.26$). It is possible that individuals with low emotional stability may feel that legislation is the only way to force the construction industry to change its ways because perhaps they doubt that cooperation and ability of individuals alone will make the construction industry sustainable. Statement eight was significant at $F(34, 149) = 1.958$, $p<.005$ with a large effect size, $\eta^2=.31$. It could be that again, individuals who scored lower on emotional stability would be anxious about land that is to be developed in case that it has harmful chemicals or something that might compromise well-being. Lastly statement twenty $F(34, 149) = 1.838$, $p<.01$ which also had a large effect of $\eta^2=.29$ was also significant. This response may have been given by those who are emotionally stable as it reflects their positive outlook on the benefits which the BUE can have, (Furnham *et al.*, 2003). At T2 only statement numbers two $F(34, 149) =1.655$, $p<.05$ with a large effect $\eta^2=.27$ and twenty $F(34,149) = 1.553$, $p<.05$ (large effect of $\eta^2=.26$) were significant.

Openness to experience did not make a difference to respondents' scores at T1 but at T2, statement eleven indicated a difference in the mean $F(26, 157) = 1.982$, $p<.01$. The effect size of this was small at $\eta^2=.12$ indicating that only 12% of the variance was accounted for by openness to experience in the scores given to statement eleven. This finding could indicate that those who scored high on openness to experience believe that the creativity (Todd *et al.*, 2009) of current generations to tackle sustainability issues would ensure that future generations are not encountered with an unmanageable environmental problem.

An independent t-test was then conducted to determine whether there were differences in responses given by males and females. The t-test indicated that there were none. A t-

test looking at the difference between participants who had taken a placement or sandwich year out in industry with those that had not, was conducted. The t-tests revealed that statement number 17 (at T2) indicated that there was a difference between the means of those who had been on a sandwich year ($\bar{x}$=5.95, SD=.950) and those who had not ($\bar{x}$=5.38, SD=1.26) t(182) = 2.07, p<.05 (two-tailed). The mean difference was .578 and the 95% confidence interval fell between .027 to 1.13. The effect size was calculated using Cohen's *d* which indicated a small effect size of *d*=.26. Statement number twenty also indicated a difference in the means between those who had industry experience ($\bar{x}$=6.14, SD=.834) and those who did not ($\bar{x}$=5.40, SD=1.38) but in this instance equal variance was not assumed t(182) = 3.53, p<.001 (two-tailed) with a mean difference of .735 and the 95% confidence interval level ranging from .314 to 1.16. In this instance there was a medium effect size of *d*=.33.

10.2.5 Economic Sub-Scale

The third subscale dealt with economic factors. Statements from time one were correlated with the same statements at time two resulting in four out of the eight statements in this subscale correlating at .2 or above.

Statement	Mean	Standard Deviation	Correlation	Skewness	Kurtosis
3	5.31	1.14	.29**	-1.16	2.03
3(T2)	5.09	1.40		-.795	.237
6	4.48	1.51	-.22*	-.398	-.539
6(T2)	3.55	1.44		.309	-.435
12	5.30	1.41	.23*	-.906	.542
12(T2)	5.31	1.31		-1.01	1.08
24	5.67	1.21	.35**	-1.05	1.21
24(T2)	5.57	1.26		-1.20	1.69

** p<.001 *p<.05

Table 38. Descriptive statistics and correlations for economic sub scale (Self-study)

Paired t-tests were conducted and it emerged that the means for statement number three were significantly different at time one ($\bar{x}$=5.31, S.D= 1.14) and at time two ($\bar{x}$=5.09, S.D= 1.40), t(183)=1.98, p<.05 (two-tailed). The mean difference was .223 and the 95% conference interval ranged from .001 to .444 with a small effect size of *d*=.17.

Statement six was also significant as the mean difference as .93 with the confidence interval ranging from .599 to 1.26, t(183)= 5.55, p<.001 (two-tailed) with a small effect size of *d*=.32.

Factor	3.	6.	9.	12.	15.	18.	21.	24.
Emotional Intelligence	.165*(T2)			.203**(T2)		-.304** -.207**(T2)		.198**
Extraversion		.186*(T2)			-.177*(T2)			
Agreeableness				.188*(T2)		-.259**		.238** .179*(T2)
Conscientiousness			.253**	.268**			.218**	
Emotional Stability				.156*				.146*
Openness to Experience						-.175*		

** p<.001 *p<.05

Table 39. Table of correlations between the economic subscales and psychological constructs (Self-study)

Correlations were calculated between the subscales and the psychological factors which were the five factors of personality (extraversion, agreeableness, conscientiousness, emotional stability and openness to experience) and emotional intelligence. Table 39 above indicates which item numbers (at both times one and two) correlated significantly with the psychological factors.

ANOVA was once again conducted on the economic subscale of the SAS and as with the social subscale, levels of emotional intelligence did not seem to have an effect on economic statements. The relevant statement numbers can be seen in table 32 and the statements themselves in table 33 in section 10.2.2.

Extraversion did not seem to show any differences in mean scores at T1, but at T2 statement numbers three $F(31, 152) = 1.717$, $p<.05$ with a large effect size of $\eta^2=.26$ was significant. By speaking with others, extraverts are able to assert their opinions as to why the effectiveness of construction would not have to diminish even if considerable changes are made. Similarly, extraverts might be more vocal in expressing their views that the construction industry wastes money on obtaining materials which it then does not use as this was statement six $F(31, 152) = p<.05$ (with a large effect size as well of $\eta^2=.026$). Item twenty-one $F(31, 152) = p<.001$ seemed to have a significant difference and large effect size of $\eta^2=.30$. Through the act of being sociable (Furnham *et al.,* 2003; Boeve-de Paw *et al.,* 2010) extraverted individuals may demonstrate excitability (Boeve-de Paw *et al.,* 2010) regarding technology and how it may serve a purpose in helping mechanise sustainable construction practices thus making a profit.

Agreeableness seemed to suggest differences before the joint project took place as questions eighteen $F(28, 155) = 1.783$, $p< .05$ (with a medium effect size of $\eta^2=.24$) and twenty-four $F(28, 155) =1.828$, $p<.05$ (large effect size of $\eta^2=.25$) were both significant. Statement eighteen which stated that acting sustainably is only worthwhile if it reduces costs may be significant with individuals who scored lower on agreeableness as this view portrays a fairly pessimistic view of sustainability. Had highly agreeable individuals thought this way it would be expected that they would want to promote sustainability without it having financial benefits. Statement twenty-four on the other hand relates to the benefits a company can reap if they act sustainably as in the long run, their waste reduction may yield money to be reinvested in other areas. At T2 none of the eight questions that comprise the economic subscale were significant.

Conscientiousness as an independent variable was able to differentiate scores for statements three $F(29, 154)= 1.812$, $p<.05$ with a large effect $\eta^2=.25$. The need for achievement is something that conscientious individuals strive for (Furnham *et al.,* 2003), therefore they are likely to be of the opinion that construction work does not need to be any less effective if substantial changes are made. Item number nine $F(29, 154)= 1.562$ $p<.05$ which had a medium effect of $\eta^2=.23$ may have been significant because conscientious individuals are likely to plan and make thorough assessments and evaluations before undertaking a project.

Item twelve was significant at $F(29, 154)= 1.746$, $p<.05$ with a large effect size of $\eta^2=.25$. Conscientious individuals may feel that not only is it a company's responsibility to report their sustainability objectives and goals, but that it is also an achievement that should be attained as it can create a competitive advantage. Item twenty-one was the last statement at T1 which was significant at $F(29, 154)=1.863$, $p<.01$ with a large effect of $\eta^2=.26$. This statement may have been significant as it once again reflects an achievement that can be attained. At T2, only statement number nine was significant $F(29, 154)= 1.912$, $p<.01$ (large effect size $\eta^2=.26$). This statement may have been significant for this specific trait because conscientious individuals are known to deliberate and plan (Todd *et al.,* 2009) and therefore they would be sure to make an informed decision as to whether it is more cost effective to build a new building or to refurbish an existing one. On the whole, these significant results represent behaviours which may be engaged in by conscientious individuals or at least reflect accomplishments that conscientious people see as feasible to achieve.

Emotional stability seemed to pick out differences in the scores for statement number 15 $F(34, 149)= 1.592$, $p<.05$ with a large effect of $\eta^2=.26$. This response may have been given by those who are higher in emotional stability as if the statement were worded differently, those lower in emotional stability might have been the ones who reacted to it. Hirsh (2010) found that those who scored low on emotional stability demonstrated more concern for the environment which this result does not.

Item twenty-four $F(34, 149)= 2.867$, $p<.001$ was the other significant result at T1 (large effect size of $\eta^2=.39$) indicating that 39% of the variance is accounted for due to an individual's level of emotional stability. This statement also suggests that those with high levels of emotional stability responded in this way as it is unlikely that reducing waste

would cause anxiety if it did have financial benefits attached to it in the long run. At T2, only statement three was significant $F(34, 149)= 1.571$, $p<.05$ with a large effect size of $\eta^2=.26$. It is likely that those with high levels of emotional stability responded positively to this as it would appear that those who are less anxious and worried would be more likely to embrace change. From these results it could be concluded that this cohort was fairly emotionally stable as their responses seemed to indicate more positive views on sustainable construction and its impact on construction finance.

Openness to experience was unable to indicate differences in answers at T1 but at T2 statement number nine $F(26, 157)= 1.884$, $p<.01$ with a medium effect level $\eta^2=.24$ was significant. As people who are high in openness to experience are fairly creative and intellectually capable (Todd *et al.*, 2009) they may be able to devise clever solutions to refurbishing an existing building rather than having to build from new. Statement twelve $F(26, 157)= 2.092$, $p<.005$ (large effect of $\eta^2=.26$) may reflect an intelligence strategy by which the promotion of a socially acceptable and positive endeavour (practising sustainability) can be used as both a marketing tool and a way to increase business efficiency. Therefore it is not surprising that those with the openness trait see it as important. Statement twenty-one $F(26, 157)= 1.724$, $p<.05$ was significant with a medium effect size of $\eta^2= .22$. Individuals who are open to experience are generally considered creative and intelligent, therefore it would be characteristic of them to be of the opinion that technology can assist in lessening the environmental burden.

Independent t-tests were conducted on gender and their response scores which indicated that on statement 15, males ($\bar{x}=5.39$, $SD=1.44$) gave significantly higher scores than women ($\bar{x}=4.69$, $SD=1.66$) at T1. The mean difference was .694 while the 95% confidence level ran from .077 to 1.310 $t(182) = 2.22$, $p<.05$ (two-tailed). The effect size was small at $d=.45$.

A t-test looking to see if there were differences between the answers given from those that had industry experience and those who did not, showed no statistically significant differences.

10.2.6 Individual Item Analysis 2012 Data

10.2.6.1 Environment Scale

For the environmental subscale eight out of the nine items correlated at .2 or higher.

Table 40 has the descriptive statistics and correlations. The statements of the SAS can be found in table 33 in section 10.2.2.

Statement	Mean	Standard Deviation	Correlation	Skewness	Kurtosis
1	4.14	1.42	.43**	-.353	-.911
1(T2)	4.20	1.53		-.455	-.732
4	6.12	1.04	.20**	-2.183	6.900
4(T2)	5.72	1.32		-1.492	2.44
7	5.70	1.06	.38**	-1.062	1.868
7(T2)	5.45	1.28		-1.05	1.17
10	5.69	1.11	.41**	-1.316	2.685
10(T2)	5.56	1.26		-.948	.582
13	5.24	1.08	.31**	-.398	.041
13(T2)	5.05	1.37		-.748	.355
19	5.52	1.08	.24**	-.795	.810
19(T2)	5.18	1.38		-.851	.492
22	3.28	1.37	.25**	.298	-.683
22(T2)	3.54	1.51		.227	-.637
25	3.14	1.28	.24**	.834	-.179
25(T2)	3.55	1.54		.123	-.630

** p<.001

Table 40. Descriptive statistics and correlations for environmental subscale (Self-study)

Paired t-tests indicated that statement numbers four, seven, nineteen, twenty-two and twenty-nine had statistically significant differences in mean scores at time one and two. Statement number four had a higher mean at time one ($\bar{x}$=6.12, S.D=1.04) than at time two ($\bar{x}$=5.72, S.D= 1.32) with a mean difference of .39 and a confidence interval of .19 to .59, t(212)=3.81, p<.001 (two-tailed)and a small effect size of *d*=.34.

Statement seven had a mean of ($\bar{x}$=5.70, S.D=1.06) at time one and at time two ($\bar{x}$=5.45, S.D=1.28). The mean difference was.26 .with the 95% confidence interval ranging from .81 to .44, t(212)=2.87,p<.05 (two-tailed) with a small effect size of *d*=.21.

Statement nineteen had a mean of ($\bar{x}$=5.52, S.D=1.08) at time one and at time two ($\bar{x}$=5.18, S.D=1.38). The mean difference was .34 with the 95% confidence interval ranging from .13 to .55, t(212)=3.20,p<.05 (two-tailed)with a small effect size of *d*=.31.

Statement twenty-two had a mean of ($\bar{x}$=3.28, S.D=1.37) at time one and at time two ($\bar{x}$=3.54, S.D=1.51). The mean difference was -.26 with the 95% confidence interval ranging from -.497 to -.02, t(212)=-2.13,p<.05 (two-tailed) with a small effect size of *d*=.18.

Statement twenty-five had a mean of ($\bar{x}$=3.14, S.D=1.28) at time one and at time two ($\bar{x}$=3.55, S.D=1.54). The mean difference was -.42 with the 95% confidence interval ranging from -.65 to -.18, t(212)=-3.5,p<.001 (two-tailed)with a small effect size of *d*=.29.

Correlations were calculated between the subscales and the psychological factors which were the five factors of personality (extraversion, agreeableness, conscientiousness, emotional stability and openness to experience) and emotional intelligence. Table 41 indicates which item numbers (at both times one and two) correlated significantly with the psychological factors.

Factor	1.	4.	7.	10.	13.	16.	19.	22.	25.
Emotional Intelligence			.136*		.142*	-.178**			
		.248** (T2)	.214** (T2)	.146* (T2)			.195** (T2)		
Extraversion								-.182**	
Agreeableness		.161*	.251**	.256**		-.147*	.139*		
		.214**		.137*					
Conscientiousness	.154*		.210**				.215**		.138*
	.214** (T2)	.243** (T2)	.159* (T2)	.248** (T2)			.184**(T2)		
Emotional Stability		.158* (T2)							
Openness to Experience		.297**	.261**	.176**	.220**	-.258**		-.239**	-.158*
		.187** (T2)	.166* (T2)						

** p<.001 *p<.05

Table 41. Correlations between the independent variables and the items in the environmental subscale (Self-study)

One-way analysis of variance indicated that, before the joint project took place, emotional intelligence was able to identify a change in score means in item number sixteen $F(57, 155)= 1.460$, $p<.05$ (large effect size of $\eta^2=.35$) which indicated that 35% of the variance was accounted for by participants' level of emotional intelligence. It is likely that this statement which states that in previous years, the construction industry has posed a threat to the environment was significant because of the word "threat" within it which may have elicited a compassionate response from participants. More differences emerged at T2 with item numbers seven $F(57, 155)= 1.805$, $p<.005$ with a large effect size of $\eta^2=.39$. This statement may have been statistically significant because of the word "harmful" in it, thus their level of emotional intelligence may have influenced the reason why they believe that the environmental choice should be made. Statement sixteen was also significant $F(57, 155)= 1.461$, $p<.05$ with a large effect $\eta^2=.35$. Lastly, statement nineteen $F(57, 155)=1.469$, $p<.05$ with a large effect size of $\eta^2=.35$ was statistically significant. Perhaps statement nineteen, which is about the use of renewable energy and recycled materials, is interacting with more knowledge, as if participants are aware of the benefits of using recycled materials and renewable energy, their emotional intelligence would be able to highlight their significance in sustainable construction practices.

Extraversion was not able to differentiate between scores before the joint project took place, however at T2 items seven $F(34, 178)= 1.500$, $p<.05$ (medium effect size $\eta^2=.22$) and thirteen $F(34, 178)= 1.567$, $p<.05$ (medium effect size $\eta^2=.23$) were significant suggesting that there were differences in mean scores in these questions. These two statements are related to materials and the amount of energy it takes to produce them and the impact this has on the environment. This statistical significance through extraversion may indicate that those who are high in extraversion are likely to discuss these types of issues with their peers and colleagues.

When agreeableness was the independent variable, seven out of the possible nine items were significant. The first statement of them was four $F(30, 182)=2.120$, $p<.001$ which had a large effect size of $\eta^2=.26$. Not uncharacteristically, those high in agreeableness felt that it was important to adopt a sustainable approach to choosing materials as this would in turn help the environment. Statement seven $F(30, 182)= 2.774$, $p<.001$ which had a large effect size $\eta^2=.31$ could have been significant because it relates to statement four regarding the choice of materials, specifically knowing where and how they have been

sourced. Therefore if the materials have been obtained locally, it suggests a sustainable approach to selecting materials. Statement ten related to the minimisation of various types of pollution which was considered significant by agreeable individuals $F(30, 182)= 3.354$, $p< .001$ with a large effect $\eta^2=.36$. Statement thirteen $F(30, 182)= 1.820$, $p<.01$ which had a medium effect $\eta^2=.23$. It is another example of a possible interaction between areas of knowledge, as individuals would have to be aware of the benefits that less embodied energy within the construction process provides. Thus by knowing that it would be beneficial, those who were highly agreeable were able to indicate its significance. Item sixteen $F(30, 182)= 1.623$, $p<.05$ with a medium effect of $\eta^2=.21$ may have been significant because it acknowledges that in the past, the BUE may have posed a threat to the environment. The very nature of agreeable people which is to be helpful and altruistic (Widiger and Trull, 1997; Todd *et al.*, 2009), and they may believe that the construction industry is taking all the necessary precautions to help the environment. Statement nineteen advocated the use of renewable energy and recycled materials more prominently in areas where such facilities existed, $F(30, 182)= 2.030$,$p <.005$ with a large effect size $\eta^2=.25$. In accordance with the empathetic and helpful nature of agreeable individuals, it is not surprising that they would feel that such practices are worthwhile. Finally, item twenty-five $F(30, 182)= 1.661$, $p<.05$ which had a medium effect size of $\eta^2=.21$, supports the finding from statement sixteen. At T2 however, only statement number ten had statistically significant different scores $F(30, 182)=1.651$, $p<.05$. This result had a medium effect size of $\eta^2=.21$.Similarly to T1, statement ten was significant which may indicate that those with high levels of the agreeableness trait feel that it is of utmost importance to reduce pollution of any kind in construction activities.

Before the group project was undertaken, conscientiousness was able to distinguish between item number four $F(30, 182)=2.159$, $p<.001$ with a large effect size of $\eta^2=.27$. Conscientious individuals may find it important to comply (Furnham *et al.*, 2003) with common or best practice, which may be a reason why the importance to choose a sustainable approach to material selection was highlighted amongst those with this personality trait. Item ten was also significant $F(30, 182)=1.843$, $p<.01$ which had a medium effect size of $\eta^2=.23$. The need to minimise pollution in construction practices reflects responsibility (Hirsh and Dolderman, 2007), need for achievement (Furnham *et al.*, 2003) and thoroughness which is a common trait in individuals who are highly conscientious. At T2, the number of significant differences in scores doubled to four

items the first of which was question number four $F(30, 182)=1.722$, $p<.05$ (medium effect size $\eta^2=.24$). Statement seven was significant at $F(30, 182)=1.795$, $p<.01$ with a large effect of $\eta^2=.25$ which also reflects the responsibility and thoroughness which conscientious individuals possess as they felt that it is important to know where and how materials have been sourced. Item nineteen $F(30, 182)= 1.614$, $p<.05$ with a medium effect size of $\eta^2=.23$ may have been significant because individuals who possess this personality trait feel the need to deliberate and plan (Todd *et al.*, 2009) their actions carefully, therefore they would want to plan to use renewable energy and recycled materials where possible. Lastly statement twenty-two $F(30, 182)=1.574$, $p<.05$ which also had a medium effect of $\eta^2=.22$ was significant which may be because conscientious people may already live sustainable lifestyles (i.e. recycle, use environmentally friendly products etc.). They may feel that their own actions are enough to help the environment; therefore they may feel that the message of environmental degradation is indeed an exaggerated one. To summarize then, most of these statistically significant statements could be described as potential behaviours conscientious individuals would engage in.

Emotional stability did not detect any differences in scores before the project began, but after the final data had been collected, statement four was highly significant $F(38, 174)= 1.869$, $p<.005$. This finding had a large effect size of $\eta^2=.29$ which accounts for 29% of the variance in these scores. It is possible that respondents may have scored higher in emotional stability as the item was the importance of adopting a sustainable approach to choosing materials, therefore indicating a fairly level-headed response rather than a worrisome or anxious one.

The final personality factor was openness to experience which was able to detect differences among participant answers before the project began for item number four $F(30, 182)= 2.159$, $p<.001$ with a large effect of $\eta^2=.26$ and item ten $F(30, 182)=1.843$, $p<.01$ with a medium effect of $\eta^2=.23$. No differences were identified after the project had ended. It is likely that those who are high in openness to experience would be more likely to embrace the importance of adopting a sustainable approach to choosing materials and believe that the reduction of pollution should be an aim in any construction project through creative problem solving (Todd *et al.*, 2009).

An independent t-test was conducted to see if there were differences in the mean scores of responses given by males and females. The t-test concluded that in terms of

environmental aspects, there were no gender differences among responses. A further independent t -test was conducted to see if there were differences amongst those who had completed a sandwich year and those who had not. The results of the t-test surprisingly indicated that in statement number 16 at T2 those who had industry experience had lower scores ($\bar{x}$=2.42, S.D=1.29) than those who had not undertaken a sandwich year ($\bar{x}$=2.97, S.D=1.54). The mean difference was -.544 and the confidence interval ranged from -1.072 to -.016 t(208)= -2.030, p<.05. A small effect size of *d*=.39 was calculated.

10.2.7 Society Scale

In the society subscale six out of the eight statements correlated well with one another. Statement numbers can be referred to in table 33, section 10.2.2.

Statement	Mean	Standard Deviation	Correlation	Skewness	Kurtosis
2	4.59	1.56	.41**	-.48	-.75
2(T2)	4.71	1.48		-.59	-.35
8	5.76	1.07	.32**	-1.01	1.95
8 (T2)	5.44	1.15		-.80	1.15
11	5.99	1.12	.35**	-1.39	2.17
11 (T2)	5.62	1.33		1.33	1.36
14	5.33	1.13	.27**	-.62	.42
14 (T2)	5.15	1.37		-1.13	1.21
17	5.82	1.05	.22**	-.901	.940
17 (T2)	5.51	1.28		-1.13	1.21
20	5.81	.987	.20**	-1.19	3.10
20 (T2)	5.46	1.32		-1.12	1.27

** p<.001

Table 42. Descriptive statistics and correlations for society subscale (Self-study)

Paired t-tests showed that statement numbers eight, eleven, seventeen and twenty were statistically significant at times one and two.

Statement eight had a mean difference of .32 with a confidence interval ranging from .15 to .49, the mean for time one was ($\bar{x}$=5.76, S.D=1.07) and at time two ($\bar{x}$=5.44, S.D=1.15), t(212)=3.65 ,p<.001 (two-tailed) with a small effect size of *d*=.29.

Statement eleven had a mean difference of .37 with a confidence interval ranging from .19 to .57, the mean for time one was ($\bar{x}$=5.99, S.D=1.12) and at time two ($\bar{x}$=5.62, S.D=1.33), t(212)=3.88,p<.001 (two-tailed) with a small effect size of *d*=.31.

Statement seventeen had a mean difference of .31 with a confidence interval ranging from .11 to .51, the mean for time one was ($\bar{x}$=5.82, S.D=1.05) and at time two ($\bar{x}$=5.51, S.D=1.28), t(212)=3.09,p<.05 (two-tailed) with a small effect size of *d*=.27.

Statement twenty had a mean difference of .35 with a confidence interval ranging from .15 to .55, the mean for time one was ($\bar{x}$=5.81, S.D=.99) and at time two ($\bar{x}$=5.46, S.D=1.32), t(212)=3.43 ,p<.0 01 (two-tailed) with a small effect size of *d*=.30.

Table 43 demonstrates the correlations between personality and emotional intelligence factors and the corresponding item numbers which comprise the social subscale of the SAS.

