

# Good Practice Learning and Teaching for Sustainability in Higher Education

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

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## **Declaration**

I certify that except where due acknowledgement has been made, the work is that of the author alone; the work has not been submitted previously, in whole or in part, to qualify for any other academic award; the content of the thesis is the result of work which has been carried out since the official commencement date of the approved research program; any editorial work, paid or unpaid, carried out by a third party is acknowledged; and, ethics procedures and guidelines have been followed.

Orana Jade Sandri

6<sup>th</sup> of November 2014



## Personal Acknowledgements and Dedications

I dedicate this dissertation to my beautiful daughter Jalena, my mum - your personal resilience, motivation and unconditional love have been inspirational beyond words, and my nana Ruth, your company and love are deeply missed. Thank you to my sister for your endless support and care; to my father, who taught me to question everything, and to Gai, for helping me realise that an intellectual pursuit is meaningless without spiritual connection and presence. I would also like to thank my extended family and friends, Sean, Judy, Ruth, William, Kathryn, and Christel for your care and support. It gives me great strength and happiness to know I have such an amazing, inspirational and loving family and friends.



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## Abstract

Over the past 30 years, sustainable development has emerged as the imperative for the 21st Century in response to global challenges such as pollution, biodiversity loss, and social inequality, to name but a few. Universities play a critical role in equipping graduates with the capabilities and knowledge to respond to issues in increasingly complex local and global systems. While the case for education for sustainability (EfS) in higher education (HE) is well researched, what constitutes quality learning and teaching (L&T) practice for sustainability needs further exploration. Through a qualitative, multiple case study inquiry of four university level courses, this dissertation explores what is unique to the learning experience and delivery of EfS in HE and what ‘good practice’ L&T in EfS should involve based on the accounts of learners and teachers in the case study courses. This research makes an original contribution to knowledge by combining existing theory of good practice EfS with empirical research using participant observation, learner surveys and focus groups, and interviews with educators to better understand what needs to be considered in course design and delivery of EfS based on lived experience of L&T in EfS. The research found that good practice is learner-centred. The empirical data validates existing theory and the findings provide insight into factors such as teacher passion, learner empowerment and reflexivity to facilitate deep, ongoing learning. Sharing the research findings with university educators will assist them in developing effective L&T practice in EfS and fill a research gap on empirical research of L&T processes and outcomes in EfS in HE.



## 1.0 Chapter One: Introduction

### Contents

- 1.1 Research context
- 1.2 Research gap
- 1.3 Research questions and aims
- 1.4 Brief introduction to the research

### 1.1 Research context

Over the past three decades the concept of sustainability and sustainable development have emerged as a response to increasing global ecological and social challenges such as resource depletion, pollution, food security and inequality (Beder 2006, Dresner 2008). Sustainability is a vision of how humans can live more equitably with each other, in balance with our natural systems. Sustainable development is a process whereby humans can achieve this vision through reducing ecological impacts and working to achieve ‘enough for all, forever’ (Hopkins 2009:42). Needless to say, a global transition to a ‘peaceful and sustainable society’ (UNESCO 2011:42) is not a straightforward task. The interconnected and systemic nature of global sustainability challenges such as climate change, increasing social inequality (Knox and Marston 2009) and the ‘food-energy-environment trilemma’ (Harvey and Pilgrim 2010) require a fundamental shift in how these problems are understood and responded to. Lang *et al.* (2006:45) argue that ‘the challenges of sustainability have been inextricably connected to education and learning’. Raskin (in Sterling 2009a:77) contends that ‘the shape of the global future rests with the reflexivity of human consciousness – the capacity to think critically about why we think what we do – and then to think and act differently’.

Education is an essential tool to encourage and develop such critical capacities and reflexive practice. However, ‘traditional education has not provided the training for graduates to work towards developing solutions to the new and complex world problems emerging’ (Sibbel 2009:79). From a systems perspective, every discipline has a role in shaping a more sustainable future through both education and practice. Education of future professionals

therefore plays a critical role in sustainable development. Higher Education (HE) is an important site to promote change by equipping graduates with the capabilities, knowledge and values to begin to address sustainability challenges in their personal and professional lives (Kevany 2007, Murray and Murray 2007, Shephard 2008, Sibbel 2009).

### **Sustainability and sustainable development**

The concept of sustainable development emerged in the 1970s in response to observations and concerns raised by international interest groups such as the Club of Rome about the ecological limits to human growth and physical development. The notion of our Earth's finite carrying capacity and the idea of ecological limits (the amount of human growth and development that the Earth can sustain without serious ecological damage or collapse) challenged conventional assumptions that Earth's resources were infinite (Beder 2006). Sustainable development recognises that to sustain (and achieve for many) a level of human and ecological wellbeing, people must live in balance with our ecological systems in a manner in which the Earth can sustain over a long period of time. The 1987 World Commission on Environment and Development report 'Our Common Future' is seen as the key document that put sustainable development on the international agenda. The report defined sustainable development as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland 1987:41). Along with living within ecological limits, the principle of 'equitable distribution' of resources around the world was a 'cornerstone' of the Our Common Future report (Dresner 2008:32).