Factor	2.	5.	8.	11.	14.	17.	20.	23.
Emotional Intelligence		.144*	.171*	.157*		.181**	.213**	
		.206** (T2)	.246** (T2)	.198** (T2)	.145* (T2)	.179** (T2)	.273**(T2)	
Extraversion				.193**	.154*	.201**	.192**	
Agreeableness			.324**	.210**	.209**	.234**	.207**	
			.168*(T2)	.166*(T2)	.186**(T2)	.146*(T2)	.163*(T2)	
Conscientiousness			.150*	.243**	.190**		.147*	
			.181**	.212**	.253**	.177**	.166*	
Emotional Stability					-.135*			
Openness to Experience			.236**	.250**			.157*	
		.140*(T2)	.231**(T2)			.140*(T2)	.165*(T2)	

** p<.001 *p<.05

Table 43. Correlations between the items in the society subscale and psychological factors (Self-study)

To further explore any relationships between the psychological factors used and the items of the society subscale, ANOVAs were conducted to see if changes in the mean scores could be identified. Before the students were given the brief of the joint project, their emotional intelligence scores seemed to suggest that some believed that communities would not benefit from what the BUE does (statement number five) $F(57, 155)=2.066$, $p<.001$. This finding had a large effect size of $\eta^2=.43$ which means that 43% of the variance is explained by individuals' level of emotional intelligence. After the project had been completed, ANOVA indicated that there were differences between the means of statement number two $F(57, 155)=2.007$, $p<.001$ which had a large effect of $\eta^2=.42$. This finding may indicate that those who were lower in emotional intelligence are of the opinion that it is not enough to care for the environment on an individual level, it must be enforced by government if it is going to be effective. Item number five was also significant $F(57, 155)=1.738$, $p<.005$ with a large effect size of $\eta^2=.38$ again confirming that it is likely that this cohort had lower levels of emotional intelligence. Statement fourteen $F(57, 155)=1.454$, $p<.05$ which had a very large effect of $\eta^2=.54$ signifying that 54% of the variance of answers on the statement were explained by the level of emotional intelligence the respondent had. Perhaps this result emerged because the respondents were able to express concern for others and what effects construction may have on their well-being, and thus feel that it is important that the construction industry informs the wider community of the effects it is having on the environment. Statement twenty $F(57, 155)=1.592$, $p<.05$ had a large effect of $\eta^2=.37$ was significant. Just as statement five was significant by those who scored lower on emotional intelligence, the opposite response was seen by those who appear to have high levels of emotional intelligence by acknowledging that communities may indeed benefit from what the BUE does.

Extraversion was able to distinguish between the differences in scores for statement five before the intervention took place ($F(34, 178)=1.65$, $p<.05$)and it could be that those who are somewhat to highly sociable would want to inform the wider community of the benefits of BUE activities while those who are more introverted might not see the benefits of doing so. The effect size of this finding was medium in size as eta-squared $\eta^2=0.25$. This cohort seemed to only be likely to express how communities are not benefitting from what the BUE does. Swami *et al.* (2010) found extraverted women to be highly concerned about the environment while those who scored lower on extraversion were not as worried about the environment. The opposite result was found for males.

Although a majority of the sample was male, it is not known if this data follows the same pattern of results as Swami *et al.* (2010) reported.

At T1 agreeableness distinguished item eight significant at $F(30, 182)=2.831$, $p<.001$ with a large effect size of $\eta^2=.32$. Highly agreeable people were of the opinion that land should be thoroughly inspected before it is developed as the inspection would uncover anything harmful which might affect the users of the building in the future displaying their philanthropic tendencies. Item eleven was significant at $F(30, 182)=1.59$, $p<.05$ with a medium effect of $\eta^2=.21$. As those who are agreeable are helpful and compassionate, it is reassuring to find that they felt that it was the current generation's responsibility to protect the environment for the benefit of future ones. Lastly, item seventeen $F(30, 182)= 1.788$, $p<.05$ had a medium effect of $\eta^2= .23$. Agreeable individuals also felt that the only way resources would be saved is by increasing the awareness of society, therefore enabling them to make sustainable choices. No differences were found at T2.

When assessing whether different levels of conscientiousness distinguished between the mean scores of participants' answers, only statement eleven $F(57, 155)=1.825$, $p< .01$ was significant before the project started. It did however have a large effect size of $\eta^2=.25$. As the conscientious trait is associated with dutifulness and responsibility (Furnham *et al.*, 2003; Hirsh and Dolderman, 2007) it was not supported that this statement of current generations protecting the environment for future generations was significant. Upon completion of the project, participant answers differed more prominently as item eleven was still significant $F(57, 155)=1.783$, $p<.01$ which had a large effect size of $\eta^2=.25$. Item fourteen $F(57, 155)=1.506$, $p<.05$ had a medium effect size of $\eta^2=.22$ suggesting that the responsibility and duty that conscientious individuals feel was expressed in their agreement with the statement that the industry should inform the wider community about the effects construction has on the environment. Statements seventeen $F(57, 155)=2.388$, $p<.001$ and twenty $F(57, 155)= 2.045$, $p<.005$ both had large effect sizes calculated at $\eta^2=.31$ and .27 respectively. It is therefore likely that spreading awareness could reduce the waste of materials unnecessarily and the BUE having the potential to benefit communities are seen as attainable tasks to highly conscientious individuals.

The ANOVA showed that emotional stability was the only psychological factor which was unable to detect any differences in mean scores.

The level of participants' openness to experience indicated that at T1 item number eleven had differences in the mean scores F(30, 182) = 1.962, p<.005. This finding had a medium effect size of η^2=.24. It may be that those who are highly open to experience allow themselves to be in tune with their feelings, therefore feel that it is the duty of current generations to protect the environment for those in the future by coming up with effective solutions by which to protect the environment.

At T2 item number five F(30, 182)= 1.819, p<.01 and statement number twenty-three F(30, 182)= 1.718, p<.05 also showed that there were differences in the scores given by participants. Both of these statements indicated medium effect sizes of η^2=.23 and .22. Possibly those with higher levels of openness to experience feel that bad practise is the result of poor planning and management as more innovative solutions were not thought of. The results would indicate that those who scored lower on openness to experience believe that the BUE will not benefit communities.

Independent t-tests were conducted with gender which indicated that item numbers two and eight highlighted gender differences. For item number two males scored on average ($\bar{x}$=4.48, S.D=1.57) and females scored ($\bar{x}$=5.28, S.D=1.21) with a mean difference of -.798 and the 95% confidence interval ranging from -1.344 to -.252 t(209)=-2.880, p<.005 (two-tailed) indicating that females tended to have a higher opinion of legislation being the only way to make the construction industry change its practices. The effect size of this t-test was medium at *d*=.58. Statement number eight also indicated that females score higher when asked about land inspection issues ($\bar{x}$=6.14, S.D=.867) than males ($\bar{x}$=5.69, S.D=1.08). In this instance, equality of variance could not be assumed, but nevertheless, the t-test was significant t(209)= -2.696, p<.01(two-tailed) with a mean difference of -.447 and a confidence level interval of -.78 to -.115. The effect size was small *d*=.46.

A further independent t-test was conducted to explore whether students who had taken a sandwich year gave different answers to those students who had not but the t-test revealed no such differences.

10.2.8 Economic Scale

In this subscale, seven out of the eight statements correlated with each other at the recommended level. The statements which correlated with each other can be seen in full in table 33, section 10.2.2.

Statement	Mean	Standard Deviation	Correlation	Skewness	Kurtosis
3	5.23	1.17	.31**	-1.03	1.27
3(T2)	4.88	1.30		-.450	-.340
6	3.43	1.36	.23**	.280	-.330
6 (T2)	3.79	1.61		.162	-.641
9	5.64	1.21	.20**	-1.18	2.00
9 (T2)	5.45	1.34		-1.11	1.18
12	5.47	1.23	.26**	-1.12	1.51
12 (T2)	5.38	1.30		-.982	1.23
15	5.47	1.41	.36**	-1.18	1.04
15 (T2)	4.88	1.41		-.65	.133
18	2.68	1.54	.27**	.929	.046
18 (T2)	3.45	1.81		.382	-1.00
24	5.80	1.04	.20*	-1.34	3.38
24 (T2)	5.32	1.44		-1.11	.706

** p<.001 *p<.05

Table 44. Descriptive statistics and correlations for economic subscale (Self-study)

Statement three had a mean difference of .36 with a confidence interval ranging from .16 to .55, the mean for time one was ($\bar{x}$=5.23, S.D=1.17) and at time two ($\bar{x}$=4.88, S.D=1.27), t(212)=3.61 ,p<.001 (two-tailed) with a small effect size of d=.29.

Statement six had a mean difference of -.36 with a confidence interval ranging from -.61 to -.12, the mean for time one was ($\bar{x}$=3.43, S.D=1.36) and at time two($\bar{x}$=3.79, S.D=1.56), t(212)=-2.89 ,p<.005 (two-tailed) with a small effect size of d=.25.

Statement fifteen had a mean difference of .59 with a confidence interval ranging from .38 to .79, the mean for time one was ($\bar{x}$=5.47, S.D=1.38) and at time two ($\bar{x}$=4.88, S.D=1.39), t(212)=5.48 ,p<.001 (two-tailed) with a small effect size of d=.43.

Statement eighteen had a mean difference of -.76 with a confidence interval ranging from -1.05 to -.50, the mean for time one was ($\bar{x}$=2.68, S.D=1.54) and at time two ($\bar{x}$=3.45, S.D=1.81), t(212)=-5.56 ,p<.001 (two-tailed) with a medium effect size of d=.50.

Statement twenty-four had a mean difference of .48 with a confidence interval ranging from .26 to .71, the mean for time one was ($\bar{x}$=5.80, S.D=1.04) and at time two ($\bar{x}$=5.32, S.D=1.44), t(212)=4.41 ,p<.001 (two-tailed) with a small effect size of d=.39.

Factor	3.	6.	9.	12.	15.	18.	21.	24.
Emotional Intelligence	.165*		.156*					
			.206**(T2)	.142* (T2)				
Extraversion						-.215**		.182**
Agreeableness			.168*	.185**		-.245**		.140*
			.153*(T2)	.177*(T2)			.148*(T2)	
Conscientiousness			.190**	.184**	-.178**			
			.150*(T2)	.236**(T2)				
Emotional Stability	.146*							
Openness to Experience			.172*			-.177**		
						-.229**(T2)		

** p<.001 *p<.05

Table 45. Correlations between the psychological factors and items which are in the economic subscale (Self-study)

The table above highlights the statistically significant correlations that emerged between the psychological factors and the individual items in the economic subscale of the SAS. Further analysis into what these values mean using ANOVA suggests that emotional intelligence indicated that there were differences in scores regarding choosing the cheaper option than the environmental one (statement number 15) $F(57, 155)=1.464$, $p<.05$. The eta-squared value was calculated at .35 signifying a large effect size. No differences were identified at T2 though. It is quite unusual to have a significant result on emotional intelligence to economic aspects but it could be that those who do not take into account the state of others, or the environment, are more likely to think about the financial implications of a project. Therefore they might find it easier to choose the cheaper (non-environmentally friendly option) as it seems plausible that they would not want to pay more than they have to for what materials they need.

Extraversion indicated differences in scores relating to item number twenty-four which discussed cutting down waste and the implications that could have on monetary savings at T1 $F(34, 178)=1.608$, $p<.05$ with a medium effect size of $\eta^2=.23$ while no differences were highlighted by the ANOVA at T2. It could be that discussion and the exchange of ideas on waste management and having less waste on site may lead to financial benefits which extraverted individuals are likely to share with others.

Agreeableness was the factor which seemed to show the highest number of differences between scores as T1, item number nine $F(30, 182)=2.458$, $p<.001$ with a large effect size of $\eta^2=.28$ was significant. It would appear that highly agreeable individuals see the importance and usefulness of evaluating whether it is worthwhile refurbishing a building rather than building a new one.

Statement twelve was significant at $F(30, 182)=1.826$, $p<.05$ with a medium effect size of $\eta^2=.23$. As with statement nine, those who were highly agreeable are more likely to have responded in this way as companies who report their sustainability plans are making society and other companies aware of their achievements and how they are helping the environment. On the other hand, statement number eighteen $F(30, 182)=1.666$, $p<.05$ (medium effect of $\eta^2=.22$) seems to have been a significant statement to those who scored lower on agreeableness as helpfulness is an inherent quality in this personality trait, and therefore highly agreeable people would want to practice sustainability irrespective of the financial benefits it has. Lastly, statement twenty-four was significant $F(30, 182)=1.698$, $p<.05$ with a medium effect of $\eta^2=.22$. This statement may have been answered in this way by those who are highly agreeable as they will be more likely than those who scored low on agreeableness to want to reduce waste and

not use an unnecessary amount of resources but are still aware of the fact that doing good can lead to financial benefits as well. At T2, statement number six was significant $F(30, 182)=2.444$, $p<.001$ with a large effect size $\eta^2=.29$. Those who were highly agreeable will have responded in this way as someone who is consciously trying not to degrade the environment would not spend money or materials when they are not needed. Item nine was significant $F(30, 182)=1.556$, $p<.05$ with a medium effect size of $\eta^2= .20$. Again, it is those that want to help others who believe that it is important to first establish whether an existing building can be refurbished before more materials need to be consumed to construct a new building. Item twenty-one was significant $F(30, 182)=1.977$, $p<.005$ with a large effect size $\eta^2=.25$. Again, this response suggests that those who are agreeable would want to believe that anything be it technology or individual actions would help promote sustainability. Finally, item twenty-four was statistically significant at $F(30, 182)=1.760$, $p<.05$ with a medium effect size of $\eta^2=.22$, which confirms the findings from T1.

Conscientiousness was only an indicator of differences in mean scores on statement 12 $F(33, 179)=1.583$, $p<.05$ with a medium effect size of $\eta^2=.23$ at T1 but not T2. This result might be an indication that the respondents only seemed to agree that there is a need for companies to publish their sustainability plans and targets because conscientious individuals tend to be high achievers, reflects a behaviour that they themselves would tend to perform.

The analysis including emotional stability was unable to find any differences among economic responses at T1 and T2.

Openness to experience at T1 did not find any differences between scores but at T2 statement number 18 $F(30, 182)= 2.072$, $p<.005$ (large effect of $\eta^2=.25$) and twenty-one $F(30, 182)=1.861$, $p<.01$ (medium effect size of $\eta^2=.22$) were highly significant. Respondents to this question may have scored lower on openness to experience as they seemed to agree that sustainability was only worthwhile if it reduces costs. Those who scored higher on the openness trait felt optimistic that technological advancements would not further degrade the environment as innovative technology reflects creative ideas which are something that agreeable individuals can relate to.

Independent t-tests were conducted to compare the mean scores given by males and females. Item twenty-four was the only one in which differences were noticed as males scored higher ($\bar{x}=5.86$,

S.D=1.013) than females ($\bar{x}$=5.47, S.D=1.13) t(209)= 2.06, p<.05 (two-tailed) with a mean difference of .391 and a confidence interval ranging from .017 to .764. A small effect size was evident as *d*=.36.

A further investigation into differences in means led to an independent t-test to be run for those who had completed a sandwich year and those who had not. The results indicated that statement number 15 at the end of the two week project highlighted differences in scores. Students that had taken a sandwich year out in industry scored higher ($\bar{x}$=5.29, S.D=1.43) than students who had not taken a year out ($\bar{x}$=4.78, S.D=1.37). The mean difference between these scores was .510 with a confidence interval of .023 to .998 t(209)=2.065, p<.05 (two-tailed). The effect size here was small *d*=.36. The reason for this difference in answers is that those who had exposure to the construction industry would be more aware that cost dictates a lot of the practices which can often be the cheaper options rather than the more beneficial environmental ones.

A factor which was different in the data collected in 2012 from 2011 was that prior to the group project, three programme modules were given a one-off lecture on sustainability which matched the topic of each module. T-tests were conducted to see whether individuals who had these one-off sessions had different scores from those who did not. Environment was the subscale with three items which had differences in mean scores at T2. Statement number seven indicated that those who had the one-off lecture were unable to appreciate the importance of where materials come from and how they are sourced as their means were ($\bar{x}$=5.13, S.D=1.42) while those who did not have the intervention had mean scores of ($\bar{x}$=5.60, S.D=1.17) t(209)=-2.58, p<.05 (two-tailed). The mean difference was -.473 and the 95% confidence level was -.835 to -.111. A small effect size was present *d*=.36. Item number thirteen was also one in which the independent t-test was able to highlight differences amongst those who had the sustainability lecture ($\bar{x}$=4.77, S.D=1.32) and those who did not ($\bar{x}$=5.18, S.D=1.38). The mean difference was -.410 and the 95% confidence level was -.802 to -.019 t(209)= -2.11,p<.05 (two-tailed). The effect size of this finding was small at *d*=.30. Finally, statement number twenty-two highlighted differences in means as those who had received the one-off session scored ($\bar{x}$=4.06, S.D=1.37) and those who did not receive the session scored ($\bar{x}$=3.28, S.D=1.51) t(209) = 3.63, p<.001 (two-tailed). The mean difference was .777 and the confidence intervals ranged from .355 to 1.19. A medium effect size of *d*=.54 was calculated. This finding would suggest that students who received the session on sustainability believed more strongly that the impact the BUE has on the environment is largely inflated.

In the society subscale only question number two at T2 indicated a statistically significant difference in means as the students who did not receive the sustainability lecture scored ($\bar{x}$=4.87, S.D=1.54) while those who did scored ($\bar{x}$=4.39, S.D=1.31). The mean difference was -.488 while the 95% confidence interval was -.910 to -.066 t(209)= -2.28, p<.05 (two-tailed). A small effect size of *d*=.34 was calculated. This would suggest that students who did not attend the session believed more strongly that legislation would be the only way for the construction industry to change its ways.

For the economic subscale, statement number six indicated that there was a difference in means between those who had the lecture($\bar{x}$=3.09, S.D=1.40) and those who did not ($\bar{x}$=3.60, S.D=1.31). The mean difference was -.516 while the 95% confidence interval range was between -.900 and -.131 t(209)=-2.64, p<.01 (two-tailed). A small effect size of *d*=.37 was found.

Out of these results, it is interesting to see that item twenty-two in the environmental subscale was the only item in which the students who had received a sustainability lecture scored higher. The statement was worded in such a way which conveyed that the environmental impact that the built environment has is largely exaggerated. It could be that the context specific sustainability sessions made students realise that sustainability is already being addressed in certain construction practices but it is not being called sustainable thus media may be reporting the environmental impacts negatively.

Table 46 is a visual representation of the above results from ANOVA analyses.

		Environmental									*Society*								*Economic*							
		1.	4.	7.	10.	13.	16.	19.	22.	25.	2.	5.	8.	11.	14.	17.	20	23.	3	6	9	12.	15	18	21	24
Emotional Intelligence	2011 T1									X																
	T2						X			X																
	2012 T1						X					X											X			
	T2			X			X	X			X	X			X		X									
Extraversion	2011 T1										X	X														
	T2					X		X					X						X	X				X		
	2012 T1											X														X
	T2			X		X																				
Agreeableness	2011 T1											X		X			X							X		X
	T2			X	X	X				X			X	X		X	X									
	2012 T1		X	X	X	X	X	X		X			X	X		X					X	X		X		X
	T2				X															X	X				X	X
Conscientiousness	2011 T1			X		X							X	X			X	X	X		X	X			X	
	T2		X		X																X					
	2012 T1			X	X									X								X				
	T2		X	X				X	X					X	X	X	X									
Emotional Stability	2011 T1		X				X				X		X				X						X			X
	T2			X							X						X		X							
	2012 T1																									
	T2		X																							
Openness to Experience	2011 T1			X																						
	T2				X		X							X							X	X			X	
	2012 T1		X		X									X												
	T2											X						X						X	X	

Table 46. ANOVA chart of all significant results found in 2011 and 2012 data items in T1 and T2. Shaded areas did not have significant results (Self-study)

10.3 Student Experience/Reflections

Branch and Paranjape (2002) felt that reflection was an imporant part of learning for medical students. Dirkx *et al.* (2006) are also proponents of reflection as an integral part of learning, therefore, as a part of the Joint Project, BUE students were asked to write a 2000 word essay reflecting on their experience of working on a sustainability project. Instructions for the essay were as follows:

Reflect on the project you have just completed. Detail your knowledge of and attitudes to sustainable construction and buildings at the beginning and end of the project. You might consider including in your reflective essay:

1. What have you gained in terms of your future contribution to sustainability as a property or construction professional?
    (a) This could, for example, be related to building skills and competencies
2. Did your attitude towards sustainability change at any point during the Joint Project? You could reflect on:
    (b) Your understanding of, and attitude towards, sustainability, at the start of the project.
    (c) Whether something specific during the project has influenced and / or changed your attitude? This could include the impact of other team members' opinions.
    (d) Do you think this experience will make you change your behaviours regarding sustainability practices now or in the future?

1 (a) regarding what competencies students felt they gained related to the final question which both programme and module leaders were asked during their interviews. The researcher wanted to compare whether the students reportedly gained the sort of competencies that the academics seemed to think they needed to gain in order to be able to handle sustainability information (table 25, question 11; section 8.2). These results will be discussed in the sections that follow.

Two hundred and twenty-three final year students wrote a reflective essay. Due to the sheer number of students that undertook the Joint Project, having to further recruit students and arrange interviews would have been too time-consuming (Appendix 16). Therefore the answers which were written out by the students served as qualitative data for the researcher which is a method which has been used in previous research (Loughland *et al.,* 2002). However, a majority of the data provided by the students were not reflective accounts of their experience of the project but more of a summary of what they did.

10.3.1 Overall experience:

As mentioned in section 8.4 discursive phenomenography was used in the analysis of the academic interviews. The same method will therefore be used to analyse data provided by the students. Discursive phenomenography flows naturally from phenomenographic assumptions and is about mapping the conceptions of an experience (Hasselgren and Beach, 1997; Mann *et al.,* 2007). The diagram below is the mapping of student conceptions.

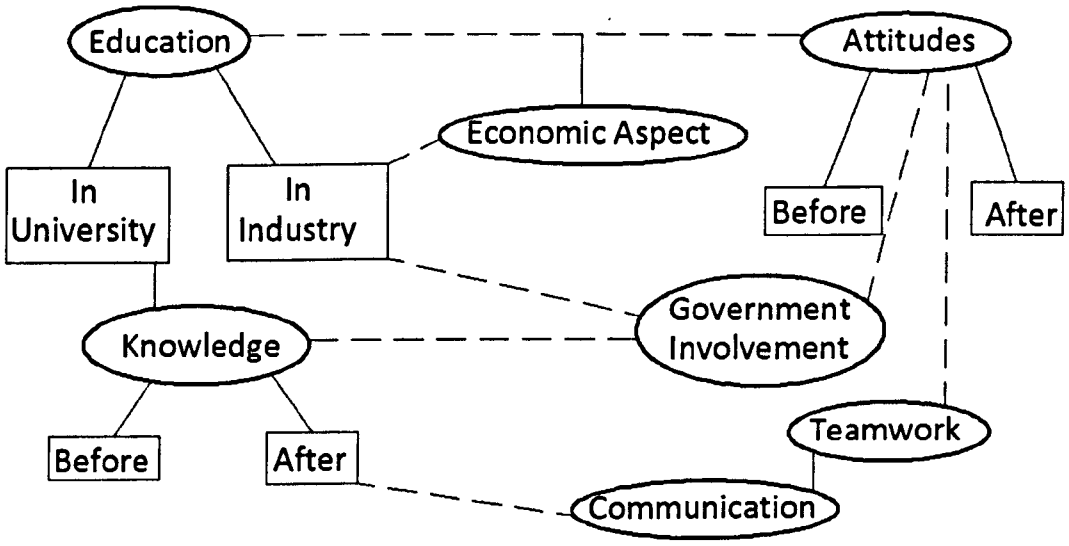


Figure 15. Students' experience of the Joint Project (Self-study)

Diagram 15 above depicts the various categories which emerged out of the analysis using the student essays. These seven categories are Attitudes, Education, Knowledge,

Government Involvement, Team work/Communication and Economic aspect. Within the analysis the categories have been classified further by assigning them to direct experience and reflection subcategories. See table 47 below.

Direct Experience	Reflection
Category1a: Attitudes	Category1b: Education
Category 2a: Knowledge	Category2b: Government Involvement
Category 3a: Team work/ Communication	Category3b: Economic Aspect

Table 47. Categories of the Joint Project student experience (Self-study)

The reasons for this classification are firstly that phenomenography is interested in the experience which people have regarding a certain phenomenon (Mann *et al.,* 2007). Secondly, in line with what the students were asked to reflect upon in the essay, certain categories kept emerging which did not relate directly to their personal experience. These emerging categories seemed to indicate the knowledge which students have gained either through their degree or from the joint project itself which seemed to help them in their reflective task- resulting in a reflection category. Therefore the categories which will be investigated under the experience grouping are attitudes, knowledge and team work/communication and those that will be explored under reflection will be Education, Government Involvement and Economic aspect.

10.3.1.1 Direct Experience:

Referring to table 47, the following sections will outline the categories which emerged from the students' direct experience of the joint project.

10.3.1.2 Category 1a: Attitudes

The attitudes held by the students could be classified into 'before' and 'after' as they reflected on their opinions regarding sustainability. *"I myself had negative views towards its involvement in construction before the joint project"* others reported to have "*naïve*" views about sustainability stating that they believed *"sustainable construction and buildings were too expensive"*. Others were dubious as to how sustainability could become an integral part of the construction industry: *"before the start of the Joint Project my thoughts towards* ***'sustainability'*** *were very passive and inert, I knew minor things about the topic through television adverts and articles but I wasn't sure how this could be*

fully adopted within the construction industry". On the other hand however, some students said that they felt positively towards sustainability before the start of the project *"my attitude towards sustainability at the start of the project was a positive one I believe, as I do recognize the advantages of thinking sustainably and agree with the reasoning behind constructing sustainable buildings".*

Following the completion of the Joint Project the response from students was that for the most part they had experienced a change in attitude *"I can now reveal my attitude has changed in favour of incorporating sustainability into all new construction projects in the future as well as renovating buildings today".* Some of the students however said that *"the joint project has not changed my attitude towards sustainability, more the case of looking at it from a different angle",* but that their level of knowledge regarding sustainability certainly had changed. Other attitudes which the final year students expressed were *"I have realised that sustainability in the real world has to be a frame of mind, not just a one-off consideration"* and that overall, sustainability is everyone's responsibility *"I believe this responsibility is down to us as a generation".*

10.3.1.3 Category 2a: Knowledge

As with the attitudes category, the knowledge category can also be divided into 'before' and 'after' clusters as the students often reflected on what they knew before undertaking the Joint Project and were very aware what they had gained during the project.

Students' assessment of their knowledge was divided into roughly three bands, those that had very little knowledge, those that only possessed theoretical knowledge or those that had a fair to good level of knowledge of what sustainability was.

Students who expressed their knowledge about sustainability as limited or at very best, basic stated: *"Prior to the joint project my beliefs and knowledge of sustainability were very basic, however I was aware that within the construction industry it was becoming an ever growing concern to be more sustainable but I wasn't fully aware of the reasons why it was and how you can become more sustainable".* Others went on to acknowledge that even if they had a good amount of knowledge, it was *"purely theoretical".* A handful of students believed they had a good amount of knowledge beforehand yet felt that the

experience of the Joint Project was still beneficial *"it was insightful to see how applied sustainability works in a construction project"... "On refection I can identify that my knowledge, understanding and attitude towards sustainability has positively developed".*

After the project, students reflected on the information which they had gained by saying: *"I have always been interested in the sustainability and development of building in this manner, this however has given me a greater knowledge and view point upon certain problems".* Participants also commented on specific elements in which their knowledge improved *"I feel that I have learnt a lot about sustainability in the community, construction, materials and labour and this is useful knowledge that I can use in the future. Also I feel I have reassured myself with regards to my knowledge of sustainability in waste management and sustainable or green technologies"* as well as what improved them, such as conducting research.

10.3.1.4 Category 3a: Team Work/Communication

A third category which was mentioned in conjunction with both attitudes and knowledge was that of group work and the influence it had: *"I thought I had a good knowledge of how a project works but after working within a group of this scale I've realised there's so many more underlying factors to consider, which are just as important as the buildings themselves".* Another element which received mention was communication as this seemed to make individuals aware that quite a few of them wanted sustainability present in the project *"I was amazed when we first discussed what our plan of action was, that everyone wanted to know how we were going to incorporate sustainability into it. This shocked me as I thought people would be interested in making money in the project but our group set out to create a sustainable legacy".*

The reason for these two elements being combined is that, had the project not involved team work, communication would not necessarily have had such a vital role in influencing other members of each group. The category of team work and communication will be explored further shortly as it was mentioned as a key competency which the students feel that they gained as a result of working on the Joint Project.

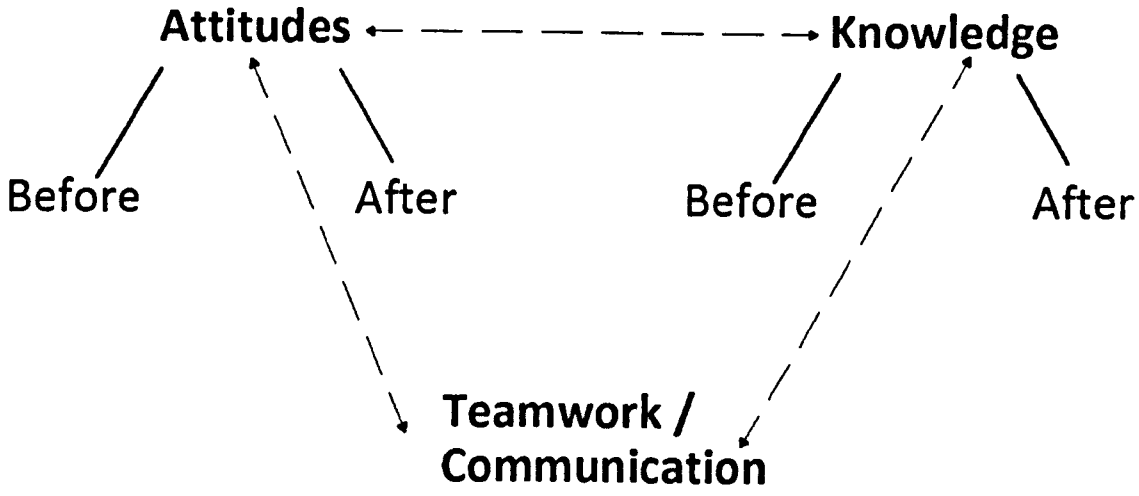


Figure 16. The interconnectedness of Teamwork/Communication on the Attitudes and Knowledge of the students (Self-study)

To summarise the direct experience section of the analysis, figure 16 depicts that through team work and communication, both the attitudes and knowledge of the students were influenced thus resulting in improved knowledge and changed attitudes amongst the majority of the participants.

10.3.2 Reflection

The thorough reading of students' essays revealed additional categories which did not directly link in with their experience of the Joint Project, but could be seen affecting sustainability and their thoughts of how sustainability could be implemented.

10.3.2.1 Category 1b: Education

A large number of students felt that education was a crucial part in changing the attitudes people have: *"I do believe gaining knowledge on subjects helps to change or reinforce beliefs and views and that generally education is the key factor for instigating any change. This is even more relevant when we are looking at changes in longstanding beliefs that the processes and methods of sculpting our environment and living spaces are correct and a good way to do things".* This statement coincided with another one where a student had

made the observation that *"People within construction tend not to fully understand what sustainability is which therefore leads to practices being slow to change".*

Also in the education category, students' musings reported a division between education that is to take place in university, and that which is to happen in the industry. Some students felt that their degree and certain modules had *"provided 'food for thought' regarding the subject of sustainability, forming the basis of my knowledge and understanding".* Others were of the opinion that universities in general could do more to promote sustainability knowledge and that the sooner individuals are educated *"the sooner we can pull the world out of the disaster we have got it into".* Respondents felt that being able to demonstrate sustainability knowledge would also lead to improved *"input to future jobs... and I will demonstrate the necessity of sustainable techniques to my fellow employers and employees".*

This cohort of students felt that their knowledge gained at university should be passed on to colleagues when out in industry: *"I learnt that it was the construction professionals that need to educate other stakeholders in the built environment".* Although the students managed to link the need for education to attitudes (Figure 15) students were of the opinion that *"the fastest way to implement sustainable practices in the industry would be to educate and encourage clients (especially government) to consider sustainability and how it will be implemented at the tender stage, as I feel the client holds a lot of power in regards to the implementation of sustainability in a project".* This quote would therefore suggest that students believe that with improved knowledge a more positive attitude towards sustainability would follow and thus sustainability would be practised more readily. Murray (2011) wrote that a change in attitude could be achieved if an individual is receptive to additional information on a certain matter. Maio and Haddock (2010) added that when information that is relevant to the attitudinal topic is considered it may help to form an attitude which is supported by coherent information and argument rather than irrelevant information.

10.3.2.2 Category 2b: Government Involvement

This category links in with the previous one as students reflected that awareness of sustainability within the industry could lead to an *"improved image"* of construction

practices by making sustainability "*compulsory*". Therefore *"if the government were to set out guidelines which clients, architects and contractors have laws to abide by when designing new buildings then sustainability can become more widespread"* the way in which this was proposed was by *"incentives and investment ...rewarding occupants of greener and intelligent buildings with savings such as tax breaks or subsidies etc."*

Figure 15 depicts that this Government Involvement category links in with attitudes, knowledge and industry therefore reflecting the fact that the level of knowledge government for example has regarding sustainability will reflect on the type of legislation that is passed. This in turn will affect the way in which the industry is to carry out construction practices while all of this will, whether it is good or bad, have an impact on one's attitude.

10.3.2.3 Category 3b: Economic Aspect

The final category which reflected students' thoughts on aspects affecting sustainability included economic facets. The financial side of the joint project appeared to give the students an introduction into the workings of triple bottom line as summaries related to having to consider both sustainability and economic viability: *"I now consider the incorporation of sustainability within projects to be a balancing act with regards to the cost and viability"* as well as considering how *"costs need to be cut as much as possible and resources used to their maximum"*. Some expressed that economics would be a hindrance to sustainability: *"I do not believe that a lack of knowledge is the main issue but in this current climate I tend to think that financial restraints are the main issue within the industry as sustainable construction tends to be a lot more expensive"*.

Figure 15 illustrates the relationships between the seven categories which emerged from the data provided by the students. The economic aspects can have an effect on what happens within the construction industry. Education and attitudes can also influence economic aspects as through education one would have a better awareness of costing and how sustainability could be implemented without economic deterioration. It could be that the experience of applying sustainable economics successfully might positively change attitudes. By having had to deal with costing, albeit imaginary, the students will

have an idea as to what will be expected of them in the construction industry if they are involved with the cost of construction.

10.3.3 Competencies:

The types of competencies which students reported that they gained during the participation of the Joint Project can be summarised into three main categories which are knowledge, personal skills and communication skills. These can be summarized in Figure 17 below:

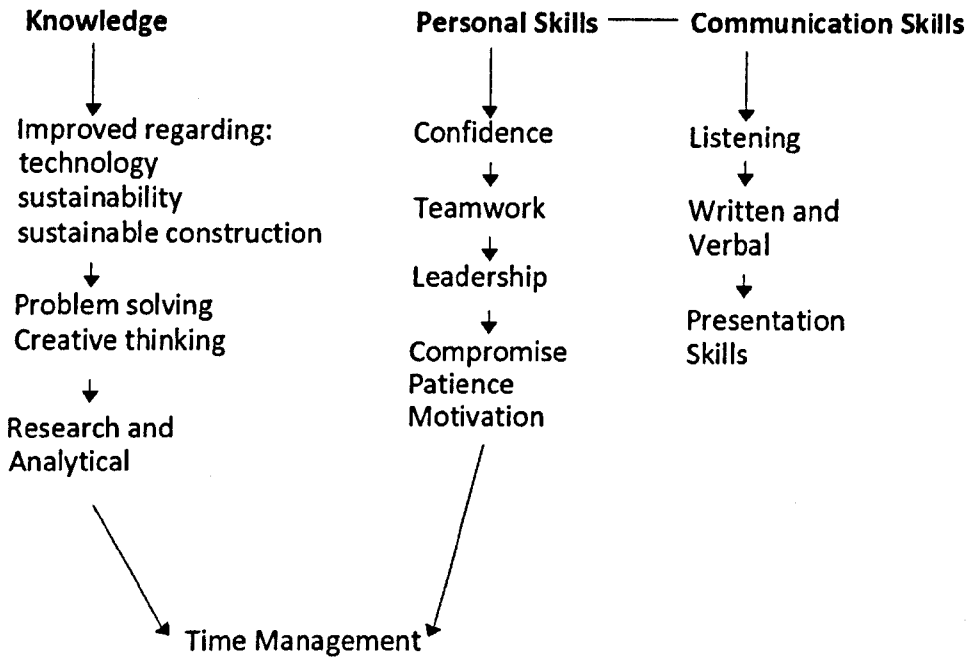


Figure 17. Gained competencies reported by students (Self-study)

Elements which came up in the knowledge category related directly to improved knowledge regarding sustainable construction, available technologies, as well as a better understanding of sustainability-including economic aspects: *"for example the quantity surveyors were very much aware of the economic side of sustainability, this integration of knowledge and skills was key to me understanding a different side to sustainability."* Other aspects which were relevant to knowledge were problem solving skills which often included creative thinking to arrive at some resolution *"Sometimes thinking out of the box is much more effective and time saving than following the guidelines set by others".* Students also commented on improved research and analytical skills which would relate

to knowledge acquisition *"after a lot of research and general knowledge we were convinced the ideas were good"*. Finally the skill of time management was also classed as a personal skill because while for some people it is more of an inherent characteristic; it is one that can be learned *"I have been able to improve ... my timekeeping skills"*.

Personal skill competencies which the students reportedly gained were elements such as confidence *"building up confidence within a working environment and working alongside other professionals"* although this was also highlighted as an area of improvement for others in voicing their opinions to their large groups: *"I would also want to gain more confidence so that I could participate in the presentation"*. Team work was also mentioned as something that was essential in completing the project in a timely manner *"ultimately I have established that through research, teamwork and discussion, solutions to overcome barriers can be achieved"*. Other personal skills which were mentioned often were leadership *"By becoming Lead Quantity Surveyor I have shown that I have leadership qualities and excellent communication amongst a team"*, patience and motivation as well as compromise. *"Through verbal discussion it was noted that ideas would be compromised through using only certain ideas of each discipline."*

The last category, which was communication skills, was not included under the personal skills category, as it was in the analysis conducted on academics' interviews because there were certain sub-categories of communication which kept being mentioned by the students, therefore it has a line connecting it to personal skills in figure 17. In their reflections, students mentioned the need to listen to the opinion of others and value what they had to say; *"Listening to and understanding the different views of the other members of the team helped me to realise that sustainability can come in different forms depending on the individual's profession"* this could also lead to increased awareness on a personal level: *"I did this by listening to others ideas in group discussions"*. Students also commented on the need for both verbal *"Communication in the group was key. To ensure good communication we used a variety of methods such as face-to-face, telephone, email and if necessary Facebook. I believe my communication skills have greatly improved from this project"* ..."*effective communication paired with daily communication was certainly present"* and written communication *"I have found that not only has it helped to develop my personal skills, such as both spoken and written communication, listening, problem*

solving etc". Students would also comment on their experiences of presenting in front of their peers to a panel of expert judges, which has also been classed under communication skills because a traditional presentation includes both written and verbal forms of communication.

Pappas (2012) cited Thorsen (2004) who offered her thoughts on how to foster individual responsibility for sustainability which included five skills which were communication, problem solving, and decision making skills as well as change management and creativity.Thorsen added that teaching students their responsibility as individuals would be the first step in achieving sustainability at a global level. For the most part, these recommendations which Thorsen made are visible within the competencies students identified within themselves. Specifically communication, decision making and problem solving skills.

As referred to by Moore (2005c), the nature of the Joint Project is for collaboration to take place within all members of the group by making contributions towards the end goal. Collaborative problem solving as well as conflict resolution assumes that solutions can be worked out by listening and understanding the varying points of view team members can have. This was something that was confirmed by the students' statements as conflict did arise and they mentioned that compromises were made.

Indirectly, the purpose of the reflective essay was to see if any of the students were able to express, or allude to, transformative learning as a result of the Joint Project. Through the critical review Taylor (2007, p. 174) conducted on transformative learning research "confirmed the essentiality of critical reflection, a disorienting dilemma as a catalyst for change" these elements appear to have been present in the Joint Project as two such instances were identified from the qualitative data. One student stated beginning to experience transformative learning *"After visiting the innovation park my views were of mixed opinion, I could see both advantages and disadvantages of sustainable materials used and the various techniques adopted"*, whereas another student came to the realisation that a transformational experience is necessary for change to occur *"After this process I am now of the opinion that people will not change their opinion simply by being told to do so. Opinions and attitudes can only be changed through a process of acquiring knowledge on a subject and then forming new, possibly contrary opinions on that subject*

due to the new information that they have gained meaning that a new opinion can be formed".

The critical reflection which Taylor (2007) mentions came from the requirement for all of the students who took part in the Joint Project to write a reflective essay. Through these essays the disorienting dilemma expressed by the students was having to work with a multidisciplinary team with varying degrees of understanding about what sustainability is and how it should be applied into a hypothetical development exercise. Within the essays, students kept bringing up the experience of working in groups of many disciplines to a tight schedule which seemed to contribute to the learning experience. For two weeks the students were not involved with any other learning or teaching therefore reinforcing the context of it being a development project. While this was expressed by the students as a challenge, Dirkx *et al.* (2006) mentioned that the support from others was what would ultimately lead to a transformational change, lending support to the fact that the project did have elements conducive to transformational learning. On the whole however, only a very few transformative experiences were reported by the students. This would confirm what Taylor (2007) noted, that it would be very difficult to achieve any more transformative learning experiences within a classroom or lecture.

10.4 Chapter Summary

The results from chapter 10 were that:

- The results from the 2012 data collection indicate that environmental and economic scores did not have any significant changes between T1 and T2. Social and overall SAS scores on the other hand seemed to decrease at the end of the two-week project. This finding does not coincide with results from the 2011 joint project in which environmental, economic and entire SAS scores decreased after the end of the project whereas scores on the society subscale increased.

- A similar downward shift on the overall SAS scores can be seen in both years of data. The differences then lie in the society subscale as in 2011 the scores increased after T2 whereas in 2012 they decreased. In 2011 economic and environmental scores significantly decreased whereas in 2012 the difference

noted was not statistically significant.

- Calculation of Cronbach's α was similar as those in Chapter 7 suggesting that the SAS is internally reliable.

- The experimental element was incorporated by giving some of the programmes that are involved in the joint project an educational intervention. It was thought that the programmes which had an educational intervention would score higher on the SAS. Mann-Whitney U did not support this suggestion as results indicated that there was no statistically significant difference between those who had a session as opposed to those who did not.

- Table 46 represented the significant results of the ANOVA analysis at individual item level. Statement one from the environmental subscale did not have one significant result which might be indicative that if the SAS is revised, statement one should be taken out.

- The individual item analysis also revealed that in certain instances, emotional intelligence could extend from caring for others into caring for the environment. It is likely this happened due to the emotive language used in some of the statements in the SAS. The findings seem to suggest that all of the psychological factors assessed were relevant in some way or another to the individual items which were analysed.
- As a systematic change in the responses given within the two-week period was identified it is possible that the scores that the SAS is capturing do not reflect attitudes, but more so knowledge or a combination of both. Possible refinement of the scale, or at least renaming the scale so that it does not mislead researchers into thinking that it solely captures attitudes is required.

- The priming sessions held at the end of semester one seemed to be most successful on the real estate management students as they had the highest mean scores at T1 before the joint project took place. After the project however, it was

the fifth year architecture students who had the highest means overall, although some attitudinal shifts or improved knoweldge was identified among the architectural technology students at the end of the group project who were also primed in semester one.

- The qualitative data indicated that the students experienced the joint project as one which changed the attitudes they held initially into positive ones where they understood the relevance of sustainability as a vital practice in the BUE. Students felt that the project improved their knowledge about sustainability as those who acknowledged that they had little knowledge beforehand felt more proficient in it after completing the project. Students also expressed improvements in their team working and communication skills.

- Students demonstrated that they reflected upon their experience by relating it to the importance that education at both university and industry level can serve as a driving force in mainstreaming sustainability knowledge and practices.

- The phenomenographic analysis also suggested that government involvement would help consolidate the argument that education would disseminate on to both existing and future construction professionals. The students reportedly gained insight into the economic aspect which is of great importance to the construction industry. Students mentioned the importance of having government impose stricter consequences for companies who do not follow sustainable best practice and rewarding those who incentivise sustainable practices. Students went on to say that government involvement in the awareness of sustainability could lead to an improved image.

- In terms of competencies, the students felt that they gained deeper understanding on sustainability as well as sustainable technologies and had a chance to use their problem solving, creative thinking, research and analytical

skills during the project. This is highly reflective of the influence that the openness to experience personality trait has on cognitive ability (Todd *et al.*, 2009).

- These competencies in turn helped students further develop personal skills such as confidence, team work, leadership, and compromise and time management. A large majority made mention of the need to listen to others, and have a chance to improve their presentation, verbal and written communication skills. For the most part, these were skills which Thorsen (2004) (as cited by Pappas, 2012) put forth. If nothing else, it seems as though the joint project was able to make the students more sustainably literate (Murray, 2011).

11. Discussion and Conclusions

11.1 Discussion

Thomas (2004) mentioned that when students enter higher education, they may not possess the skills to assess environmental problems and be able to take action. Interviews conducted with BUE academics however revealed that the LJMU curriculum does provide students with environmental knowledge alongside the core competencies of each professional programme though this is obviously built-up within the three year courses offered at LJMU.

Mann *et al.* (2007), Wright (2010) and Pappas (2012) were of the opinion that sustainability should be integrated into the curriculum throughout every programme. Sibbel (2009) offered a view that higher education is responsible for disseminating sustainability knowledge onto the wider community. If this was the case, higher education would be disseminating this knowledge to society as those who were educated would then go on to influence others by their knowledge on sustainability. The Strategic Forum for Construction (2012) reported that the construction industry accounts for approximately ten per cent of the UK's GDP and that nearly two million people are employed in this sector. Therefore there is scope for sustainability knowledge permeating through the academic and industrial grapevines onto wider society which is what figure 1 in chapter 1 was conveying. Treloar *et al.* (2003) further added that if individuals are able to understand the principles of efficient use of construction materials, attitudes to prevent waste would develop thus making the construction process more efficient. In terms of incentivising sustainable practices such as waste management, Osmani *et al.* (2006) assessed the opinions of construction professionals. Their work concluded that 70% of architects and 84% of contractors believed that training would motivate waste management to be practiced. It consequently seems feasible to begin instilling waste management practices in higher education and hope that once graduates enter the construction industry, they will be given further training on best waste management practices. Some companies have reportedly gained a competitive advantage over other companies who have not yet embraced sustainable practices (Dainty and Brooke, 2004; Alkhaddar *et al.*, 2012). It therefore seems likely that future construction professionals will have a large role to play in achieving this.

The literature suggests that sustainability would permeate into the construction industry more effectively if both BUE graduates and professionals were literate in sustainability (Thomas, 2004; DEFRA, 2005; Murray and Cotgrave, 2007; Murray and Murray, 2007; Murray, 2011). Previous studies (Teo and Loosemore, 2001; Chan *et al.,* 2002; Myers, 2005; Lo *et al.,* 2006) seem to indicate that sustainability is not highly regarded in the industry, nor that different perspectives are very prevalent. Even more up-to-date work has had similar findings (Alkhaddar *et al.,* 2012). This more recent work however, took into account what learning styles are needed in order to fully understand and then integrate sustainability into the construction industry. Todd *et al.* (2009) associated surface learning techniques with low emotional stability, thus are worthy of investigation within inherent psychological traits, education and sustainability.

The main argument for practising sustainability is that it is the right thing to do to not degrade the environment. This could be the reason why companies do not engage in sustainability because not degrading the environment is not incentive enough for companies to engage in sustainability even though there is also a strong business case for it. The triple bottom line which was described in chapter 2, particularly figure 7, indicates how social and environmental aspects of sustainability can be addressed within a business but still yield financial gains. The author feels that if the message of sustainability leading to financial rewards was the one used to argue the case for sustainability, it would be more prominent in the construction industry.

Teo and Loosemore (2001) identified that environmental consciousness is not fostered within the industry, therefore requiring higher education to prepare students with this skill before they embark in their profession. Academia guides construction professional on how to live and work in more sustainable ways (Murray and Cotgrave, 2007).The link between teaching in higher education and the construction industry is strong. It is therefore of utmost importance that research is conducted in both sectors to assess whether a different approach is needed and whether something is not being emphasised enough which would make sustainability a more mainstream practice.

Sections 2.1.1 and 2.1.2 described the various ways in which sustainability and sustainable development are thought of and defined. As there are far too many

individuals who have attempted to define sustainability and all of them have variations (WCED, 1987; Leal Filho, 2000; Hueting and Reijdners, 2004; Faber *et al.,* 2005; Atkinson, 2008; Shepherd *et al.,* 2009; Murray 2011) it would be safe to say that there will likely never be a universal definition. The researcher does not find this to be a problem because sustainability means different things to different people (Mann *et al.,* 2007) and the many definitions reflect this. It also lends support to the fact that perhaps it is too ambitious to think that every aspect of sustainability needs to be practised by every discipline that there is.

Pappas (2012) declared the importance of identifying the contribution made by each discipline to define and teach sustainability and the influence that these have on one another. In this way, both industry and academia would be able to see perhaps more clearly what areas of sustainability they should focus on. This in turn would simplify the concept of sustainability while also enabling other professional fields to quickly identify what field would complement their activities. Raynsford (1999) and Dainty and Brooke (2004) endorsed legislative penalties for companies who do not act sustainably or meet targets. This seems like a further reinforcement that sustainability is a practice that will be prevalent in the construction industry from now on. Students were also of this opinion as in their reflective writing they voiced that if the government published guidelines for all stakeholders involved in the construction process, sustainability could become commonplace.

Students also mentioned that the government should not only punish those who do not act sustainably, but also reward those who do by investment, incentives or offering subsidies.This is something that Murray (2011) also pointed out as a way by which the government attempts to incentivise behaviour change. The researcher believes that if there was a more continuous loop between government, professional bodies, education and the construction industry, incentives such as the ones the students' reflective essays proposed and what the government is currently offering may carry more weight. Although government, education, professional bodies and the construction industry pass information between each other, if these exchanges happened at a faster pace, each area would be moving towards sustainably in a collective manner rather than one group having to catch up to the rest.

Pappas (2012) emphasised that it is important to take into consideration that sustainability is often considered a synonym of environmentalism. It is this narrow scope which disregards that sustainability is dependent on other factors and that a change in any of them is likely to cause change in other factors.

On the whole, combining qualitative and quantitative methods together in this research proved to be useful as Östlund *et al.* (2011) claimed, having a sequential mixed methods model in place gave way to a logical progression of the work by informing what method would best answer the forthcoming set of aims. It could be that the uniform decrease in scores from T1 and T2 in both years may merely indicate a maturity in the information processing skills of the individuals or perhaps a more realistic outlook on sustainability across the BUE. David and Sutton (2011) remarked that mixed methods are often used for triangulation purposes as one method could be used to help verify the research findings. By adopting a mixed methods approach, the findings of the 2012 data seems to allude to this point as the comments made by students in their reflective essays seem to explain why a systematic downward shift in the mean scores was noted, although a very small number of essays gave an account of transformational learning which seemed to lead the individual to change their actions; something which Moore (2005c) mentioned was likely to happen. Moore (2005c) pointed out that in instances of transformational learning students tend to seek others who are in a similar position. Therefore a positive aspect about the joint project is that it grouped people together right from the very beginning of the project, thus students will have learned to listen to one another as well as to negotiate and share the process of constructing knowledge (Moore, 2005b) without having to seek for support from further afield.

11.2 Conclusions

The five aims listed in section 1.2 were achieved. Review of the literature identified how sustainability can manifest itself in the construction industry, such as through a building's life cycle, energy use and carbon emissions, the impact the property sector has on sustainability as well as how to waste management (see chapter 2). In academia however, a review was done on how HEFCE's strategy has outlined how sustainability should be

incorporated into the curriculum (see section 3.1). The skills professional bodies want future construction professionals to possess were also discussed (see chapter 3).

Chapter 6 was where the second aim was achieved in which a snapshot of students' ecological concern was gathered through a pilot study. Following these results, the third aim was achieved when the SAS questionnaire was developed to specifically addressed sustainability issues within the BUE.

The fourth aim which was mentioned in section 1.2 was the implementation of an experimental condition in order to compare student knowledge among those that did and did not receive and educational intervention. The results indicated that there were no statistically significant differences among student scores, therefore suggesting that sustainability knowledge is permeating evenly through all of the BUE programmes at LJMU.

The integration of many disciplines in this research has justified that there is scope to conduct studies which rely on multidisciplinary research to be able to strengthen and improve the approaches of another topic. Furnham *et al.* (2003) and Todd *et al.* (2009) listed conscientiousness as a predictor of academic performance. As the Joint Project was an educational exercise on sustainability, it seems to further lend support for the insight that personality theory can have in many aspects in which it may seem abstract initially (Hirsh and Dolderman, 2007; Boeve-de Pauw *et al.,* 2010; Hirsh, 2010; Swami *et al.,* 2010).

The final aim was the measurement of students' sustainable construction attitudes. It was expected that a group task would be able to change student attitudes regarding sustainable construction. At face value, the quantitative data suggested that student attitudes had become lower than they were before students took part in the project in both years data was collected which did not support the expected outcome. On the other hand however, the reflective essays which served as qualitative data did support the expected outcome as a majority said that the joint project changed their attitudes while others said that it did not change their attitudes but influenced the perspective from which they understood sustainability.

Pappas (2012) advocated that interdisciplinary education would enable students to deal with the complexities of sustainability. Dirkx *et al.* (2006) pointed out that transformative

learning would occur when an objective or task-oriented group project is completed followed by a self-reflective task. The findings from this research echoed Dirkx's and Andrews *et al.* (2009) sentiments as the students felt that interacting with others in order to complete the task helped them improve personal qualities as well as improve their knowledge and shift their attitudes towards sustainability (Mochizuki and Fadeeva, 2010). These personal qualities and competences included sustainable literacy, communication skills, problem solving skills, decision making skills (CIOB, 2007; Murray and Murray, 2007; QAA, 2007; Fortuin and Bush, 2010; Sahlberg and Oldroyd, 2010; RIBA, 2011; Pappas, 2012) all of which will be of use when trying to promote sustainability in the construction industry. Another end result of the joint project as reported by students was increased confidence (Cotgrave and Kokkarinen, 2011); this too is an attribute which people who have experienced transformational learning would gain (Moore, 2005c).

With the conclusion of this research, it can be said with some degree of certainty that the cohort from the 2012 data set do not consider sustainability a 'fad' and will endeavour where possible to take it into account while performing their other duties as sustainable construction professionals.

11.3 Contribution to Knowledge

This research incorporated information from areas of the applied science of construction, social sciences (education) and the humanities (psychology). This was done to apply an interdisciplinary practise-based approach to study the attitudes students have towards sustainability in the BUE. The main contribution to knowledge that this research made is the development of a measurement tool which was used to accurately assess the level of sustainability in built environment curriculum at LJMU.

Adopting a mixed methods approach enabled the use of both surveys and interviews to be used to gain a holistic view of what it is like to teach and learn about sustainability within the school of the BUE at LJMU. It is this that makes the contribution from each of the three fields clear. The contribution being made to construction management is a measurement tool specific to the BUE to assess attitudes and knowledge regarding current best practice. Measurable psychological constructs were used to determine whether they were significant in indicating a relationship amongst the sustainable issues raised in the SAS. Notions of transformative learning and the introduction of educational

interventions as well as implementing phemenonography as the qualitative analysis by which to understand experience comes from educational literature.

11.4 Main Findings

The literature stated that practicing sustainability is something that is being encouraged as the right thing to do, there also appears to be a strong business case for practising it (Dainty and Brooke, 2004; Hueting and Reijnders, 2004; Alkhaddar *et al.,* 2012). This point was noted by the students as they reported acknowledging that sustainability is a practice that is good for the environment but can bring other benefits such as social and financial improvements.

The barriers which were identified in the literature review (Teo and Loosemore, 2001; Chan *et al.,* 2002; Myers, 2005; Lo *et al.,* 2006; Alkhaddar *et al.,* 2012) seemingly indicating that sustainability is not highly regarded in the industry were echoed by the staff interviews. Specifically, the barrier mentioned was that industry still pays "lip service" to sustainability and that it is up to the future construction professionals to challenge this and make a difference. When the barriers to sustainability in academia were reviewed, Velázquez *et al.* (2005) listed lack of awareness as an obstacle. It was identified by a module and programme leader that keeping their knowledge up-to-date so that they could then impart this knowledge to their students was sometimes difficult as they stated that time for doing this was often an issue. On the whole however, all of the academic staff interviewed were proficient in the concept of sustainability but in a topic such as this one, knowledge and best practice can become outdated fairly quickly. That is not to say that lack of awareness is not a problem in schools which are less involved with environmental topics. Experiencing similar barriers would suggest that the message going out to both students and existing professionals should be the same but that perhaps the way in which the message is delivered may differ. This may be something that needs to be researched in the future to ensure that higher education institutions are following through on becoming examples of sustainable practices.

The quantitative analysis in chapters 7 and 10 showed a trend that it was more likely for scores on the SAS and its subscales to decrease at the end of the joint project rather than increase as was anticipated. When trying to determine whether students who received an educational intervention had higher scores as opposed to those who did not, the Mann-

Whitney U indicated that there was no statistical difference. This would indicate that the information which is being taught within the JMU curriculum is permeating each of the BUE programmes evenly.

The results of the individual item analysis demonstrated that there was some evidence to support the inclusion of psychological constructs in this project. When reviewing the results of the ANOVA in table 46, all three subscales had the most significant results with personality traits agreeableness and conscientiousness. This confirms what Murray (2011) stated that there are attitudes which relate to sustainability such as caring and compassion which relate to agreeableness. The characteristics often associated with agreeableness are altruism, helpfulness and empathy (Widiger and Trull, 1997; Todd *et al.*, 2009; Swami *et al.*, 2010). Research by Hirsh and Dolderman (2007), Hirsh (2010) and Swami *et al.* (2010) found agreeableness to be linked with environmental concern which, although different questionnaires were used, lends support to the possibility that agreeableness is a useful trait to understand environmental and sustainable issues.

Conscientiousness was the second personality trait which was found to be significant in both years of before and after data. Todd *et al.* (2009) stated that responsibility is a trait associated with conscientiousness. Hirsh (2010) and Swami *et al.* (2010) had similar findings and offered a suggestion as to why conscientiousness is significant when dealing with environmental and sustainable issues as it reflects the role of intellectualism and need for achievement. It may also reflect that conscientious individuals are more likely to adhere to social norms and rules (Hirsh, 2010) therefore, if an authoritative figure is saying that sustainability should be practised, conscientious individuals will do so.

From table 46, emotional intelligence appears to have been most significant on social aspects of sustainability, than by environmental issues. Only statement number 15 on economic factors was significant but this can be because economic factors do not normally evoke emotional concern other than not wanting to make a loss. The findings from the individual item analysis indicated that emotional intelligence was present mainly in environmental aspects of the study. This lends support to what Pappas (2012) mentioned: that emotion would be a core skill in promoting affirmative social change; the researcher has taken the liberty of using the measure of emotional intelligence to show this. In section 4.4 it was outlined that an outcome of the research was to see whether

students could extend concern for others into concern for the environment which seems to have happened to some extent. This further demonstrates that emotional intelligence is a fruitful avenue by which to understand how people act and react in particular contexts (Wranik *et al.,* 2007) all the while making a further unique contribution into the study of individual differences.

Contrary to what Fitness and Curtis (2005) found, the results of the individual item analysis seemed to indicate that the responses given grew stronger after the end of the joint project rather than being stable over time, even though the emotional intelligence and personality questionnaires were only administered at the beginning of the project. This could be indicating that reflection had occurred among the students whereby their responses on the SAS may have changed to be more considerate of the well-being of both social and environmental issues of sustainability. Fox and Spector (2000) stated that emotional intelligence focuses on intelligent behaviour in natural settings (see chapter 4), therefore the answers revealed in the ANOVA tests may reflect that the significant statement numbers may be the problems the students deemed important to their plans, needs, emotions and well-being.

11.5 Limitations

Limitations of this research project were that there were a lot of problems with the data, namely that it was not normally distributed and did not then meet the requirements to be able to perform parametric inferential analyses. These problems may have risen due to the time it took to create the SAS as there was not enough time to validate it properly before data had to be collected from the students. As this research followed an academic calendar, there were limited gaps deemed appropriate to conduct educational interventions and data collection in order to maximise sample size.

It was only toward the end of the project, after two years worth of before and after data had been collected, that it was considered that the Sustainability Attitude Scale may measure knowledge in addition to attitudes. This became evident from the overall SAS scores from data collected in years 2011 and 2012 as both data showed systematic downward shifts in the means, yet the qualitative data from 2012 seemed to insist that students had experienced some sort of shift in perspective. It could be that the SAS would

have benefited from a statistical underpinning such as a factor analysis (Hoxley, 2000) rather than the theoretical venn diagram which it was based on.

It is also possible that the scores which the SAS is capturing are not actually attitudes, but perhaps knowledge or a combination of knowledge and attitudes. The author would like to argue that sustainability is a state rather than an inherent trait because as information, research and knowledge develop regarding sustainability, changes in perspective will occur. The SAS scale was designed to reflect best practice foreseeably in the 2010-2015 time frame. Even the New Ecological Paradigm (Dunlap *et al.*, 2000), which has been a very popular tool in measuring general levels of environmental concern has undergone updates and amendments throughout the years (Dunlap and Jones, 2002; Dunlap, 2008).

11.6 Future Work

Improvements on this project would naturally start with the re-evaluation of the sustainability questionnaire in terms of whether it assesses more than merely attitudes, such as knowledge. This could be done by testing the questionnaire out among other universities and conducting a factor analysis (Hoxley, 2000). The refinement of the items, exclusion or addition of further items should be considered. In the first instance statement number one of the SAS could be removed as the individual item analysis did not show any significant results. It may be that the SAS scale needs to be re-named to accommodate the element of knowledge- possibly Sustainability Attitudes and Knowledge Scale (SAKS).

Despite the SAS's limitations, this research demonstrated that the SAS was an accurate way of testing sustainability within a curriculum as opposed to a more simplistic method which was used in previous research (Cotgrave, 2008). Although this thesis assessed the internal reliability of the scale with the use of Cronbach's alpha, validation studies should be conducted by other universities across the UK. In this way, higher education institutions that want to assess the level of sustainability present in their curriculum could adopt a similar methodology with the use of an experimental condition to compare student scores. The practical implications of having a single measure by which to assess sustainability within to curriculum has the potential of refining the way in which sustainability is taught across BUE schools thus ensuring that all future professionals will be competent in practising sustainable construction.

Another potential avenue of validation is sending the SAS out to industry to measure sustainable construction attitudes of existing professionals. A similar experimental condition could be applied by which professionals who have been practicing for ten or more years could be compared with those who have worked for a shorter period of time to see if any differences in their sustainability literacy skills are identified. The findings from industry could serve as indicators as to what areas of sustainability need to be emphasised more in the construction industry. Results could also highlight a group of professionals who might benefit from additional sustainability training.

The success of the SAS in this study provides encouragement for its application in other higher education institutions and industry. The sooner the scale is adequately validated, the sooner an understanding of the level of sustainability present in both sectors will be gained. Once that has been established, more adequate training and knowledge can be disseminated so that sustainable construction becomes the norm.

References

Ajzen, I., and Fishbein, M. (1980) Understanding attitudes and predicting social behaviour. Englewood Cliffs, New Jersey, Prentice.

Ajzen, I. (1991) The theory of planned behaviour. *Organisational Behaviour and Human Decision Processes.* 50(*2*); 179-211.

Ajzen, I. (2001) Nature and Operation of Attitudes. *Annual Review of Psychology.* 52(*1*); 27-58.

Alkhaddar, R., Wooder,T., Sertyesilisik, B., and Tunstall, A. (2012) Deep Learning Approach's Effectiveness on Sustainability Improvement in the UK Construction Industry. *Management of Environmental Quality: An International Journal.*23(*2*); 126-139.

Amatunga, D; Baldry, D; Sarshar, M; and Newton, R. (2002) Quantitative and qualitative research in the built environment: application of "mixed" research approach. *Work Study.* 51(*1*); 17-31.

Anderson, C., Lee, D., Pryce, G., and Taal, M. (2010) Factors affecting environmental attitudes and volunteering in England and Wales. Working paper (Unpublished).

Andrews, L., Biles, B., and Taylor, I. (2009) Effective and Transferable Teaching Methods from Wilderness Medicine: The Students' Perspective. *The Clinical Teacher.* 6(*3*); 147-151.

Atkinson, G. (2008) Sustainability, the capital approach and the built environment. *Building Research & Information.* 36(*3*); 241-247.

Attride-Stirling, J. (2001) Thematic networks: an analytic tool for qualitative research. *Qualitative Research.* 1(*3*); 385-405.

Ballantyne, R., and Packer, J. (2005) Promoting environmentally sustainable attitudes and behaviour through free-choice learning experiences: What is the state of the game? 11(*3*); 281-295.

Ball, J. (2002) Can ISO 14000 and Eco-labelling turn the Construction Industry Green? *Building and Environment.* 37(*4*); 421-428.

Barraza, L., and Robottom, I. (2008) Gaining representations of children's and adults constructions of sustainability issues. *International Journal of Environmental & Science Education.* 3(*4*); 179-191.

Barr, S. and Gilg, A. (2006) Sustainable Lifestyles: Framing environmental action in and around the home. *Geoforum.* 37(*6*); 906-920.

Berenguer, J., Corraliza, J., and Martín, R. (2005) Rural-Urban Differences in Environmental Concern, Attitudes, and Actions. *European Journal of Psychological Assessment.* 21(*2*); 128-138.

Blake, J. (1999) Overcoming the 'value-action gap' in environmental policy: tensions between national policy and local experience. *Local Environment.* 4(*3*); 257-278.

Boeve-de Pauw, J., Donche, V., and Van Petegem, P. (2010) Adolescents' Environmental Worldview and Personality : An Explorative Study. *Journal of Environmental Psychology. 31(2)*;109-117.

Brace, N., Kemp, R., and Sneglar, R. (2006) *SPSS for Psychologists* (3rd edition) Basingstoke, Palgrave Macmillan.

Branch, W., and Paranjape, A. (2002) Feedback and Reflection: Teaching Methods for Clinical Settings. *Academic Medicine.* 77(*12*); 1185-1188.

Bruce, C., and Gerber, R. (1995) University Lecturers' coceptions of student learning. *Higher Education.* 29(*4*); 443-458.

Bryman, A. (2007) Barriers to integrating quantitative and qualitative research. *Journal of Mixed Methods Research.* 1(*1*); 8-22.

Building Research Establishment (BRE) (2006) Energy Performance of Buildings Directive [Online] Available at http://www.bre.co.uk/Energy_Performance_of_Buildings_Directive (accessed 20/11/2012).

Building Research Establishment (BRE)(2011) BRE *Environmental Assessment Method.* [Online] Available at: http://www.bre.co.uk/page.jsp?id=829 (accessed 6/04/2011).

Building Research Establishment Environmental Assessment Method (BREEAM) (2011)*What is BREEAM?* [Online] Available at: http://www.breeam.org (accessed 6/04/2011).

Burnard, P. (1991) A method of analysing interview transcripts in qualitative research. *Nurse Education Today.* 11(*6*), 461-466.

Burke Johnson, R., Onwuegbuzie, A. (2004) Mixed Methods Research: A research paradigm whose time has come. *Educational Researcher.* 33(*7*); 14-26.

Burke Johnson, R; Onwuegbuzie , A; and Turner, L. (2007) Toward a definition of mixed methods research. *Journal of Mixed Methods Research.* 1(*2*); 112-133.

Chan, E., Chan, M., Scott, D., and Chan, A. (2002) Educating 21st century construction professionals. *Journal of Professional Issues in Engineering Education and Practice.* 128(*1*); 44-51.

Chartered Institute of Architectural Technologists (CIAT) (2011) Careers and Membership Handbook. [Online] Available at: http://www.ciat.org.uk/en/other/document_summary.cfm/docid/DB91C6A9-0141-4F72-A0610C4DF748220C (accessed 19/10/2012).

Chartered Institute of Building (CIOB) (2001) Sustainability and the Construction Industry [Online] Available at: www.ciob.org.uk/filegrab/sustainability.pdf?ref=74 (accessed 8/12/2009)

Chartered Institute of Building (CIOB) (2007) The CIOB Education Framework 2007 [Online] Available at: http://www.ciob.org.uk/education/framework (accessed 19/10/2012)

Chartered Institute of Building (CIOB) (2010) Procurement in the construction industry. [Online] Available at: http://www.ciob.org.uk/sites/ciob.org.uk/files/Procurement%20in%20the%20Construction%20Industry.pdf (accessed 12/01/2011).

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Cohen, J. (1992). A power primer. *Psychological Bulletin*, 112 (*1*), 155–159.

Corral-Verdugo, V. (1997) Dual 'realities' of conservation behaviour: self-reports vs. observations of re-use and recycling behaviour. *Journal of Environmental Psychology.* 17(*2*);135-145.

Corraliza, J., and Berenguer, J. (2000) Envrionmental values, beliefs and actions: A situational approach. *Environment and Behavior.* 32(*6*); 832-848.

Costanza, R., and Patten, B. (1995) Defining and predicting sustainability. *Ecological Economics.* 15(*3*); 193-196.

Cotgrave, A. J. (2008)*Achieving Literacy in Sustainability: Shifting the Paradigm for Construction Management Education.* Unpublished successful PhD thesis, Liverpool John Moores University.

Cotgrave, A. J., and Kokkarinen, N. (2010)Developing a model promoting sustainability literacy through construction curriculum design. *Structural Survey,*28(*4*); 266-280.

Cotgrave, A. J., and Kokkarinen, N. (2011) Promoting sustainability literacy in construction students: Implementation and testing of a curriculum design model. *Structural Survey,* 29(*3*); 197-212.

Creswell, J. (2009) *Research design: Qualitative, quantitative and mixed methods approaches.*(3rd ed.) London, Sage Publications Ltd.

Dainty, A., Brooke, R. (2004) Towards improved construction waste minimisation: a need for improved supply chain integration? *Structural Survey.* 22(*1*); 20-29.

Dale, A., and Newman, L. (2005) Sustainable development, education and literacy. *International Journal of Sustainability in Higher Education.* 6(*4*); 351-362.

David, M., and Sutton, C. (2011) *Social Research: An Introduction.* (2nd ed.) London, Sage Publications, Ltd.

Davis, J., Foxall, G., and Pallister, J. (2002) Beyond the intention-behaviour mythology: An integrated model of recycling. *Marketing Theory.* 2(*1*); 29-113.

Davis, G., and Morgan, A. (2008) Using the Theory of Planned Behaviour to determine recycling and waste minimisation behaviours: A case study of Bristol City, UK. *The Australian Community Psychologist.* 20 (*1*); 105-117.

Davis, J., Green, J., and Reed, A. (2009) Interdependence with the environment: commitment, interconnectedness and environmental behavior. *Journal of Environmental Psychology.* 29(*2*); 173-180.

Department for Businessm Innovation and Skills (BIS) *(2012) http://www.bis.gov.uk/about (accessed 21/08/2012)*

Department of the Environment, Food, and Rural Affairs (DEFRA) (2005) Securing ou future: Delivering UK sustainable development Strategy. The Stationary Office, London. (accessed online: 8/09/2011)

Department for Environment, Food, and Rural Affairs (DEFRA) (2011a) Mainstreaming Sustainable Development- The Government's Vision and what this means in Practice. [Online] Available at: http://sd.defra.gov.uk/news/calendar/past/2011-publications/ (accessed 18/06/2012).

Department for Environment, Food, and Rural Affairs (DEFRA) (2011b) Greening Government Commitments: Opertations and Procurement. [Online] Available at: http://sd.defra.gov.uk/gov/green-government/commitments/ (accessed 18/06/2012).

Department for Environment, Food, and Rural Affairs (DEFRA) (2011c) Waste Data Overview. [Online] Available at: www.defra.gov.uk/**statistics**/files/20110617-**waste-data-overview**.pdf (accessed 7/11/2011).

Development Education Association (DEA) (2010). The impact of Global Learning on Public Attitudes and Bhevaiours towards International Development and Sustainability. Available at: http://www.dea.org.uk/resources/item.asp?d=2076 (accessed 20/04/2010).

Dirkx, J. (1998) Transformational Learning Theory in the practice of adult education: An Overview. *Journal of Lifelong Learning.* 7(); 1-14.

Dirkx, J., Mezirow, J., and Cranton, P. (2006) Musings and Reflections on the Meaning, Context, and Process of Transformative Learning: A Dialogue Between John M. Dirkx and Jack Mezirow. *Journal of Transformative Learning.* 4(*2*); 123-139.

Dodds, W. (2008) *Humanity's footprint: Momentum, impact, and our global environment.* New York, Columbia University Press.

Dunlap, R. (2008) The new ecological paradigm scale: From marginality to worldwide use. *The Journal of Environmental Education.* 40(*1*); 3-18.

Dunlap, R., and Jones, R. (2002) Environmental Concern: Conceptual and measurement issues. From Dunlap, R; Michelson, W. (eds) *Handbook of Environmental Sociology* Westport, Greenwood Press.

Dunlap, R., Van Liere, K., Mertig, A., and Jones, R. (2000) Measuring Endorsement of the New Ecological Paradigm: A revised NEP scale. *Journal of Social Issues.* 56(*3*); 425-442.

Entwistle, N., and Tomlinson, P. (eds.) (2007) Monograph Series II: Psychological Apects of Education- Current trends. Student Learning and University Teaching. *British Journal of Educational Psychology* . Number 4.

European Council for Real Estate Professions (CEPI) (2008) The Importance of the EU for Property Professionals. [Online] Available at: http://www.cepi.eu/index.php?page=publications&hl=en (accessed 02/12/2011).

Faber, N., Jorna, R., and van Engelen, J. (2005) The Sustainability of 'Sustainability'- A Study into the Conceptual Foundations of the Notion of 'Sustainability'. *Journal of Environmental Assessment Policy and Management.* 7(*1*); 1-33.

Fitness, J., and Curtis, M. (2005) Emotional Intelligence and the Trait Meta-Mood Scale: Relationships with Empathy, Attributional Complexity, Self-control, and responses to interpersonal conflict. *E-Journal of Applied Psychology: Social Section.* 1(*1*); 50-62.

Forum for the Future (2011) The Five Capitals Model – a framework for sustainability. [online] Available at:http://www.forumforthefuture.org/project/five-capitals/overview (accessed 19/04/2012).

Forsberg, A., and von Malmborg, F. (2004) Tools for environmental assessment of the built environment. *Building and Environment.* 39(*2*); 223-228.

Fortuin, I., and Bush, R. (2010) Educating Students to Cross Boundaries between Disciplines and Cultures and between Theory and Practice. *International Journal of Sustainability in Higher Education.* 11(*1*); 19-35.

Fox, S., and Spector, P. (2000) Relations of Emotional Intelligence, Practical Intelligence, General Intelligence and Trait affectivity with Interview Outcomes: It's not all just 'G'. *Journal of Organizational Behavior.* 21(*2*); 203-220.

Furnham, A., Chamorro-Premuzic, T., and McDougall, F. (2003) Personality, cognitive ability, and beliefs about intelligence as predictors of academic performance. *Learning and Individual Differences.* 14(*1*); 49-66.

Gibson, R., Hassan, S., Holtz, S., Tansey, J., and Whitelaw, G. (2005) *Sustainability Assessment: Criteria, Processes and Apoplications.*Earthscan, London.

Giorgi, A. (1999) A phenomenological perspective on some phenomenographic results on learning. *Journal of Phenomenological Psychology.* 30(*2*);68-94.

Goldberg, L. R. (1992). The development of markers for the Big-Five factor structure. *Psychological Assessment.* 4(*1*); 26-42.

Goldberg, L., Johnson, J., Eber, H., Hogan, R., Ashton, M., Cloninger, C., and Gough, H. (2006) The International Personality Item Pool and the future of public-domain personality measures. *Journal of Research in Personality,* 40(*1*), 84-96.

Goleman, D. (1996) *Emotional Intelligence: Why it can matter more than IQ?* London, Bloomsbury Publishing

Goodhew, S. (2003) *Sustainability in Construction. Student Learning Package 1, Student-centred Learning in Construction Education,* University of Plymouth, Plymouth.

Goudie, A. (2000) *The human impact on the natural environment.* (5th ed.)Oxford, Blackwell Publishers LTD.

Greene, J. (2008) Is mixed methods social inquiry a distinctive methodology? *Journal of Mixed Methods Research.* 2(*1*); 7-22.

Hair, J., and Anderson, R. (2010) *Multivariate Data Analysis: A global perspective.* (7th ed.) New Jersey, Pearson Education.

Hasselgren, B., and Beach, D. (1997) Phenonemography- a "good-for-nothing brother" of phenomenology? Outline of an analysis. *Higher Education Research and Development.* 16(*2*); 191-202.

Higher Education Funding Council for England (HEFCE) (2009) [Online] Available at: http://www.hefce.ac.uk/pubs/year/2009/200903/ (accessed 16/10/2012).

Higher Education Funding Council for England (HEFCE) (2011) [Online] Available at: http://www.hefce.ac.uk/whatwedo/lgm/sd/ (accessed 19/10/2012).

Her Majesty's Government (HMG) (2008) Strategy for Sustainable Construction. [Online] Available at: http://www.bis.gov.uk/files/file46535.pdf (accessed 29/05/2010).

Hirsh, J. (2010) Personality and Environmental Concern. *Journal of Environmental Psychology.* 30(*2*); 245-248.

Hirsh, J., and Dolderman, D. (2007) Personality predictors of consumerism and environmentalism: A preliminary study. *Personality and Individual Differences.* 43(6); 1583-1593.

Hoxley, M. (2000) Measuring UK Construction prefessional Service Quality: The what, how, when and who. *Journal of Quality and Reliability Management.* 17(*4*); 511-526.

Hueting, R., and Reijnders, L. (2004) Broad Sustainability Contra Sustainability: The Propoer Construction of Sustainability Indicators. *Ecological Economics.* 50(*3-4*); 249-260.

Jones, P., Trier, C., and Richards, J. (2008) Embedding Education for Sustainable Development in Higher Education: A Case Study Examining Common Challenges and Opportunities for Undergraduate Programmes. *International Journal of Educational Research.* 47(*6*); 341-350.

Kaiser, F., Hübner, G., and Bogner, F. (2005) Contrasting the Theory of Planned Behavior with the Value-Belief-Norm Model in explaining conservation behavior. *Journal of Applied Social Psychology.* 35(*10*); 2150-2170.

Kerby, J., Shukur, Z., and Shalhoub, J. (2011) The Relationships between Learning Outcomes and Methods of Teaching Anatomy as Perceived by Medical Students. *Clinical Anatomy.* 24(*4*); 489-497.

Kerfoot,B., DeWolf, W., Masser, B., Church, P., and Federman, D. (2007) Spaced Education Improves the Retention of Clinical Knowledge by Medical Students: A Randomised Controlled Trial. *Medical Education.* 41(*1*);23-31.

Kitto, S., Chesters, J., and Grbich, C. (2008) Quality in qualitative research: Criteria for authors and assessors in the submission and assessment of qualitative research articles for the Medical Journal of Australia. *Medical Journal of Australia.* 188(*4*); 243-246.

Knussen, C., Yule, F., MacKenzie, J., and Wells, Mark. (2004) An analysis of intentions to recycle household waste: The roles of past behaviour, perceived habit, and perceived lack of facilities. *Journal of Environmental Psychology.* 24(*2*); 237-246.

Kokkarinen, N., and Cotgrave, A. J. (2010a) Student Attitudes Toward the Environment. 5th Annual Built Environment and Natural Environment (BEAN) Conferenfe. 18th -19th May, Liverpool, UK.

Kokkarinen, N., and Cotgrave, A. J. (2010b) Exploring Sustainability Strategies: How can Education Help? ARCOM Doctoral Workshop. 25th June, Wolverhampton, UK.

Kokkarinen, N., and Cotgrave, A. J. (2010c) Built Environment Student Attitudes Toward the Environment. 26th Annual ARCOM Conference. 6-8th September, Leeds, UK.

Kokkarinen, N., and Cotgrave, A. J. (2011) Cementing Attitudes: Constructing a Questionnaire. 6th Annual Built Environment and Natural Environment (BEAN) Conferenfe. 10th May, Liverpool, UK.

Kokkarinen, N., and Cotgrave, A. J. (2012) An Exploration into Academics' Experience of Sustainability Education. 7th Annual Built Environment and Natural Environment (BEAN) Conference. 30th May, Liverpool, UK.

Kollmus, A., and Agyeman, J. (2002) Mind the Gap: why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research.* 8(*3*); 239-260.

Laerd Statistics (2012a) Mann-Whitney U Test Using SPSS. [Online] Available at: https://statistics.laerd.com/spss-tutorials/mann-whitney-u-test-using-spss-statistics.php (accessed 23/08/2012).

Laerd Statistics (2012b)Wilcoxon Signed Rank Test Using SPSS. [Online] Available at: https://statistics.laerd.com/spss-tutorials/wilcoxon-signed-rank-test-using-spss-statistics.php (accessed 23/08/2012).

Larsen, G. (2009) An inquiry into the theoretical basis of sustainability. From Dillard, J., Dujon, V., King, M. (eds.) *Understanding the Social Dimension of Sustainability.* Oxon, Routledge.

Larsen, K. (1995) Environmental Waste: Recycling attitudes and correlates. *The Journal of Social Psychology.* 135(*1*); 83-88.

Leal Filho, W. (2000) Dealing with misconceptions on the concept of sustainability. *International Journal of Sustainability in Higher Education.* 1(*1*); 9-19.

Lehtonen, M. (2004) The environmental-social interface of sustainable development: capabilities, social capital, institutions. *Ecological Economics.* 49*(2)*; 199-214.

Levine, T., and Hullet, C. (2002) Eta Squared, Partial Eta Squared, and Misinterpreting of Effect Size in Communication Research. *Human Communication Research.* 28(*4*); 612-625.

Lingard, H., Graham, P., and Smithers, G. (2000) Employee perceptions of the solid waste management system operating in a large Australian contracting organization: implications for company policy implementation. *Construction Management and Economomics.* 18(*4*); 383-393.

Liverpool John Moores University (LJMU) (2010) Business Management Module Handbook.

Liverpool John Moores University (LJMU) (2011a) Advanced Architectural Design Projects Module Handbook.

Liverpool John Moores University (LJMU) (2011b) Sustainable Property Module Handbook.

Loewenthal, K. M (2001) *An introduction to Psychological Tests and Scales.* (2nd ed.) Hove. Psychology Press.

Lo, S., Zhao, C., and Cheng, W. (2006) Perceptions of building professionals on sustainable development: A comparative study between Hong Kong and Shenyang. *Energy and Buildings.* 38(*11*); 1327-1334.

Loughland, T., Reid, A., and Petocz, P. (2002) Young People's Conceptions of Environment: A phenomenographic analysis. *Environmental Education Research.* 8(*2*); 187-197.

Maio, G., and Haddock, G. (2010) The Psychology of Attitudes and Attitude Change. London, Sage Publications Ltd.

Mann, L., Dall'Alba, G., and Radcliffe, D. (2007). Using phenomenography to investigate different ways of experiencing sustainable design. Proceedings of the American Society of Engineering Education *(ASEE)* Annual Conference. 24-27 June, Hawaii.

Mannetti, L., Pierro, A., and Livi, S. (2004) Recycling: Planned and self-expressive behaviour. *Journal of Environmental Psychology.* 24(*2*); 227-236.

Marton, F. (2007) Towards a pedagogical theory of learning. Chapter 2 in Entwistle, N., and Tomlinson, P. (eds.) Monograph Series II: Psychological Apects of Education- Current trends. Student Learning and University Teaching. *British Journal of Educational Psychology* . Number 4.

Mayer, J., and Salovey, P. (1997) What is emotional intelligence? From Salovey, P and Sluyter, D. (eds.) *Emotional development and emotional intelligence: Educational Implications.* New York, Basic Books.

Mayer, J., Salovey, P., Caruso, D., and Sitanerios, G. (2001) Emotional Intelligence as a Standard Intelligence. *Emotion.* 1(*3*); 232-242.

McEnrue, M., Groves, K., and Shen, W. (2009) Emotional Intelligence Development: Leveraging Individual Characteristics. *Journal of Management Development.* 28(*2*); 150-174.

Mezirow, J. (2003) Transformative Learning as Discourse. *Journal of Transformative Education.*1(*1*); 58-63.

Mochizuki, Y., and Fadeeva, Z. (2010) Competences for Sustainable Development and Sustainability: Significance and Challenges for ESD. *International Journal of Sustainability in Higher Education.* 11(*4*); 391-403.

Morse, J., Barrett, M., Mayan, M., Olson, K., and Spiers, J. (2002) Verification strategies for establishing reliability and validity in qualitative research. *International Journal of Qualitative Methods.*1(*2*); 1-19.

Moore, J. (2005a) Seven recommendations for creating sustainability education at the university level: A guide for change agents. *International Journal of Sustainability in Higher Education.* 6(*4*); 326-339.

Moore, J. (2005b) Barriers and pathways to creating sustainability education programs: policy, rhetoric and reality. *Environmental Education Research.* 11(5); 537-555.

Moore, J. (2005c) Is Higher Education Ready for Transformative Learning? A Questions Explored in the Study of Sustainability. *Journal of Transformative Education.* 3(*1*); 76-91.

Murray, P. (2011) *The Sustainable Self: A Personal approach to Sustainability Education.* London, Earthscan.

Murray, P., and Cotgrave, A. J. (2007) Sustainability Literacy: the future paradigm for construction education? *Structural Survey.* 25(*1*);7-23.

Murray, P., and Murray, S. (2007) Promoting sustainability values within career-oriented degree programmes. *International Journal of Sustainability in Higher Education.* 8(*3*); 285-300.

Myers, D. (2005) A review of construction companies' attitudes to sustainability. *Construction Management and Economics.* 23(*8*);781-785.

Nidumolu, R., Prahalad, C., Rangaswami, M. (2009) Why Sustainability is now the Key Driver of Innovation. *Harvard Business Review.* 87(*9*); 56-64.

Office of Government Commerce (OGC) (2007) Achieving Excellence in Construction Procurement Guide. Available at: http://www.ogc.gov.uk/documents/CP0016AEGuide11.pdf (accessed 8/12/09).

O'Riordan, T., Cameron, J., and Jordan, A. (eds.) (2001) *Reinterpreting the precautionary principle.* Cameron May, London.

Ortiz, O., Castells, F., and Sonnemann, G. (2009) Sustainability in the construction industry: A review of recent developments based on LCA. *Construction and Building Materials.* 23(*1*); 28-39.

Osmani, M., Glass, J., and Price, A. (2006) Architect and Contractor Attitudes to Waste Minimisation. *Waste and Resource Management.* 159 (*2*); 65-72.

Pan, W., Gibb, A., and Dainty, A. (2007) Perspectives of UK housebuilders on the use of Offsite Modern Methods of Construction. *Construction Management and Economics.* 25(*2*); 183-194.

Pappas, E. (2012) A new systems approach to sustainability: University responsibility for teaching sustainability in contexts. *Journal of Sustainability Education.* 3; 3-18.

Pearce, D. (2006) Is the construction sector sustainable?: definitions and reflections. *Building Research & Information.* 34(*3*); 201-207.

Petty, R., Wegener, D., and Fabrigar, L. (1997) Attitudes and Attitude Change. *Annual Review of Psychology.* 48(); 609-647.

Poon, C. (2007) Management of construction and demolition waste. *Waste Management.* 27();159-160.

Quality Assurance Agency (QAA) (2007) *Subject benchmark statement: Architectural Technology.* Available: http://www.qaa.ac.uk/Publications/InformationAndGuidance/Pages/Subject-benchmark-statement-Architectural-technology.aspx (accessed: 20/02/2012)

Raynsford, N. (1999) The UK's approach to sustainable development in construction. *Building Research & Information.* 27(*6*); 419-423.

Reid, A., and Petocz, P. (2006) University Lecturers' Understanding of Sustainability. *Higher Education.* 51(*1*);105-123.

Reis, G., and Roth, W-M. (2010) A Feeling for the Environment: Emotion Talk in/for the Pedagogy of Public Environmental Education. *The Journal of Environmental Education.* 41(*2*); 71-87.

Riley, M., and Cotgrave, A. J. (2004) *Construction Technology 2: Industrial and Commercial Building.* London, Palgrave Macmillan.

Royal Institute of British Architects (RIBA) (2011) UK Validation [Online] Available at: http://www.architecture.com/EducationAndCareers/Validation/UKvalidation.aspx (accessed on: 19/10/2012).

Rogers, P., Jalal, K., and Boyd, J. (2008) *An introduction to sustainable development.* (2nd ed.) London, Earthscan.

Rosenthal, R. (1991) Meta-analytic procedures for social research (rev. ed.) Newbury Park, Sage.

Ross, J., and Tomlinson, B. (2011) Negabehaviors and Environmental Sustainability. *Journal of Sustainability Education.* 2; 1-13.

Sahlberg, P., and Oldroyd, D. (2010) Pedagogy for economic competitiveness and sustainable development. *European Journal of Education.* 45(*2*); 280-299.

Sale, J; Lohfeld, L; and Brazil, K. (2002) Revisiting the quantitative-qualitative debate: Implications for mixed methods research. *Quality & Quantity.* 36; 43-53.

Saklofske, D., Austin, E., Minski, P. (2003) Factor structure and validity of a trait emotional intelligence measure. *Personality and Individual Differences.* 34(*4*);707-721.

Salovey, P; and Mayer, J. (1990) Emotional intelligence. *Imagination, cognition and personality.* 9(*3*); 185-211.

Schlegelmilch, B., Bohlen, G., and Diamantopoulos, A. (1996) *European Journal of Marketing.* 30(*5*); 35-55.

Schultz, P.W., Shriver, C., Tabanico, J., and Khazian, A. (2004) Implicit connections with nature. *Journal of Environmental Psychology.* 24(*1*); 31-42.

Senbel, M., McDaniels, T., and Dowlatabadi, H. (2003) The ecological footprint: a non-monetary metric of human consumption applied to North America. *Global Environmental Change.* 13(*2*); 83-100.

Shepherd, D; Kuskova, V; Patzelt. H. (2009) Measuring the values that underlie sustainable development: The development of a valid scale. *Journal of Economic Psychology.* 30(*2*); 246-256.

Sibbel, A. (2009) Pathways towards sustainability through higher education. *International Journal of Sustainability in Higher Education.* 10(*1*); 68-82.

Strategic Forum for Construction (2012) Strategic Forum Targets 2012. [Online] Available at: http://strategicforum.org.uk/ (accessed 18/06/2012).

Swami, V., Chamorro-Premuzic, T., Sneglar, R., and Furnham, A. (2010) Egotistic, altruistic and biospheric environmental concerns: A path analytic investigation of their determinants. *Scandinavian Journal of Psychology.* 51(*2*);139-145.

Tabachnick, B; Fidell, L. (2007) Using multivariate statistics (5th ed.) Boston: Pearson Education.

Tam, V; Tam, C. (2006) A review on the viable technology for construction waste recycling. *Resources, Conservation and Recycling.* 47(*3*);209-221.

Tan, H.,Plowman, D., and Hancock, P. (2007) Intellectual Capital and Financial Returns of Companies. *Journal of Intellectual Capital.* 8(*1*);76-95.

Tashakkori, A., and Teddlie, C. (eds.) (2003) *Handbook of mixed methods in social and behavioral research.* London, Sage Publications Ltd.

Taylor, E. (2007)An update of transformative learning theory: A critical review of the empirical research (1999-2005). *International Journal of Lifelong Learning.* 26(*2*);173-191.

Teddlie, C., and Tashakkori, A. (2009) *Foundations of mixed methods research: Integrating quantitative and qualitative approaches in the social and behavioral sciences.* London, Sage Publications Ltd.

Teo, M; Loosemore, M. (2001) A theory of waste behaviour in the construction industry. *Construction Management and Economics.* 19(*7*); 741-751.

Thalheimer, W., & Cook, S. (2002). How to calculate effect sizes from published research articles: A simplified methodology. [Online] available at http://work-learning.com/effect_sizes.htm (accessed 11/06/2012).

Thomas, I. (2004) Sustainability in tertiary curricula: what is stopping it happening? *International Journal of Sustainability in Higher Education.* 5(*1*); 33-47.

Tickle, J., Heatherton, T., and Wittenberg, L. (2001) Can Personality Change? Chapter 11 in *Handbook of Personality Disorders: Theory, Research, and Treatment.* Livesley, J. (Ed.) London: Guilford Press.

Todd, v., McIlroy, D., and Bunting, B. (2009) Individual Differences in Education: What do we know beyond ability? *The Irish Journal of Environmental Psychology.* 30 (*3-4*); 147-160.

Todorov, V., and Marinova, D. (2009) Models of Sustainability. 18th World IMACS/MODSIM Congress; Cairns, Australia 13-17 July.

Tonglet, M; Phillips, P; Read, A. (2004) Using the Theory of Planned Behaviour to investigate the determinants of recycling behaviour: a case study from Brixworth, UK. *Resources, conservation and recycling.* 41(*3*); 191-214.

Torgler, B., and García-Valiñas, M. (2007) The determinants of individuals' attitudes towards preventing environmental damage. *Ecological Economics.* 63*(2/3);* 536-552.

Treloar, G., Gupta, H., Love, P., and Nguyen, B. (2003) An analysis of factors influencing waste minimisation and use of recycled materials for the construction of resudential buildings. *Management of Environmantal Quality: An International Journal.*14(*1*); 135-145.

Velázquez, L., Munguía, N., and Sánchez, M. (2005) Deterring sustainability in higher education institutions: An appraisal of the factors which influence sustainability in higher education institutions. *International Journal of Sustainability in Higher Education.* 6(*4*); 383-391.

VELS (2009) Sustainability perspectives in the VELS: sustainability matrix overview. [online] Available at: http://vels.vcaa.vic.edu.au/support/crosscurricular/sustainability.html (accessed 11/11/2009).

Watson Wyatt (2009) Are 'Green' Buildings Good for your Portfolio? [Online] Available at: www.climatechangecapital.com (accessed 01/12/2011).

Wegner, E. (2000) Communities of practice and social learning systems. *Organization.* 7(*2*); 225-246.

Widiger, T., and Trull, T. (1997) Assessment of the Five-Factor Model of Personality. *Journal of Personality Assessment.* 68(*2*);228-250.

Wood, W. (2000) Attitude Change: Persuasion and Social Influence. *Annual Review of Psychology.* 51; 539-570.

World Comission on Environment and Development (WCED) (1987*) Our common future*. New York, Oxford University Press.

Wranik, T., Barrett, L., and Salovey, P. (2007) Intelligent emotion regulation: Is knowledge power? From Gross, J. (ed.) *Handbook of emotion regulation.* New York, Guilford Press.

Wright, T. (2010) University presidents' conceptualizations of sustainability in higher education. *International Journal of Sustainability in Higher Education.* 11(*1*); 61-73.

Yahya, K., and Boussabaine, H. (2006). Eco-costing of construction waste. *Management of Environmental Quality: An International Journal.* 17(*1*); 6-19.

Yuan, H., and Shen, L. (2011) Trend of the Research on Construction and Demolition Waste Management. 31(*4*); 670-679.

Östlund, U., Kidd, L., Wengström, Y., and Rowa-Dewar, N. (2011) Combining qualitative and quantitative research within mixed methods research designs: A methodological review. *International Journal of Nursing Studies.* 48(*3*); 369-383.

Additional Publications:

Riley, M., Kokkarinen, N., and Pitt, M. (2010) Assessing Post Occupancy Evaluation in Higher Education Facilities. *Journal of Facilities Management*. 8(*3*); 202-213.

Kokkarinen, N., and Cotgrave, A.J. Developing Positive Attitudes to Sustainability via Educational Interventions: An Exploration of what may Work. *Intended for the Institute of Civil Engineers* (In Preparation).

Appendices

Appendix 1

Dear Noora,

The scale is not copyrighted, and you have my permission to use it. You may find the atached article I was asked to write to commemorate the 30th anniversary of the original scale of interest, and perhaps a couple of other pieces dealing with the measurement of environmental attitudes more generally.

Good luck with your work.

From: Kokkarinen, Noora
Sent: Thursday, October 01, 2009 7:03 AM
To: Dunlap, Riley
Subject: New Ecological Paradigm

Dr. Dunlap,

I am currently a PhD student in Liverpool John Moores University in the United Kingdom. I will be looking at the attitudes towards the environment students have, particularly those studying construction related subjects, in relation to developing educational interventions which would promote sustainability. I would like to know if it would be possible to use the revised New Ecological Paradigm Scale (2000) in my research as my university does not hold the copyright for this scale.

Sincerely,
Noora Kokkarinen

Appendix 2

LIVERPOOL JOHN MOORES UNIVERSITY

PARTICIPANT INFORMATION SHEET

Built Environment student attitudes toward the environment.

Name of Researcher and School/Faculty
Noora Kokkarinen for the School of the Built Environment and the School of Natural Sciences and Psychology.

You are being invited to take part in a PhD research study. Please take the time to read the following information before deciding whether to take part. This is to make sure that you understand why the research is being conducted and what it involves. If you would like some more information or something is not clear please ask.

1. What is the purpose of the study?

As industrialization has become more significant in the past few years, so have views about the environment. The purpose of this study is to measure attitudes students have about the environment.

2. Do I have to take part?

Taking part in the study is optional and you may withdraw from it at any point without giving a reason. Withdrawing will not affect any future treatment you receive and will not be used against assessment of coursework or examinations. If you do take part in the study, online registration will be taken as consent.

3. What will happen to me if I take part?

You will be asked to complete an online questionnaire. Completing the questionnaire should take no longer than 40 minutes.

4. Are there any risks / benefits involved?

No risks have been identified for taking part in this study. The benefits of taking part in the study may include better teaching delivery during lectures/workshops by staff and more appropriate assessment methods.

5. Will my taking part in the study be kept confidential?

Any information that you provide will be kept strictly confidential. You will not be asked to provide your name on the questionnaires or other documents. All data will be anonymous. Data from the questionnaires will be kept by the researcher and will not be passed on to third parties. All information you provide will be stored securely and destroyed by shredding or deleting electronic information within one year of the completion of the study.

6. What will happen to the results of the research study?

The results of the research will be used for a PhD dissertation which may be published in an academic journal. You will not be identified in any report or publication.

7. Has this study been approved by an ethics committee?

This study has gained ethical approval from the Liverpool John Moores Research Ethics Committee (REC).

8. Who to contact with enquiries about this study?

Any questions that you have about your participation, withdrawal and role in the study should be addressed to Noora Kokkarinen who is organizing this study.

Noora Kokkarinen School of the Built Environment, Liverpool John Moores University,

LIVERPOOL JOHN MOORES UNIVERSITY

CONSENT FORM

Title of project: Built Environment student attitudes toward the environment.

Name of Researcher: *Noora Kokkarinen - School of the Built Environment*

1. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights. ☐
3. I understand that any personal information collected during the study will be anonymised and remain confidential ☐
4. I agree to take part in the above study ☐

Name of Participant	Date	Initials/Signature
_____	_____	_____

Name of Researcher	Date	Initials/Signature
Noora Kokkarinen	_____	NK

Name of Person taking consent *(if different from researcher)*	Date	Signature
_____	_____	_____

This study is longitudinal, that means that you will be asked to complete a follow-up questionnaire at a later date. **PLEASE** write down your **student number** so that you can be identified for this purpose. Your responses will be kept confidential.

Age: _____
Gender: [] Male [] Female

Course of study:
[] Construction Management

[] Real Estate Management/REM and Business
[] Quantity Surveying
[] Building Surveying
[] Civil Engineering
[] Building Services Engineering/BSE and Project Management
[] Architectural Technology
[] Other _____

What year are you in?
[] 1st [] 2nd [] 3rd

Final year students only: Were you on a sandwich year (worked in industry)?
[] Yes [] No

1st and 2nd year students only: Are you planning on doing a sandwich year (work in industry)?
[] Yes [] No

New Ecological Paradigm

Please read the following statements carefully and answer using the following scale:

Strongly Agree (**1**) Unsure (**3**) Strongly Disagree (**5**)
Mildly Agree (**2**) Mildly Disagree (**4**)

1. We are approaching the limit of the number of 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 unsure that we do NOT make the earth unliveable.
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.

Five Factor Model

On the following pages, there are phrases describing people's behaviours. Please use the rating scale below to describe how accurately each statement describes ***you***. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then circle the appropriate number.

Response Options

1: Very Inaccurate
2: Moderately Inaccurate
3: Neither Inaccurate nor Accurate
4: Moderately Accurate
5: Very Accurate

1.	I am the life of the party	1	2	3	4	5
2.	I feel comfortable around other people	1	2	3	4	5
3.	I start conversations	1	2	3	4	5
4.	I talk to a lot of different people at parties	1	2	3	4	5
5.	I don't mind being the centre of attention	1	2	3	4	5
6.	I don't talk a lot	1	2	3	4	5
7.	I keep in the background	1	2	3	4	5
8.	I have little to say	1	2	3	4	5
9.	I don't like to draw attention to myself	1	2	3	4	5
10.	I am quiet around strangers	1	2	3	4	5
11.	I am interested in people	1	2	3	4	5
12.	I sympathize with others' feelings	1	2	3	4	5
13.	I have a soft heart	1	2	3	4	5
14.	I take time out for others	1	2	3	4	5
15.	I feel others' emotions	1	2	3	4	5
16.	I make people feel at ease	1	2	3	4	5
17.	I am not really interested in others	1	2	3	4	5
18.	I insult people	1	2	3	4	5
19.	I am not interested in other people's problems	1	2	3	4	5
20.	I feel little concern for others	1	2	3	4	5
21.	I am always prepared	1	2	3	4	5
22.	I pay attention to details	1	2	3	4	5
23.	I get chores done right away	1	2	3	4	5
24.	I like order	1	2	3	4	5
25.	I follow a schedule	1	2	3	4	5
26.	I am exacting in my work	1	2	3	4	5
27.	I leave my belongings around	1	2	3	4	5
28.	I make a mess of things	1	2	3	4	5
29.	I often forget to put things back in their proper place	1	2	3	4	5
30.	I shirk my duties	1	2	3	4	5
31.	I am relaxed most of the time	1	2	3	4	5
32.	I seldom feel blue	1	2	3	4	5
33.	I get stressed out easily	1	2	3	4	5
34.	I worry about things	1	2	3	4	5
35.	I am easily disturbed	1	2	3	4	5
36.	I get upset easily	1	2	3	4	5
37.	I change my mood a lot	1	2	3	4	5
38.	I have frequent mood swings	1	2	3	4	5
39.	I get irritated easily	1	2	3	4	5
40.	I often feel blue	1	2	3	4	5

41.	I have a rich vocabulary	1	2	3	4	5
42.	I have a vivid imagination	1	2	3	4	5
43.	I have excellent ideas	1	2	3	4	5
44.	I am quick to understand things	1	2	3	4	5
45.	I use difficult words	1	2	3	4	5
46.	I spend time reflecting on things	1	2	3	4	5
47.	I am full of ideas	1	2	3	4	5
48.	I have difficulty understanding abstract ideas	1	2	3	4	5
49.	I am not interested in abstract ideas	1	2	3	4	5
50.	I do not have a good imagination	1	2	3	4	5

Trait Meta Mood Scale

Using the rating scale below, please rate the strength of your agreement/disagreement to the following statements. Write your response to each statement in the box.

1 = Strongly disagree 3 = Neither agree or disagree
2 = Somewhat disagree 4 = Somewhat agree 5 = Strongly agree

Statement Number	Statement	
1	I try to think good thoughts no matter how badly I feel.	
2*	People would be better off if they felt less and thought more.	
3*	I don't think it's worth paying attention to your emotions or moods.	
4*	I don't usually care much about what I am feeling.	
5*	Sometimes I can't tell what my feelings are.	
6	I am rarely confused about how I feel.	
7	Feelings give direction to life.	
8	Although I am sometimes sad, I have a mostly optimistic outlook.	
9*	When I am upset I realise that the "good things in life" are illusions.	
10	I can't believe in acting from the heart.	
11*	I can never tell how I feel.	
12	The best way to handle my feelings is to experience them to their fullest.	
13	When I am upset I remind myself of all the pleasures from life.	
14*	My beliefs and opinions always seem to change depending on how I feel.	
15	I am aware of my feelings on a matter.	
16*	I am usually confused about how I feel.	
17*	One should never be guided by emotions.	
18*	I never give into my emotions	
19*	Although I am sometimes happy, I have a mostly pessimistic outlook.	
20	I feel at ease with my emotions.	

21	I often pay attention to how I feel.	
22*	I can't make sense out of my feelings.	
23*	I don't pay much attention to my feelings.	
24	I often think about my feelings.	
25	I am usually very clear about my feelings	
26	No matter how badly I feel, I try to think about pleasant things.	
27*	Feelings are a weakness humans have.	
28	I usually know my feelings about a matter.	
29*	It is usually a waste of time to think about your emotions.	
30	I almost always know exactly how I am feeling.	

Appendix 3

```
DESCRIPTIVES VARIABLES=EcologicalView Extraversion Agreeableness
Conscientiousness Neuroticism Openness EI
  /STATISTICS=MEAN STDDEV MIN MAX.
```

Descriptives

```
[DataSet1] F:\PhD\NEPPilotDec2009.sav
```

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
EcoWorldView	99	16	75	50.78	10.464
Textra	99	16	50	33.79	7.518
Tagree	99	10	49	39.41	5.914
Tconsc	99	14	49	35.03	7.297
Tneuro	99	10	50	30.95	8.100
Topen	99	25	50	36.71	4.951
TEI	99	77	144	103.93	13.014
Age	99	18	54	27.45	8.152
Valid N (listwise)	99				

```
CORRELATIONS
  /VARIABLES=EcologicalView Extraversion Agreeableness Conscientiousness
Neuroticism Openness EI
  /PRINT=TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Correlations

Correlations

		EcoWorldView	Textra	Tagree	Tconsc	Tneuro
EcoWorldView	Pearson Correlation	1	-.219*	.133	.113	-.1

	Sig. (2-tailed)		.030	.188	.264	.(
	N	99	99	99	99	
	Pearson Correlation	-.219*	1	.042	.015	.2
Textra	Sig. (2-tailed)	.030		.679	.880	.(
	N	99	99	99	99	
	Pearson Correlation	.133	.042	1	.299**	-.(
Tagree	Sig. (2-tailed)	.188	.679		.003	.(
	N	99	99	99	99	
	Pearson Correlation	.113	.015	.299**	1	.(
Tconsc	Sig. (2-tailed)	.264	.880	.003		.;
	N	99	99	99	99	
	Pearson Correlation	-.196	.207*	-.042	.031	
Tneuro	Sig. (2-tailed)	.052	.040	.677	.762	
	N	99	99	99	99	
	Pearson Correlation	-.148	.166	.057	-.109	.'
Topen	Sig. (2-tailed)	.144	.100	.576	.284	.'
	N	99	99	99	99	
	Pearson Correlation	-.072	.358**	.385**	.061	.'
TEI	Sig. (2-tailed)	.479	.000	.000	.548	.'
	N	99	99	99	99	

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

```
REGRESSION
  /DESCRIPTIVES MEAN STDDEV CORR SIG N
  /MISSING LISTWISE
  /STATISTICS COEFF OUTS R ANOVA CHANGE
  /CRITERIA=PIN(.05) POUT(.10)
  /NOORIGIN
  /DEPENDENT EcologicalView
  /METHOD=ENTER Age Gender Agreeableness Openness
  /METHOD=ENTER Neuroticism Conscientiousness
  /METHOD=ENTER Extraversion EI.
```

Regression

```
[DataSet1] F:\PhD\NEPPilotDec2009.sav
```

Descriptive Statistics

	Mean	Std. Deviation	N
EcoWorldView	50.78	10.464	99
Age	27.45	8.152	99
Gender	1.17	.379	99
Tagree	39.41	5.914	99
Topen	36.71	4.951	99
Tneuro	30.95	8.100	99
Tconsc	35.03	7.297	99
Textra	33.79	7.518	99

TEI	103.93	13.014	99

Correlations

		EcoWorldView	Age	Gender	Tagree	Topen
Pearson Correlation	EcoWorldView	1.000	.196	-.008	.133	-.
	Age	.196	1.000	-.158	-.040	-.
	Gender	-.008	-.158	1.000	.087	-.
	Tagree	.133	-.040	.087	1.000	.
	Topen	-.148	-.160	-.246	.057	1.
	Tneuro	-.196	-.200	-.156	-.042	.
	Tconsc	.113	.023	.021	.299	-.
	Textra	-.219	-.230	.154	.042	.
	TEI	-.072	-.101	.014	.385	.
Sig. (1-tailed)	EcoWorldView	.	.026	.470	.094	.
	Age	.026	.	.060	.348	.
	Gender	.470	.060	.	.196	.
	Tagree	.094	.348	.196	.	.
	Topen	.072	.057	.007	.288	
	Tneuro	.026	.024	.061	.339	.
	Tconsc	.132	.412	.418	.001	.
	Textra	.015	.011	.065	.339	.
	TEI	.240	.159	.444	.000	.
N	EcoWorldView	99	99	99	99	
	Age	99	99	99	99	
	Gender	99	99	99	99	
	Tagree	99	99	99	99	
	Topen	99	99	99	99	
	Tneuro	99	99	99	99	
	Tconsc	99	99	99	99	
	Textra	99	99	99	99	
	TEI	99	99	99	99	

Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	Topen, Tagree, Age, Gender[b]	.	Enter
2	Tneuro, Tconsc[b]	.	Enter
3	Textra, TEI[b]	.	Enter

a. Dependent Variable: EcoWorldView

b. All requested variables entered.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Chang	
					R Square Change	F Change
1	.273[a]	.075	.035	10.277	.075	1.899
2	.315[b]	.099	.040	10.252	.024	1.233
3	.346[c]	.120	.042	10.243	.021	1.077

a. Predictors: (Constant), Topen, Tagree, Age, Gender

b. Predictors: (Constant), Topen, Tagree, Age, Gender, Tneuro, Tconsc

c. Predictors: (Constant), Topen, Tagree, Age, Gender, Tneuro, Tconsc, Textra, TEI

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	802.443	4	200.611	1.899	.117[b]
	Residual	9928.158	94	105.619		
	Total	10730.600	98			
2	Regression	1061.696	6	176.949	1.684	.134[c]
	Residual	9668.904	92	105.097		
	Total	10730.600	98			
3	Regression	1287.611	8	160.951	1.534	.157[d]
	Residual	9442.989	90	104.922		
	Total	10730.600	98			

a. Dependent Variable: EcoWorldView

b. Predictors: (Constant), Topen, Tagree, Age, Gender

c. Predictors: (Constant), Topen, Tagree, Age, Gender, Tneuro, Tconsc

d. Predictors: (Constant), Topen, Tagree, Age, Gender, Tneuro, Tconsc, Textra, TEI

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	45.403	12.666		3.585	.001
	Age	.226	.132	.176	1.717	.089
	Gender	-.723	2.902	-.026	-.249	.804
	Tagree	.266	.177	.150	1.504	.136
	Topen	-.285	.222	-.135	-1.285	.202
2	(Constant)	50.153	14.129		3.550	.001
	Age	.184	.135	.143	1.368	.175

	Gender	-1.343	2.933	-.049	-.458	.648
	Tagree	.218	.186	.123	1.172	.244
	Topen	-.236	.224	-.112	-1.052	.295
	Tneuro	-.198	.134	-.153	-1.476	.143
	Tconsc	.096	.151	.067	.636	.526
	(Constant)	54.296	14.667		3.702	.000
	Age	.158	.136	.123	1.165	.247
	Gender	-.491	2.989	-.018	-.164	.870
	Tagree	.235	.202	.133	1.164	.247
3	Topen	-.173	.232	-.082	-.747	.457
	Tneuro	-.159	.137	-.123	-1.165	.247
	Tconsc	.100	.151	.070	.662	.510
	Textra	-.206	.156	-.148	-1.320	.190
	TEI	-.017	.096	-.022	-.181	.857

a. Dependent Variable: EcoWorldView

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics
						Tolerance
1	Tneuro	-.149[b]	-1.441	.153	-.148	.915
	Tconsc	.056[b]	.533	.595	.055	.893
	Textra	-.175[b]	-1.694	.094	-.173	.904
	TEI	-.095[b]	-.847	.399	-.087	.784
2	Textra	-.154[c]	-1.464	.147	-.152	.872
	TEI	-.072[c]	-.637	.525	-.067	.769

a. Dependent Variable: EcoWorldView

b. Predictors in the Model: (Constant), Topen, Tagree, Age, Gender

c. Predictors in the Model: (Constant), Topen, Tagree, Age, Gender, Tneuro, Tconsc

Appendix 4

LIVERPOOL JOHN MOORES UNIVERSITY

PARTICIPANT INFORMATION SHEET

Student Attitudes toward the Environment

Name of Researcher and School/Faculty
Noora Kokkarinen for the School of the Built Environment and the School of Natural Sciences and Psychology.

You are being invited to take part in a PhD research study. Please take the time to read the following information before deciding whether to take part. This is to make sure that you understand why the research is being conducted and what it involves. If you would like some more information or something is not clear please ask.

6. What is the purpose of the study?
As industrialization has become more significant in the past few years, so have views about the environment. The purpose of this study is to measure attitudes students have about the environment throughout the course of their degree.

7. Do I have to take part?
Taking part in the study is optional and you may withdraw from the study at any point without giving a reason. Withdrawing from the study will not affect any future treatment you receive. If you do take part in the study please fill in the consent form.

8. What will happen to me if I take part?
You will be asked to complete a set of questionnaires. Completing them should take no longer than 30 minutes.

9. Are there any risks / benefits involved?
No risks have been identified for taking part in this study. The benefits of this study are to gain understanding on how built environment students consider the environmental impact caused by construction practices.

10. Will my taking part in the study be kept confidential?
Any information that you provide will be kept strictly confidential. You will not be asked to provide your name on the questionnaires **however, you will be asked for your student number for tracking purposes**. Data from the questionnaires will be kept by the researcher and will not be passed on to third parties. All information you provide will be stored securely and destroyed by shredding within one year of the completion of the study.

6. What will happen to the results of the research study?
The results of the research will be used for a PhD dissertation which may be published in an academic journal. You will not be identified in any report or publication.

8. Has this study been approved by an ethics committee?

This study has gained ethical approval from the Liverpool John Moores Research Ethics Committee (REC).

8. Who to contact with enquiries about this study?

Any questions that you have about your participation, withdrawal and role in the study should be addressed to Noora Kokkarinen who is organizing this study.

Noora Kokkarinen School of the Built Environment, Liverpool John Moores

LIVERPOOL JOHN MOORES UNIVERSITY

CONSENT FORM

Title of project: Built Environment student attitudes toward the environment.

Name of Researcher: *Noora Kokkarinen - School of the Built Environment*

5. I confirm that I have read and understand the information provided for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily ☐

6. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and that this will not affect my legal rights. ☐

7. I understand that any personal information collected during the study will be anonymised and remain confidential ☐

8. I agree to take part in the above study ☐

Initials of Participant _____ Date _____ Signature/Initials _____

Name of Researcher	Date	Signature/Initials	
Noora Kokkarinen			

This study is longitudinal, that means that you will be asked to complete a follow-up questionnaire at a later date. **PLEASE** write down your **student number** so that you can be identified for this purpose. Your responses will be kept confidential.

Age: _____
Gender: [] Male [] Female

Course of study:
[] Construction Management
[] Real Estate Management/REM and Business
[] Quantity Surveying
[] Building Surveying
[] Civil Engineering
[] Building Services Engineering/BSE and Project Management
[] Architectural Technology
[] Other _____

What year are you in?
[] 1st [] 2nd [] 3rd

Final year students only: Were you on a sandwich year (worked in industry)?
[] Yes [] No

1st and 2nd year students only: Are you planning on doing a sandwich year (work in industry)?
[] Yes [] No

Sustainability Attitudes Scale

The statements below express different perspectives on sustainability within the built environment (which refers to everything in your surroundings that are man-made such as parks, roads, streets, buildings etc.). Please read each statement carefully and circle the number that best represents your attitude toward that statement. If possible **AVOID** using 'Neither Agree nor Disagree' as your answer. Your knowledge is **not** being tested; there are no right answers.

Response Options **1:** Very Strongly Disagree **2:** Strongly Disagree **3:** Somewhat Disagree **4:** Neither Agree nor Disagree **5:** Somewhat Agree **6:** Strongly Agree **7:** Very Strongly Agree

1. There will be sufficient natural resources if they are used prudently.	1	2	3	4	5	6	7
2. Legislation is the only way to make the industry change its ways.	1	2	3	4	5	6	7
3. The effectiveness of construction work does not have to diminish even if substantial changes are made.	1	2	3	4	5	6	7
4. It is important to adopt a sustainable approach to choosing materials.	1	2	3	4	5	6	7

5. Communities cannot benefit from what the built environment does.	1	2	3	4	5	6	7
6. The construction industry wastes money on procuring materials that do not get used.	1	2	3	4	5	6	7
7. It is important to know where and how materials are sourced so that the less environmentally harmful choice is made.	1	2	3	4	5	6	7
8. Thorough inspection of land, which is to be (re)developed, needs to be carried out to ensure the well-being of communities.	1	2	3	4	5	6	7
9. It would be good practice to evaluate the cost of refurbishment against new build.	1	2	3	4	5	6	7
10. Minimising water, noise and spatial pollution should be a goal in any activity.	1	2	3	4	5	6	7
11. Current generations have the obligation to protect the environment for the benefit of future generations.	1	2	3	4	5	6	7
12. Companies reporting their sustainability plans as well as their accomplishments have a competitive advantage over other companies.	1	2	3	4	5	6	7
13. Construction practices could use significantly less embodied energy.	1	2	3	4	5	6	7
14. The industry should inform the wider community of the effects construction work has on the environment.	1	2	3	4	5	6	7
15. It is often easier to choose the non-environmentally friendly option; either due to cost, availability or lack of knowledge.	1	2	3	4	5	6	7
16. In previous years, the construction industry has posed a threat to the environment.	1	2	3	4	5	6	7
17. Resources could be saved by increased awareness.	1	2	3	4	5	6	7
18. Acting sustainably is only worthwhile if it reduces costs.	1	2	3	4	5	6	7
19. The use of renewable energy as well as recycled materials should become more prominent in areas where facilities exist.	1	2	3	4	5	6	7
20. The built environment has the potential to benefit communities through the infrastructure it provides.	1	2	3	4	5	6	7
21. Technological advancements will ensure that the construction industry will not degrade the environment.	1	2	3	4	5	6	7
22. The environmental impact that the built environment has is largely exaggerated.	1	2	3	4	5	6	7
23. Poor planning and management are the main cause of bad practice.	1	2	3	4	5	6	7
24. Cutting down waste can have financial benefits attached to it in the long run.	1	2	3	4	5	6	7
25. The construction industry does enough to protect the environment.	1	2	3	4	5	6	7

Five Factor Model

On the following pages, there are phrases describing people's behaviours. Please use the rating scale below to describe how accurately each statement describes ***you***. Describe yourself as you generally are now, not as you wish to be in the future. Describe yourself as you honestly see yourself, in relation to other people you know of the same sex as you are, and roughly your same age. So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence. Please read each statement carefully, and then circle the appropriate number.

Response Options

1: Very Inaccurate
2: Moderately Inaccurate
3: Neither Inaccurate nor Accurate
4: Moderately Accurate
5: Very Accurate

1.	I am the life of the party	1	2	3	4	5
2.	I feel comfortable around other people	1	2	3	4	5
3.	I start conversations	1	2	3	4	5
4.	I talk to a lot of different people at parties	1	2	3	4	5
5.	I don't mind being the centre of attention	1	2	3	4	5
6.	I don't talk a lot	1	2	3	4	5
7.	I keep in the background	1	2	3	4	5
8.	I have little to say	1	2	3	4	5
9.	I don't like to draw attention to myself	1	2	3	4	5
10.	I am quiet around strangers	1	2	3	4	5
11.	I am interested in people	1	2	3	4	5
12.	I sympathize with others' feelings	1	2	3	4	5
13.	I have a soft heart	1	2	3	4	5
14.	I take time out for others	1	2	3	4	5
15.	I feel others' emotions	1	2	3	4	5
16.	I make people feel at ease	1	2	3	4	5
17.	I am not really interested in others	1	2	3	4	5
18.	I insult people	1	2	3	4	5
19.	I am not interested in other people's problems	1	2	3	4	5
20.	I feel little concern for others	1	2	3	4	5
21.	I am always prepared	1	2	3	4	5
22.	I pay attention to details	1	2	3	4	5
23.	I get chores done right away	1	2	3	4	5
24.	I like order	1	2	3	4	5
25.	I follow a schedule	1	2	3	4	5
26.	I am exacting in my work	1	2	3	4	5
27.	I leave my belongings around	1	2	3	4	5
28.	I make a mess of things	1	2	3	4	5
29.	I often forget to put things back in their proper place	1	2	3	4	5
30.	I shirk my duties	1	2	3	4	5
31.	I am relaxed most of the time	1	2	3	4	5
32.	I seldom feel blue	1	2	3	4	5
33.	I get stressed out easily	1	2	3	4	5
34.	I worry about things	1	2	3	4	5
35.	I am easily disturbed	1	2	3	4	5
36.	I get upset easily	1	2	3	4	5
37.	I change my mood a lot	1	2	3	4	5
38.	I have frequent mood swings	1	2	3	4	5
39.	I get irritated easily	1	2	3	4	5
40.	I often feel blue	1	2	3	4	5
41.	I have a rich vocabulary	1	2	3	4	5
42.	I have a vivid imagination	1	2	3	4	5
43.	I have excellent ideas	1	2	3	4	5
44.	I am quick to understand things	1	2	3	4	5
45.	I use difficult words	1	2	3	4	5
46.	I spend time reflecting on things	1	2	3	4	5
47.	I am full of ideas	1	2	3	4	5
48.	I have difficulty understanding abstract ideas	1	2	3	4	5
49.	I am not interested in abstract ideas	1	2	3	4	5
50.	I do not have a good imagination	1	2	3	4	5

Trait Meta Mood Scale

Using the rating scale below, please rate the strength of your agreement/disagreement to the following statements. Write your response to each statement in the box.

1 = Strongly disagree 3 = Neither agree or disagree
2 = Somewhat disagree 4 = Somewhat agree 5 = Strongly agree

Statement Number	Statement	
1	I try to think good thoughts no matter how badly I feel.	
2*	People would be better off if they felt less and thought more.	
3*	I don't think it's worth paying attention to your emotions or moods.	
4*	I don't usually care much about what I am feeling.	
5*	Sometimes I can't tell what my feelings are.	
6	I am rarely confused about how I feel.	
7	Feelings give direction to life.	
8	Although I am sometimes sad, I have a mostly optimistic outlook.	
9*	When I am upset I realise that the "good things in life" are illusions.	
10	I can't believe in acting from the heart.	
11*	I can never tell how I feel.	
12	The best way to handle my feelings is to experience them to their fullest.	
13	When I am upset I remind myself of all the pleasures from life.	
14*	My beliefs and opinions always seem to change depending on how I feel.	
15	I am aware of my feelings on a matter.	
16*	I am usually confused about how I feel.	
17*	One should never be guided by emotions.	
18*	I never give into my emotions	
19*	Although I am sometimes happy, I have a mostly pessimistic outlook.	
20	I feel at ease with my emotions.	
21	I often pay attention to how I feel.	
22*	I can't make sense out of my feelings.	
23*	I don't pay much attention to my feelings.	
24	I often think about my feelings.	
25	I am usually very clear about my feelings	
26	No matter how badly I feel, I try to think about pleasant things.	
27*	Feelings are a weakness humans have.	
28	I usually know my feelings about a matter.	
29*	It is usually a waste of time to think about your emotions.	

30	I almost always know exactly how I am feeling.	

Thank you for completing this questionnaire!

Appendix 8

Student Attitudes toward the Environment

As you will recall from last week, you were asked to give your student number because this was a follow-up study. **Please provide your student number** so that your scores can be matched:

Sustainability Attitudes Scale

The statements below express different perspectives on sustainability within the built environment (which refers to everything in your surroundings that are man-made such as parks, roads, streets, buildings etc.). Please read each statement carefully and circle the number that best represents your attitude toward that statement. If possible **AVOID** using neither 'Neither Agree nor Disagree' as your answer. Your knowledge is **not** being tested; there are no right answers.

Response Options **1:** Very Strongly Disagree **2:** Strongly Disagree **3:** Somewhat Disagree **4:** Neither Agree nor Disagree **5:** Somewhat Agree **6:** Strongly Agree **7:** Very Strongly Agree

1. There will be sufficient natural resources if they are used prudently.	1	2	3	4	5	6	7
2. Legislation is the only way to make the industry change its ways.	1	2	3	4	5	6	7
3. The effectiveness of construction work does not have to diminish even if substantial changes are made.	1	2	3	4	5	6	7
4. It is important to adopt a sustainable approach to choosing materials.	1	2	3	4	5	6	7
5. Communities cannot benefit from what the built environment does.	1	2	3	4	5	6	7
6. The construction industry wastes money on procuring materials that do not get used.	1	2	3	4	5	6	7
7. It is important to know where and how materials are sourced so that the less environmentally harmful choice is made.	1	2	3	4	5	6	7
8. Thorough inspection of land, which is to be (re)developed, needs to be carried out to ensure the well-being of communities.	1	2	3	4	5	6	7
9. It would be good practice to evaluate the cost of refurbishment against new build.	1	2	3	4	5	6	7
10. Minimising water, noise and spatial pollution should be a goal in any activity.	1	2	3	4	5	6	7

11. Current generations have the obligation to protect the environment for the benefit of future generations.	1	2	3	4	5	6	7
12. Companies reporting their sustainability plans as well as their accomplishments have a competitive advantage over other companies.	1	2	3	4	5	6	7
13. Construction practices could use significantly less embodied energy.	1	2	3	4	5	6	7
14. The industry should inform the wider community of the effects construction work has on the environment.	1	2	3	4	5	6	7
15. It is often easier to choose the non-environmentally friendly option; either due to cost, availability or lack of knowledge.	1	2	3	4	5	6	7
16. In previous years, the construction industry has posed a threat to the environment.	1	2	3	4	5	6	7
17. Resources could be saved by increased awareness.	1	2	3	4	5	6	7
18. Acting sustainably is only worthwhile if it reduces costs.	1	2	3	4	5	6	7
19. The use of renewable energy as well as recycled materials should become more prominent in areas where facilities exist.	1	2	3	4	5	6	7
20. The built environment has the potential to benefit communities through the infrastructure it provides.	1	2	3	4	5	6	7
21. Technological advancements will ensure that the construction industry will not degrade the environment.	1	2	3	4	5	6	7
22. The environmental impact that the built environment has is largely exaggerated.	1	2	3	4	5	6	7
23. *Poor planning* and management are the main cause of bad practice.	1	2	3	4	5	6	7
24. Cutting down waste can have financial benefits attached to it in the long run.	1	2	3	4	5	6	7
25. The construction industry does enough to protect the environment.	1	2	3	4	5	6	7

Thank you for taking part in this study!

Appendix 5

Descriptives

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	184	20	42	22.79	3.852
EmotionalIntelligence	184	72	134	105.21	11.104
Extra	184	11	50	35.50	7.227
Agree	184	14	50	38.51	6.213
Consc	184	20	50	36.20	6.588
EmoStab	184	11	50	34.61	7.316
Open	184	15	50	35.40	5.390
T1Env	184	17	57	44.30	5.126

T1Soc	184	17	51	40.41	4.892
T1Econ	184	19	50	39.93	4.624
T2Env	184	19	53	40.80	5.563
T2Soc	184	15	56	42.24	6.865
T2Econ	184	19	51	38.76	5.165
T1SAS	184	53	157	124.64	11.857
T2SAS	184	65	152	121.81	15.132
Valid N (listwise)	184				

```
CORRELATIONS
```

Correlations

Correlations

		T1Env	T1Soc	T1Econ	T2Env	T2Soc	T2Ecc
T1Env	Pearson Correlation	1	.517**	.462**	.115	.046	
	Sig. (2-tailed)		.000	.000	.119	.534	
	N	184	184	184	184	184	
T1Soc	Pearson Correlation	.517**	1	.469**	.141	.149*	
	Sig. (2-tailed)	.000		.000	.057	.044	
	N	184	184	184	184	184	
T1Econ	Pearson Correlation	.462**	.469**	1	.099	.165*	
	Sig. (2-tailed)	.000	.000		.180	.025	
	N	184	184	184	184	184	
T2Env	Pearson Correlation	.115	.141	.099	1	.615**	.5
	Sig. (2-tailed)	.119	.057	.180		.000	
	N	184	184	184	184	184	
T2Soc	Pearson Correlation	.046	.149*	.165*	.615**	1	.6
	Sig. (2-tailed)	.534	.044	.025	.000		
	N	184	184	184	184	184	
T2Econ	Pearson Correlation	.009	.057	.119	.589**	.611**	
	Sig. (2-tailed)	.901	.443	.109	.000	.000	
	N	184	184	184	184	184	

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

```
NPAR TESTS
  /WILCOXON=T1Env T1Soc T1Econ WITH T2Env T2Soc T2Econ (PAIRED)
  /MISSING ANALYSIS.
```

Frequencies

```
[DataSet1] F:\PhD\Longitudinal Study\January
2011\ReducedSampleImputation.sav
```

Statistics

		T1Env	T1Soc	T1Econ	T2Env	T2Soc	T2Econ	T1SAS
N	Valid	184	184	184	184	184	184	18
	Missing	0	0	0	0	0	0	
Median		45.00	41.00	40.00	41.50	43.00	39.00	126.0
Range		40	34	31	34	41	32	10

NPar Tests

```
[DataSet1] F:\PhD\Longitudinal Study\January
2011\ReducedSampleImputation.sav
```

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
T2SAS - T1SAS	Negative Ranks	99[a]	91.66	9074.00
	Positive Ranks	75[b]	82.01	6151.00
	Ties	10[c]		
	Total	184		

a. T2SAS < T1SAS

b. T2SAS > T1SAS

c. T2SAS = T1SAS

Test Statistics[b]

	T2SAS - T1SAS
Z	-2.197[a]
Asymp. Sig. (2-tailed)	.028

a. Based on positive ranks.

b. Wilcoxon Signed Ranks Test

NPar Tests

```
[DataSet1] F:\PhD\Longitudinal Study\January
2011\ReducedSampleImputation.sav
```

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
T2Env - T1Env	Negative Ranks	135[a]	92.83	12531.50
	Positive Ranks	41[b]	74.26	3044.50
	Ties	8[c]		
	Total	184		

T2Soc - T1Soc	Negative Ranks	60[d]	84.56	5073.50
	Positive Ranks	116[e]	90.54	10502.50
	Ties	8[f]		
	Total	184		
T2Econ - T1Econ	Negative Ranks	102[g]	84.45	8614.00
	Positive Ranks	65[h]	83.29	5414.00
	Ties	17[i]		
	Total	184		

a. T2Env < T1Env

b. T2Env > T1Env

c. T2Env = T1Env

d. T2Soc < T1Soc

e. T2Soc > T1Soc

f. T2Soc = T1Soc

g. T2Econ < T1Econ

h. T2Econ > T1Econ

i. T2Econ = T1Econ

Test Statistics[c]

	T2Env - T1Env	T2Soc - T1Soc	T2Econ - T1Econ
Z	-7.018[a]	-4.015[b]	-2.561[a]
Asymp. Sig. (2-tailed)	.000	.000	.010

a. Based on positive ranks.

b. Based on negative ranks.

c. Wilcoxon Signed Ranks Test

```
FREQUENCIES VARIABLES=T1Env T1Soc T1Econ T2Env T2Soc T2Econ T1SAS T2SAS
  /STATISTICS=RANGE MEDIAN
  /ORDER=ANALYSIS.
```

Appendix 6

Dear _____

As a part of my PhD I am looking to *interview module/programme* leaders to get their opinions on sustainability in the curriculum.

As a module/programme leader of module/programme, would you be willing to be interviewed?

Kind regards,
Noora Kokkarinen

Appendix 7

Interview Schedule for Programme/Module Leaders

What does the term sustainable/sustainable *development mean to* you?[1]

What are the key issues facing module in the next few years?$_1$

What role, if any, do you feel the module in general should play in acheiving sustainability?$_1$

What, if any barriers do you see preventing the module from engaging in sustainability initiatives?$_1$

Do you think there are external factors which prevent sustanability being more prominent in the module? (i.e. Curriculum/ University Policy/Professional body accreditation)[2]

Do you foresee different barriers and challenges in the future?$_1$

Do you think the module could advertise the sustainability component more prominently?$_4$

In what ways would you want to promote/include sustainability education in the module?$_4$

Are sustainable messages embedded into the teaching material or is sustainability mentioned separately from the core aspects of the module?$_4$

Do you think the promotion of sustainability in the construction industry (once students graduate) will be more likely to happen if the students have a transformative experience through educational interventions/increased sustainability knowledge while at university?[3]

Is it likely that students would become more engaged learners and possibly gain positive sustainability/environmental attitudes if they had a more empathetic/emotional attachement to the environment?$_5$

What competencies would you want students in the module to gain with regards to acting sustainably in the construction industry? Personal lives?$_6$

Appendix 8

Interviewee	QST Tech Project
Interviewer	Noora Kokkarinen
Date	

[1] Adapted from Wright (2010)
$_4$ From own findings
[2] Adapted from Jones, Trier and Richards (2008)
$_6$ Adapted from EE readings
[3] Adapted from Taylor (2007)
$_5$ Transformative learning readings

Venue	

NK: If you could just give your position and what module you are module leader for please

YM: Yeah my name is Yassime Melanie and I'm Senior Lecturer in Built Environment in the Quantity Surveying section. I'm joint module leader for the final year joint project for the QS jointly with Damien in addition to other modules as of course Programmes

NK: And err if we could just start off with how would you, what comes to mind when you think of the term sustainable or use of term sustainable development.

YM: Well I come from a different background than most of my colleagues though I've got some background in environment and energy. So when I think about sustainable I think about using resources today in order to develop whatever initiatives taking in to consideration future generation. So that's the general term.

NK: Ok

YM: plus its sustainability, sustainable and sustainable development. And that's the original definition of the term. Within the context of construction industry therefore its got to do with resources used in the construction industry and therefore the resources have to take in to consideration future generation, not only from a resource prospective but more importantly from an environmental impact on future generations. So that's my general understanding of the concept

NK: Ok. And then if you were to think about sustainability and achieving sustainability within the context of the module do you feel that the quantity surveying technology project does that or could it do more in promoting sustainability from the way you've described it.

YM: Well the way our thinking about introducing the, a new joint project within the QS section is to challenge the student with a sustainable development that will integrate not only sustainability as a general concept but maybe integrating energy dimension and therefore challenging student from the prospective of integrating alternative source of energy in a development. i.e.; in a project that they will be undertaking. So obviously we know that one of the environmental damage of construction has is the amount of energy it uses for heating, cooling and the whole construction process and so we try to find how the student think in terms of alternative source of energy to integrate in building. So this was the initial idea, Damien and myself discussed over the summer and we will be working on these dimensions to the project that the student will do.

NK: And do you think there will be any barriers or something that prevents this from happening in the module

YM: I think my opinion again coming from an energy background is how much information the student have had when they arrive to undertake this project. In terms of their knowledge or energy and building in particular but also energy use and energy resources in general from, and their impact sorry on the environment. So that's probably all of the problems I expect will be facing with QS student coming probably more from a background which combine obviously construction technology with how much information do they have about energy resources and energy sources, the origin of the actual resources that they use and how much information. I think there is a little bit more bias towards or this within the QS to look to consider probably more on the contract/financial dimension to project and

so that would be probably the challenging bit for us. So therefore we'll have to try to overcome this

NK: Yeah. And then if you were to think in terms of external barriers either within the curriculum or university policy, professional bodies and however they choose to accredit the modules, do you think those will have any bearing.

YM: Yeah externally I mean obviously again whatever we try to develop is going to have a sort of, be affected by external factors. Whether in terms of us getting the information to communicate to student from industry, from professional bodies again and also from, I think at university level there is a lot of awareness from the university prospective in terms of the sustainable dimension of the university operation. So it is from this prospective I don't think it's a major issue but if we go beyond and think about the professional sector that these student will be working in, I don't think there is too much, a lot of awareness and also not only awareness but might be the wrong where there might be some kind of awareness. But when it comes to do the practical side of operation in the construction industry and in the professional sector in terms of supplying different services, there is a lack of practical aspect apart from some of the, I would say probably administrative targets set by different institutions regarding targets. But you can meet targets in different ways so that, this is something maybe which creates some kind of problems from academical, for people who are trying to communicate or try to make future professional aware about a number of issues. Ok.

NK: And then in terms of as you mentioned specifically administrative targets, do you think there will be different challenges in the future, either external or internal that may, that may either stop sustainability from happening

YM: One of the thing which is probably for the future is to try to link, I'm talking about now externally, about the industry say and whatever we say about the construction industry applies to other sectors but how can we and, this would be probably a challenge for the industry and for government to ensure that we have evidence that in a particular construction activity we can link the financial reward of a particular project to the environmental impact i.e. in terms of producing financial information like accounting information, how can we see in a sort of like an accounting document profit and loss account etc. How can we see the evidence that this activity has actually internalised the environmental damage and at this stage there are some attempt to try to link both. At national level its feasible if you think about, from a national accounting prospective then government can sort of try to build economic data whereby they can sort of link industrial activity but that's at industrial level with there how output is delivered and then maybe we can account from the environmental impact. But at industry level, at private business level when you look at the information on a construction project yes there is some kind of evidence about waste, waste minimalisation etc. But how do we link this with financial performance and how do we ensure that in the process the company or the industry is internalising you know this environmental damage so that we'll have some kind of link between finance. Its still early stages but that's probably one of the challenge. And that's why I said administratively its easy to say this is the target we've been set as an industry by government and government have to meet targets set by international organisation like greenhouse gases, emission etc. So it trickles down to industry but for me this is more of an administrative process and it doesn't show the performance, financial performance and link it to environmental issue. So that's one I'm probably a little bit yeah

NK: Yeah, something to consider for the future. Do you think in terms of the Quantity Surveying technology project that its advertised both to current students and

prospective students and there is a sustainability component within the learning outcomes and in the learning materials

YM: Yeah this is the, obviously if, you're aware that we are in the early stages of developing the new curriculum, 24 credit, sorry modules and the year long modules etc. So now the challenge for us is to ensure that the way the module is developed in terms of learning outcomes and learning objectives, then it'll fit within the concern for sustainable project and environmental project. So that's the idea which we discussed. But obviously it's the first attempt because if you go back last year, the year before there is some element in term of the project but this is a new project which we are developing Damien and myself and it will have a sustainable component to major component, I say early stages, we think energy is an important dimension to sustainability and that's probably where we think we need to create awareness in the link between energy and environment and sustainability within the construction process. Ok so that's, we will include it, and it is to be included in the learning outcome

NK: Yeah. And then as you just mentioned that specifically the energy aspect is possibly because its your background area as well but also it seems that that is something that quantity surveyors will have to keep in mind for their professional careers as well so you ideally what you're trying to do

YM: Well that's something that I believe strongly because I think that yes if you are a construction professional, you're quantity surveying then obviously your key skill is to ensure that whether you work for and that's my understanding again, I'm not a quantity surveyor so when you pass on this to multi surveyors then they might sort of think what the hell is this guy saying but that's my opinion that I think my understanding of quantity surveying is really to look at the financial dimension and in a very short sighted view consider basically from a client prospective or from a contractor prospective, whoever you work for is to try to minimise cost and try to ensure that you can generate a good profit margin for your employer, if it's a contractor if you are working for a client obviously try to look at the opposite, try to minimise the overall cost. But in reality its financial management that's my understanding of quantity surveying, obviously there is the other dimension which is the contract dimension but all lead towards finance and costs and financial control does the term I was looking for. But when you look at this narrow definition where would you fit sustainability, where would you fit environmental awareness, where would you fit the, its basically that a construction process today has to look at where environment sustainability are very sort of very wide concept so if you narrow it down to the construction process then we know that the construction industry has or uses about 40% of energy in the economy and generate therefore a large proportion of greenhouse gases because we still rely on fossil fuel for generating for example electricity. So I start with this point and say, develop a project, see how this project, is it sustainable. My understanding of sustainable for me would be to say that this is generating 30% to 40% from alternative source of energy and that for me is a good start. If we move towards construction, building any aspect of the construction product or service will generate awareness of alternative sources. And I've had the pleasure of working with QS's this year on their dissertation and looking at alternative sources of energy like wind and how do we integrate wind energy in the construction. In Building, solar photovoltaic. So there's a lot of stuff and I think that's what the government is trying to do in terms of using government building and try to integrate sustainable energy so. Its not the fact that my background is energy it's the fact that I think the key issue is you should link sustainability, environment and energy at least in the short term

NK: Yeah

YM: Ok

NK: And then I think we can skip a few of the questions because you've sort of answered them. For me, would you say as an educator then that the promotion of sustainability attitudes within the future construction professionals. Do you think it is most, more likely to happen that they take away positive attitudes if they experience transformative learning experiences, so based on the information that you give them in the Quantity Surveying module it forces them to change whatever preconceptions they had and then do you think this is likely to happen with the right sort of information given to them.

YM: I think so, I'm absolutely positive because I've seen it already happen in a number of initiatives for the last couple of years. Just individual initiatives from staff and student who are looking for challenges in terms of their overall research project and their dissertation. So I've seen like the shift with, and this within the QS, the shift from traditional procurement, financial area topics for dissertation in to sustainability, environment, energy, renewal energy etc and how they integrate in the construction process. So there's been a shift, a positive shift in this particular area. And I've seen it in the final year dissertation and obviously you will not get to this stage of going down the route of looking at the environment, sustainability and energy unless you've had the benefit of a bit of interaction with maybe individual staff or maybe with some of the project or maybe with some of the professional but you would have had already had some little bit of background. So I see in this sense that there is a going to be a lot more awareness obviously hoping that student who come on to degree already have because its not. We also need society at large you know to be more aware. And when I think about student coming to course from college, I'm thinking about colleges, I'm thinking about schools, I'm thinking about curriculum at the early stages to try to create some awareness. There is not only QS's, if you sending people going on to business school or in other engineering programme, mechanical or whatever. So if they come from the same source, secondary education, primary secondary education then there should be some kind of preparation in order to start them thinking and then obviously they will come probably a little bit more aware and then that'll be again more challenge for us to make them aware and to try to get some kind of interest I would say.

NK: Yeah I think then it would almost be just that they have the background knowledge of environment

YM: Exactly

NK: and preservation but then they get the technological aspect from it yeah

YM: Yes because if they don't get any background, if they don't have any knowledge and then they come on to university then you'd have to start from scratch.

NK: Which then wastes time to get what you want to do

YM: Exactly so if they are a little bit aware then they will challenge you as well with questions and then they might have some knowledge which would be or interest to you if it was like a geography knowledge from a geography background of someone who did geography or whatever then they should have a lot more information of someone who did maybe sciences and then they may link it around to science but we do a bit about the science anyway.

NK: Yeah. Would you consider that you said that its, it should be that the students at a younger age are prepared to consider environmental issues. Would you say people

that may be enjoy nature more do you think they would be more likely to engage in, and to benefit from the environmental knowledge and technological

YM: Yeah

NK: knowledge at university level

YM: Well I think what then go back to early ages and it seems like the more pupils go out and learn from nature in whatever sense, whether they do Sociology or they do Psychology or they do Geography, I'm talking about "A" level here. But you can go back earlier in the training, in the teaching training programmes for kids then the more they're in contact with nature as you said, but not necessarily nature, with others and then seeing, again being aware of what's going on around different places in different parts of the world, how many students or kids are aware about what's happening in Somalia and in Africa and that's environment. Did the impact of starvation, its not just looking at you know people starving and they starve throughout the year, they've been starving for decades but the real issue is that you see the harsh environment and then to ask yourself you know compare, I mean this is very simple stuff that I would expect teacher in school to make kids aware. So just by looking at the weather in Somalia and today here then that will probably make them think and then make them think about the environment, make them think about future and future of this and you know that probably would bring a better quality kid, more aware and it'll be therefore for us to give them the technology, to give them the technical awareness on how to adapt or how to sort of materialising in a sense and idea or something they've been considering in to practical aspect in an industry which they would like to go to as a career. So it would be, I don't know maybe I'm idealistic but that would be the right sort of thing you would expect from like a training programme from kids to professional. Ok

NK: And then finally what competencies would you want students that are in the Quantity Surveying module, what would you want them to gain in terms of acting sustainably both within their personal lives and once they go out in to industry and work.

YM: Well it would be interesting to see individually where, how people benefit from one module in their sort of personal lives but obviously your personal life is going to be based on previous experiences but if we can get the student to think, professional life really in terms of how they will impact and ensure that whatever decision, if they have a, if they are at the decision making level then they will have to think sustainably but practically as well and try to if they work for in, as an advisory role or for their client well then need to make other people aware within the industry other colleagues or their employers to make them aware that the fact that. One thing we need to make sure is the fact that we need to make sure that operating sustainably can still, they can still make profit but operating sustainably and its not, it doesn't come as an extra cost. So as long as we say this course of action is not necessarily going to increase our overall cost because at the end of the day it all boils down to how much money you are going to make. Which what the Americans talk about the bottom line you know the bottom line is what you are getting you know through the process, but we, all we need to say is that our particular course of action which for us is sustainable process does not necessarily come at a higher cost but in reality we need to prove the other way around is that if you are not operating sustainably that will come as an extra cost and that's why I want to see the link between financial performance and sustainable operation. All right

NK: Yes. Well that was the last of the questions so thank you very much for your time.

YM: Ah well I hope you benefit and we benefit from this interest

NK: I'm sure I will thank you.

Appendix 9

Meeting with educational services (Traci Hudson) 28/06/2011

Ideally any sort of educational intervention would be **interactive.** They could be a part of summative activities as all assessment does not need to take place at the end of the year.

- Use of clickers in the lectures (this way students are given a chance to voice their opinions anonymously)
- Shock-tactics-making controversial statements to get students to react (can be used as a part of the clickers)
- Policy creation (or conversely evaluating existing policies and identifying which theories have had an influence on certain clauses, for example)
- Mock debates
- Concept maps
- Hands-on experience
- Role play
- Prezi- online spruced up presentations

For educational interventions to work, the Learning outcomes should be kept in mind throughout.

Pedagogy philosophy

<u>Self- directed work:</u>

Students can:

- Follow relevant tweets about a certain topic
- Follow the activity of key people for a certain amount of time
  →Open University blogs
  →Podcasts
  →Tweets
- Conduct a search term: annotated bibliography* (*can be of use to students when they start writing their dissertations or other essays/coursework)
- Follow popular press/media publications on a certain topic
- Read scientific/reliable papers citing papers which are saying that environmental problems are happening due to unsustainable practices for instance
- Wiki groups- policy drivers
- Case studies

The application of these self-directed tasks can be used as a basis for:

1. Critical review of policies (listing pros and cons/recommendations and limitations/how these have included aspects of the philosophy of sustainability)
   - groups can be shuffled every-so-often (enables dialogue between groups)
   -can lead to an in-class debate/discussion/ presentation (Prezi)
   -can be applied as a peer review/assessment exercise
   -students could be asked to engage in change management by thematic analysis as they will have built up theory

2. Students could be asked to defend a certain stance of a policy or type of practice and have the groups sum up their thoughts in a paragraph or so (in a journalistic style)
   -could be added to their portfolios as a part of their PDP or WOW skills certificate
   -they could appear as co-authors if the articles were to get published on an online journal of some sort

3. Students could be split into groups to identify/create a way/tool to disseminate sustainability information such as:
   -articles
   -toy
   -poster
   -game
   -pod-cast

   Whatever is created will reflect the amount of sustainability *information the* student has

Benefits:

- Plagiarism deterrent
- Engaged students (self-directed tasks= more time on task)
- Generalizable to wider work experience (group work, communication skills, time management, problem solving)
- Will be created with learning outcomes in mind

Appendix 10

September 26, 2011

David Bryde (Reader) **MSc Sustainability**

1st year running initially as 6-7 students on a part time basis as part of continuous professional development (CPD). 5 have progressed on to the MSc diploma (60 credits needed for that) → another way to get MSc qualification.

Distance learning: more flexible for working professionals. More time on task and self-directed learning.

Main methods of teaching:

- audio lectures
- task (set out on blackboard)
- further reading
- Wimba classroom (30 minute discussion) [acts as 'real time' class interaction]
- discussion board (forum) [acts as class interaction]

Student comments

- "I have enjoyed the course very much and found the topics interesting and thought provoking. I am constantly developing my understanding of the vast world of sustainability, especially how important construction is in respect of the issues. The learning process is excellent; the pre-recorded mini lectures are a

perfect way to learn which suit my work and personal time constraints. On a personal level getting back into formal learning has not been easy for me but hopefully as the course progresses I will get accustomed to it and it will feel a bit easier."

- "As far as course delivery goes I feel that the mini lectures are an ideal way to impart the information for the module. Both in structure and in length, the fact that you can pause, listen again and easily follow the lectures is something which is a great success of this module.
- In addition to this I have particularly enjoyed the Wimba discussion sessions which have taken place on a weekly basis. The fact that you can discuss your findings and thoughts on a weekly basis, but need never be in the same place is a great advantage to the course, and more often than not we run over the 30 minute allotted time as people become more involved in the discussions. It's something which I have begun to look forward to on a weekly basis
- Some of the key learning that has changed my views since I started this course have been my self-reflection, which has given me a greater knowledge of the subject and of the sustainability challenges that lie ahead. I have found it very thought provoking on the discussion board as to how we approach the same activity's from a different perspective, which reflect our diverse backgrounds, I have found this invaluable. The threads posted have made my views far more rounded. I have found the lectures to be inspirational and they have helped me through my day to day project work."
- "The course is being delivered in an excellent manner and I am very impressed with the Wimba Classroom sessions and Blackboard generally, that make it very easy to communicate. I have had a few technical difficulties with computer access over the term (more from our company firewalls/computer failure etc), but hopefully this is now sorted."

- Overall, I am very pleased with the course, and look forward to next term."

Appendix 11

Sustainable Business Strategies

Noora Kokkarinen

Content Outline

- Advantages of sustainable business models
- Introduction to Triple Bottom Line (TBL) and Corporate Social Responsibility (CSR)
- 7-point sustainable business model
- Examples of sustainable business decisions

"Business models driven purely by profit, with no consideration for environmental impact and no recognition of the social value of goods and services, will not prosper in a sustainable future."-
Sally Uren Chief Exec. Forum for the Future1

Why Incorporate Sustainability into a Business Strategy?

- Sustainable practices can reduce costs and save money
- Can provide access to new markets and revenue sources
- Can create a competitive advantage
- Improves company reputation

What is the Triple Bottom Line?

- Companies tend to define sustainability in this way:(Hueting and Reijnders 2004)

- People
- Planet
- Profit

Corporate Social Responsibility

- A way for companies to inform stakeholders of their economic, social and environmental performance (Myers, 2005)

  → promotes corporate transparency

- Some companies use CSR as a publicity mechanism as opposed to an embedded core business strategy.

CIOB Report: 'Corporate Social Responsibility And Construction'.

- "...recent demand from shareholders, the government, consumer groups and the public for products and services to be 'socially responsible' extends and develops these issues to an extent that can no longer be assumed to be covered by standard construction procedures."[2]

Advantages of going Green

- Operational
- Shift to energy efficiency
- Reduce business travel
- Heat-insulate buildings
- Movement-sensitive lighting

→ Reduces costs

- Reputational
- Customer loyalty

"...77% of UK consumers now believe it is important to choose a brand on the basis of its green credentials. That's an opportunity for those who act, and act in the right way, and a threat for those who don't."

-Jeremy Darroch CEO, Sky[3]

Do you know of any companies that have improved their reputation or operations by applying green principles?

7-Considerations for a Sustainable Business Model

Sally Uren

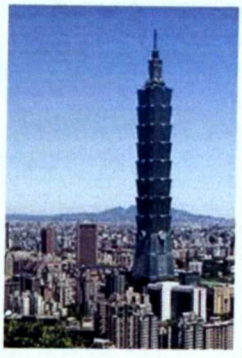
1. Experiment with new financing mechanisms
2. Aim to profit from sustainability
3. Integrate sustainability thinking into DNA of business
4. Recognise the need to change the value proposition

7-Considerations for a Sustainable Business Model (continued)

5. Start to shift your product portfolio
6. Be clear what the journey towards a truly sustainable business model looks like
7. Innovate, Innovate, innovate

Examples of Sustainable Business Decisions

- **Taipei 101** (Taiwan)
- $2 million (USD) invested into retrofit
- Energy, water and waste management savings = $700,000/year
- Payback of full investment less than 3 years



M&S Plan A

- Originally envisaged as a 5 year plan from 2007-2012 now extended to 2015.
- Aim is to incorporate sustainability as not only a selling point but part of overall business scheme

M&S (continued)

- Sustainable changes included:
  - Reduced packaging
  - Use fair trade/certified and ethically sourced products
  - Increase environmental performance of stores by sustainable construction and refurbishment methods (BRE partnership).
- In its first year it was a £200 million investment, in the second year it broke even and in year three it generated £50 million net profit.

CSR in practice

- Sky Rainforest Rescue
- While Sky receives no obvious/immediate benefits from schemes such as:
  - Sponsor an acre
  - Adopt a jaguar
- Sky hopes to benefit from the 'caring' image the affiliation with WWF may bring.
- Aim to reduce own CO_2 emissions by 25% for 2020.

Greenhouse Shaftesbury, Leeds

- A 1930's building had fallen into disrepair

- Bought in 2004, the building was retrofitted and now consists of office space, apartments, hotel and conference centre.
- Greenhouse has saved over 1.5 Olympic-sized swimming pools of water and the solar panels have heated over 27,000 showers. Residents and office tenants save 60% on their energy bills.

RICS believes that:

- "...unsustainable construction, investment and management practices will lead to accelerated building obsolescence and losses with regard to asset value and financial performance"
- "Sustainable buildings may prove to be more competitive, trade at a rental premium to the market, have shorter vacant periods, reduced obsolescence and slower depreciation, ultimately commanding higher capital values."

Industry professionals recognise the importance of sustainability issues in commercial real estate.

Approximately half of 400 UK industry professionals surveyed in 2007 by Jones Lang LaSalle said sustainability was critical to corporate real estate.

80% said it would be critical within two years

Over 50% of respondents said they would pay up to 5% more for sustainable buildings.

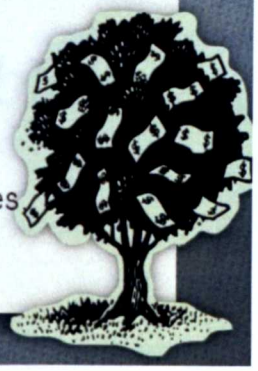
While a further 25% said they would pay 5-10% more for a sustainable property.

CIOB: Reducing Construction Costs

- Environmentally sound materials which are less processed or come from reclaimed or renewable sources will become more attractive. This is due to increased global construction activity and rising oil prices, while economies of scale not previously present will enhance these differences.
- Price of timber has reduced significantly over the last eight years compared to other materials.
- The ever-increasing costs of materials will begin to make off-site construction and other types of efficient construction techniques even more attractive over the coming years.

In Summary

- Applying green strategies into any business **can** be economically viable.
- Sustainable ideas don't even have to be elaborate; they just need to benefit people and planet, not just profit.
- Going green can give a company a competitive advantage over others.
- Many professional bodies appreciate the benefits that sustainability can bring to day-to-day construction activities.



References

- [1]http://sd.defra.gov.uk/2011/01/sustainable-business-model-a-seven-point-plan/
- [2]http://aggregain.wrap.org.uk/sustainability/sustainability_in_construction/index.html
- [3]http://sd.defra.gov.uk/2011/02/the-rise-of-long-term-thinking/
- Hueting, R., and Reijnders, L. (2004) Broad Sustainability Contra Sustainability: The Proper Construction of Sustainability Indicators. *Ecological Economics*. 50(3-4); 249-260.
- Myers, D. (2005) A review of construction companies' attitudes to sustainability. *Construction Management and Economics*. 23(8);781-785.

Elements of sustainable design

- Energy efficiency
  - Where will energy come from?
  - What technologies can reduce/maximise energy use?
  - What kind of insulation can be used?
- Materials
  - Available locally?
  - Are materials recyclable/recycled/renewable?
- Site-specific design
  - Will tenants benefit from its location?
  - Does it interfere with the landscape/natural environment?

Sustainable Materials

- Reclaimed stone/wood (where possible)
- Use (FSC) certified wood
- Bamboo
- Straw bale construction
- Products with low volatile organic compound (VOC)
  - Paints, adhesives, sealants
- Eco friendly insulation:
  - Sheep wool, cotton, soy based foams, cellulose

Successful Sustainable Design

- VillageGreen
- CADE Winery
- Heron Tower
- Taipei 101
- Eden Project

Split into groups

Consider the following while evaluating your case study:

- What elements make the design sustainable?
- What materials have been used?
- Are there clever design solutions?
- Does the design blend in or disrupt the surrounding area?

Appendix 13

Assessing case studies

Below are a few examples of sustainable architecture. Split into groups and read the information given about each one. Discuss whether aspects such as the choice of site and design solutions are effectively sustainable, and if not, what you would have done instead.

Village Green Herman Miller International HQ, Chippenham

This furniture company office space has had certificates from both BREEAM 'Excellent' and LEED 'Gold' awarded to it. Village Green was designed with best practice sustainable design in mind. The building integrates passive cooling and environmental controls to reduce heating and operational costs. In addition to the consideration of sustainability issues, approximately 75% of spaces in the building have natural day light while 95% of office spaces have views of the outside.

Features of the building include that it has exposed concrete slabs that cool the building at night, while a computerised system adjusts airflow without the need for air-conditioning to be used. Energy efficient lamps were used which have motion sensors which will automatically shut-off if a certain room is not in use. Sustainable materials used included FSC certified timber, locally sourced recyclable aggregate materials. The interiors consist of recyclable carpets and low VOC paints and adhesives.

Despite its environmental qualities, Village Green cost the same amount to procure when compared to standard commercial buildings.

Cade Winery, California

Cade is Napa Valley's first organically-farmed, Leadership in Energy and Environmental Design (LEED) Gold certified winery. Situated on a mountainside, the architecture is unassuming, with simple lines. As the pictures indicate, the design of the building is not obtrusive to the surrounding landscape as the design is intended to simulate the 'rolling hills' of the valley. The winery also put some acres of their own land into the Napa Land Trust so to maintain a balance between the wineries of the area and natural vegetation.

Additional features to the winery are that it has a network for caves which totals to about 15,000 sq. feet which are used to store wine barrels. The caves themselves benefit of natural ventilation and slopes slightly so that the barrels are not ruined if there is water in the caves. Most of the materials used for building were recycled such as their galvanized steel, recycled blue jeans and soy based foam (used as insulation), fly ash concrete and FSC certified wood.

Heron Tower, London

This primarily commercial property is located in the heart of the city of London, near other landmark buildings such as the Gherkin, Royal Exchange and the Lloyd's Building and has achieved BREEAM rating of 'Excellent'.

The building itself is closely linked to public transport and is easily accessible. The sustainable features of the tower include Passivhaus design, layered facades, and energy efficient mechanical systems. Glass is a material that was extensive used in the building as it allows for a lot of natural day light lessening the need of artificial lighting. The south side of the tower has photovoltaic panels which produce renewable energy while also creating a solar shield.

Taipei 101, Taiwan

Taipei 101 was completed in 2004 making it the taller building in the world until 2010. In July 2011 the building received LEED certification of 'Platinum' after it was retrofitted with sustainable technologies, making it the tallest and largest green building in the world.

While the exterior of the building was designed to be earthquake and resistant to typhoon winds; a total of $1.8 million was spent on energy efficient technologies (heating, cooling and ventilation) inside the building.

Taipei 101 is a good example of buildings which were not designed to be sustainable in the first instance, but how technological solutions installed inside the building made it more efficient to run.

Eden Project, Cornwall

The site in which the Eden Project is located used to be quarry.

Once a quarry comes to the end of its 'economic' use, the site is often left as it is and floods as a result. The flooding feature added to the design of the Eden complex as the rainwater which would cause the flooding is now harvested and used on the site.

Although the design as a whole may seem intrusive to the surroundings, it is nestled in what used to be the quarry and therefore cannot be seen from a far. Aside from the biomes, the rest of the Eden layout blends quite well with the environment.

Appendix 14a

Property Professionals and Sustainability

Property professionals operate in the built and natural environment. Accordingly, it is increasingly important for them in carrying out their professional services to be aware of European legislation on environmental issues. In particular, what is the importance to property professionals of the sustainability agenda?

The environment started to have an impact on development in the European Union with the 1979 Directive on the conservation of wild birds and continued with measures such as the 1985 Directive on the assessment of certain public and private projects on the environment. Legislation such as the 1992 Directive on the conservation of natural habitats and of wild fauna and flora followed.

Energy supply, land contamination, waste management and transport are all issues of sustainability which can be relevant to property professionals, as can habitat/biodiversity loss, social exclusion (in terms of social housing), and water supply issues. Investors are increasingly taking account of environmental sustainability in making investment decisions as are public authorities in providing social housing. The European Parliament resolution of 10 May 2007 on housing and regional policy expresses support for the Commission's campaign for sustainable energy. This means that property professionals operating in different areas must know about a building's environmental sustainability. These sustainability factors impact on the design and construction of buildings and their cost.

Property developers need to know about environmental impact assessments. They also need to know about European legislation on waste and water management, an area which continues to develop with the European Parliament's recent approval of directives on waste and water quality.

Buildings have a major impact on the sustainability agenda in environmental, economic and social terms. Eighty per cent of the European Union's greenhouse gas emissions come from energy, forty per cent of Europe's energy consumption comes from the buildings sector. In October 2006 the European Commission adopted an Energy Efficiency Action Plan, with the strategic objective of boosting energy efficiency with a target to save twenty per cent of the European Union's total primary energy consumption by 2020. The construction and renovation of buildings needs to take these matters into account.

The buildings sector not only accounts for forty per cent of the European Union's energy requirements but also offers the largest single potential for energy efficiency. Research shows that more than one-fifth of the present energy consumption could be saved by 2010 by applying more ambitious standards to new buildings and those undergoing renovation. The question of improved energy efficiency has been tackled in earlier existing instruments including the 1992 Boiler Directive, the 1989 Construction Products Directive and the buildings provisions in the 1993 SAVE Directive. There have also been a number of instruments introduced with a view to improving energy use, such as the 2002 Directive on Energy Performance of Buildings, the 2004 Directive on Combined Heat and

Power, the 2005 Directive on Energy Using Products and the 2006 Directive on the Promotion of Energy End-use Efficiency and Energy Services.

The 2002 Directive on Energy Performance of Buildings requires that a minimum level of energy performance applies to all new buildings and large existing buildings which undergo major renovation, an energy performance certificate be provided when buildings are constructed, sold or newly rented, and the regular inspection of boilers and air-conditioning systems in order to guarantee a proper and energy efficient operation of these appliances. It is anticipated that proposals for the recasting of the 2002 Directive will be introduced before the end of 2008.

Other environmental directives have an effect on the environment within which property professionals operate. Examples include the 2004 Directive on Environmental Liability with Regard to the Prevention and Remedying of Environmental damage and the 2006 Directive on the Management of Waste from Extractive Industries. Different EU policies (such as water, waste, chemicals, industrial pollution prevention, nature protection, pesticides, agriculture) contribute to soil protection. In addition in 2006 the European Commission adopted a Soil Thematic Strategy and a proposal for a Soil Framework Directive with the objective to protect soils across the EU. The proposed Soil Framework Directive remains under discussion but the issue of contaminated land is one of which property professionals must be aware.

All the examples given illustrate the importance of the European Union to property professionals. With the expansion of the European Union and extension of the Single European market its importance will increase. In the circumstances, property professionals cannot afford not to be aware of the significance to them of the European Union. They must also recognize the importance of being organized at a European level in order to take full advantage of the opportunities offered in the European market.

Appendix 14b

Executive Summary

In 2010, Key Note estimated that the waste management market grew by 2.6% in terms of value, reaching £8.12bn. This recovery came after a decline of 8% was observed in 2009, when market value dropped to £7.91bn. In terms of volumes, the level of waste generated in the UK fell over the 5-year review period, in line with the country's aims of becoming a zero waste economy.

The market is divided into two main sectors — municipal waste and commercial and industrial (C&I) waste. The majority of municipal waste arisings are generated from household collections and civic amenity sites, which also includes waste such as street litter. C&I waste arises from business activity, for example, in the retail sector or business services sector; and industrial output, for example, from the manufacturing of metals or chemicals. There has been a mounting effort from waste management companies and councils to manage more effectively the waste collected from these sectors, e.g. by introducing new food waste services and new initiatives to combat C&I waste. One such initiative allows businesses to use civic amenity sites to offload waste.

The most important issue currently affecting the waste management industry in the UK is the Government's objective in becoming a 'zero waste' economy. In order to achieve this, waste is now diverted up the waste management chain, in such a way that favours prevention, reuse and recycling, rather than landfills and incineration. The UK aims to take the lead internationally regarding environmental legislation, and waste reduction will be a major aspect of this policy stance. As a result, the level of waste generated by the UK and sent to landfill is likely to continue to reduce over the forthcoming years. However, just how this is going to happen is, as yet, unclear, following widespread criticism of the waste management industry and the Government's *Waste review*, which was undertaken in June 2011, and has since been criticised for not having enough substance.

Key Note predicts that the waste management market will increase by 22% in terms of value of the next 5 years. Market value is likely to be boosted by the increasing number of services now available that ensure waste is handled in an environmentally-sound way. For example, the immediate future is likely to see anaerobic digestion become a more popular waste management option, with a number of waste management firms having already investing in this particular type of energy recovery technology.

Appendix 14c

Is waste and recycling the future for industrial property?

Much has been made in the property press in the last year regarding the emergence of a new type of occupier in the industrial and logistics sector. Waste management companies such as Biffa, Cyclamax, Greenstar and SCA recycling have taken long leases on buildings that were originally designed for logistics and distribution.

What is driving this sector and will the spike in take up continue?

The emergence of the waste and recycling sector has been in many respects a perfect storm, driven by EU and UK legislation, technology advances, corporate responsibility and the availability of suitable land and buildings.

The UK lags behind the rest Europe as currently 61% of our waste goes to landfill, by 2020 we must reduce this by 65%. Local authorities will also be affected by the landfill tax which will soon rise to £72 per tonne, from £40 per tonne Lastly, for every extra tonne a local authority exceeds its landfill target they have the potential to be fined up to £150 per tonne by central Government.

Secondly, the UK government has set a target to achieve 20% of all electricity from renewable sources by 2020. Waste has the potential to be a fossil fuel alternative and help the UK reach the 20% target.

Research from BNP Paribas Real Estate estimates that the industry will require 50 million sq ft of property to meet these requirements.

Indeed, as early as 2003, the private sector was also starting to realise the scale of the problem. Biffa reported that up to 300 landfill sites will close in the coming years and must be replaced by up to 3000 smaller sites across the country.

The good news for the property industry is that the vast majority of technologies that are being utilised for waste sorting, energy generation and the creation of by-products can be employed into existing buildings or sites allocated for industrial or logistics activities. In the future we envisage Energy from Waste plants acting as anchor tenants on future distribution park developments, taking waste and producing a renewable source of energy and heat that is useful to neighbouring occupiers with high energy requirements.

The second piece of good news for the property industry is that we are at the tip of the iceberg in terms of requirements turning into deals. Private operators are now beginning the shift from landfill in earnest and sites will be required for a raft of activities such as waste sorting, waste preparation and finally energy recovery.

Moreover, the waste industry has a perception of being immature, poorly resourced and populated by small companies. This, however, is changing rapidly; the top 20 waste management companies in 2009 turned over almost £5 billion with only one reporting a decrease in revenues. The UK Department of Business, Innovation and Skills estimated that the Waste Management and Recycling Industry has an annual turnover of £25 billion and employs 400,000 people. This figure will only increase as we utilise our waste more sensibly and sustainably.

Appendix 15

Descriptives

Notes

Output Created		04-SEP-2012 15:18:35
Comments		
Input	Data	F:\PhD\Longitudinal Study\January2012\Jan24_JP.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	213
Missing Value Handling	Definition of Missing	User defined missing values are treated as missing.
	Cases Used	All non-missing data are used.

Syntax		DESCRIPTIVES VARIABLES=Age T1Env T1Soc T1Econ T1SAS T2Env T2Soc T2Econ T2SAS EI Extraversion Agreeableness Conscientiousness EmoStability Openness /STATISTICS=MEAN STDDEV MIN MAX.
Resources	Processor Time	00:00:00.02
	Elapsed Time	00:00:00.01

[DataSet1] F:\PhD\Longitudinal Study\January2012\Jan24_JP.sav

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age	213	15	52	23.18	4.644
T1Env	213	25	53	41.49	3.970
T1Soc	213	19	56	44.50	4.998
EconomicT1	213	21	49	38.55	4.099
SAST1	213	65	151	124.54	10.022
T2Env	213	23	57	41.10	5.451
SocialT2	213	12	56	42.24	7.078
EconomicT2	213	19	56	38.28	5.655
T2SAS	213	61	162	121.62	15.844
EmoIntel	213	76	137	106.25	11.644
Extra	213	13	50	34.70	6.539
Agree	213	17	53	38.73	6.066
Consc	213	15	49	35.25	6.328
EmoStab	213	10	50	34.06	6.758
Open	213	21	50	35.15	5.078
Valid N (listwise)	213				

```
FREQUENCIES VARIABLES=StudentID T1Env T1Soc T1Econ T1SAS T2Env T2Soc
T2Econ T2SAS
  /STATISTICS=RANGE MEDIAN
  /ORDER=ANALYSIS.
```

Frequencies

Notes

Output Created		04-SEP-2012 15:18:57
Comments		
Input	Data	F:\PhD\Longitudinal Study\January2012\Jan24_JP.sav

	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	213
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics are based on all cases with valid data.
Syntax		FREQUENCIES VARIABLES=StudentID T1Env T1Soc T1Econ T1SAS T2Env T2Soc T2Econ T2SAS /STATISTICS=RANGE MEDIAN /ORDER=ANALYSIS.
Resources	Processor Time	00:00:00.03
	Elapsed Time	00:00:00.03

```
[DataSet1] F:\PhD\Longitudinal Study\January2012\Jan24_JP.sav
```

Statistics

		StudentID	T1Env	T1Soc	EconomicT1	SAST1	T2Env	Soc
N	Valid	212	213	213	213	213	213	
	Missing	1	0	0	0	0	0	
Median		392956.50	42.00	45.00	39.00	125.00	41.00	
Range		403034	28	37	28	86	34	

```
NPAR TESTS
  /WILCOXON=T1SAS WITH T2SAS (PAIRED)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created		04-SEP-2012 15:20:33
Comments		
Input	Data	F:\PhD\Longitudinal Study\January2012\Jan24_JP.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data File	213

Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /WILCOXON=T1SAS WITH T2SAS (PAIRED) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01
	Number of Cases Allowed[a]	112347

a. Based on availability of workspace memory.

Wilcoxon Signed Ranks Test

Ranks

		N	Mean Rank	Sum of Ranks
T2SAS - SAST1	Negative Ranks	113[a]	110.88	12530.00
	Positive Ranks	91[b]	92.09	8380.00
	Ties	9[c]		
	Total	213		

a. T2SAS < SAST1

b. T2SAS > SAST1

c. T2SAS = SAST1

Test Statistics[a]

	T2SAS - SAST1
Z	-2.459[b]
Asymp. Sig. (2-tailed)	.014

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

```
NPAR TESTS
  /M-W= T1SAS T2SAS BY Intervention(1 2)
  /MISSING ANALYSIS.
```

NPar Tests

Notes

Output Created	04-SEP-2012 15:21:10
Comments	

Input	Data	F:\PhD\Longitudinal Study\January2012\Jan24_JP.sav
	Active Dataset	DataSet1
	Filter	<none>
	Weight	<none>
	Split File	<none>
	N of Rows in Working Data *File*	213
Missing Value Handling	Definition of Missing	User-defined missing values are treated as missing.
	Cases Used	Statistics for each test are based on all cases with valid data for the variable(s) used in that test.
Syntax		NPAR TESTS /M-W= T1SAS T2SAS BY Intervention(1 2) /MISSING ANALYSIS.
Resources	Processor Time	00:00:00.00
	Elapsed Time	00:00:00.01
	Number of Cases Allowed[a]	98304

a. Based on availability of workspace memory.

Mann-Whitney Test

Ranks

	Intervention	N	Mean Rank	Sum of Ranks
SAST1	Yes	70	109.61	7672.50
	No	143	105.72	15118.50
	Total	213		
T2SAS	Yes	70	104.24	7296.50
	No	143	108.35	15494.50
	Total	213		

Test Statistics[a]

	SAST1	T2SAS
Mann-Whitney U	4822.500	4811.500
Wilcoxon W	15118.500	7296.500
Z	-.432	-.458
Asymp. Sig. (2-tailed)	.665	.647

a. Grouping Variable: Intervention

Appendix 16

What Building Surveyors experienced:

I don't think that my attitude or beliefs with regard to sustainability changed drastically during this process. However I do believe gaining knowledge on subjects helps to change or re-enforce beliefs and views and that generally education is the key factor for instigating any change. This is even more relevant when we are looking at changes in longstanding beliefs that the processes and methods of sculpting our environment and living spaces are correct and a good way to do things.

I believe that the experience of working in groups will help me greatly when I'm in industry as it has given me an idea of how professionals interact within the workplace.

What Construction Managers experienced:

I did however have somewhat a mundane attitude towards including sustainability in our project as it seems to be something people know they should talk and care about but it's not really looked into strongly. I deem from being a construction student for so many years Sustainability has become an area I have spoken of so often in my past work that I have become a bit tiresome and disinterested in the subject thus not using my skills to the greatest advantage that I know I am capable of within the field. I feel within this project my attitude became a bit more positive once again when I started to engage in what possibilities lied before us in regards to making the project interesting by incorporating some of these technologies that maybe I had never came across before.

Through the experience of working in a cross-sectional group of various disciplines, I am of the impression on reflection that awareness of sustainability from an undergraduate perspective could be of a minimum and that more could be done in university and in the industry to create a greater awareness, which could hopefully lead to the industry having a greater level of sustainability and an improved image.

What Read Estate Management {and Business} Experienced:

My attitude and understanding of sustainability was that there needs to be a lot more awareness in the built environment about how sustainability can benefit everyone, not just the environment. During my day to day life before the project I was probably not as sustainable as I could have been. I would use my car frequently even though I live in the city centre and would find it a chore to recycle. I hoped that after the project was completed I would have a better understanding and more of a conscience about being sustainable in my day to day life and carrying it through to my future career in the built environment.

What Architectural Technologists experienced:

From a personal perspective, the treatment and our attitudes towards the environment is the single most important thing we face as a global society. From a logical and purely practical perspective, the sooner we adopt a global, united attitude towards the issue of sustainability and the environment, the sooner we can pull the world out of the disaster we have gotten it into.