The definition of sustainability I use in this dissertation is based on the principles of social equity drawn from Our Common Future Report, living within ecological limits drawn from the notion of limits to growth and the recognition that 'all things are connected' (Chief Seattle in Shiva 2005:7). Therefore, sustainability is a vision of a way of living based on these principles. Sustainability is a state in which humans live within the Earth's carrying capacity. To do this, social and political systems must be organised in a way that achieves this balance while distributing resources equitably among current generations. Sustainable development is understood as the continual and evolving process to achieve these aims. Development for the purposes of this dissertation is not about physical growth, but the continual development of the non-physical social systems such as political, economic, educational, and cultural and belief systems.

## Sustainability in higher education

According to Cotton and Winter (2010:56):

Sustainability in HE is no longer novel. Across the globe, national, regional, and trans-regional networks for what might be termed sustainable HE have been set up, the number of international meetings and networks focusing on this area continues to grow, and several declarations on sustainability in HE have been signed in the past 10 years or so by university provosts, deans and rectors.

There have been a number of important international developments that have supported and advocated for the inclusion of sustainability in HE. In 1992, the UN Conference on Environment and Development in Rio de Janeiro 2002 produced Agenda 21 which stated that education, including HE, was 'critical' in building capacity to respond to environmental and sustainable development challenges. Following this, the Talloires Declaration was created in 1994 for and by universities and included a 10 point plan for promoting sustainability in HE. By October 2009, 390 universities had signed on to the declaration around the world (Jones *et al.* 2010). A decade later UNESCO led the UN Decade of Education for Sustainable Development 2005-14 which recognised the 'leading' role HE had to play in sustainable development and advocated learner-centred approaches for Education for Sustainable Development (ESD) (Jones *et al.* 2010). Along with these major developments, several international declarations specifically for sustainability in HE have been developed and signed around the world. These include Halifax 1991, Kyoto 1993, Swansea 1994, COPERNICUS 1997 and Luneburg 2000 (Wals and Blewitt 2010).

Alongside the developments of sustainability in HE, research on sustainability in HE has also become an established field with many academic articles, journals and special issues on the topic of Education for Sustainability (EfS) and ESD (for example Journal of Education for Sustainable Development, International Journal of Sustainability in Higher Education, The Journal of Environmental Education). 'All these different developments indicate that ESD has matured into a well-established field not only of learning and teaching, but also of research' (Barth and Michelsen 2013:108).

There has been much discussion and literature written on definitions of EfS/ESD (Cook *et al.* 2010). EfS is both the study of these principles related to sustainability and their rationale (global sustainability issues and challenges), and the development of capabilities to help people contribute to the evolving process of sustainable development through lifelong

learning. The latter element is why some choose to use the term ESD as opposed to sustainability. According to Barth and Michelsen (2013:105) 'ESD emphasizes aspects of learning that enhance the transition toward sustainability' and therefore education is processed based. This dissertation draws on Sterling's definitions of sustainability education to understand the different types of education related to sustainability and sustainable development. Education about sustainability is learning *about* sustainability with the learning objective to instil knowledge and awareness of sustainability, while EfS includes learning about sustainability and the development of capabilities to achieve sustainability. Finally, education *as* sustainability or sustainability education takes the underpinning systems theory of sustainability and applies this to the learning process itself so that rather than L&T sustainability as a fixed end state (and learning for and about this state), sustainability itself is seen as an evolving process and understanding with no 'fixed endpoint', and as a result of this view, the nature of sustainability and responses change over time through the learning process so that content and knowledge learnt adapts to changing priorities and contexts related to sustainability. This dissertation uses the term education for sustainability; this best represents the intent of the courses under investigation whereby learners are taught about sustainability, and given the opportunity to develop capabilities to create and implement processes for sustainable development to achieve sustainability. The title of this dissertation 'good practice L&T for sustainability in higher education' sits in line with the language of 'education for sustainability'.

## **1.2 Research gap**

While there are a number of texts that present theories of what good practice learning and teaching (L&T) for EfS involves, little empirical research currently exists on good practice and the lived experience of L&T in EfS. To date, 'most action taken by universities so far has been through the management and impacts of its operations and campuses, rather than on pedagogic or curricular reform' (Christie *et al.* 2012:2). The dominant focus of introducing sustainability in HE has been on environmental impacts and 'greening the campus' (Wals and Blewitt 2010). However, a new phase of sustainability in HE is emerging that 'focuses precisely on the learning and teaching implications of sustainability' (Wals and Blewitt 2010:57). Empirical research on this critical aspect of sustainability in HE however is limited. As Christie *et al.* (2012:21) argue, 'EfS pedagogy has largely remained untested in classrooms'. The dominant focus of EfS in HE research over the past decade has been on the value of sustainability education for universities and where sustainability can locate within the



university. In Australia, research on campus-wide changes including university policy, academic development (Hegarty 2008), organisational processes and learning (Filho and Carpenter 2006, Noonan and Thomas 2004), and drivers and barriers for embedding sustainability in university curriculum (Lang *et al.* 2006, Noonan and Thomas 2004, Sibbel 2009) have been documented to varying degrees. Research on EfS curriculum in HE exists, however these studies look at quantity of courses with sustainability content (see Lang *et al.* 2006, Noonan and Thomas 2004) rather than quality of content and delivery. This research provides a valuable insight into the uptake of sustainability in university curriculum, however it does not investigate the quality of the courses or programs with sustainability content. With so much attention focused on getting sustainability up on the university agenda, less attention has been paid to what constitutes quality EfS L&T once university educators have accepted the challenge to embed EfS into curriculum.

Within recent literature on sustainability (and environmental education more broadly), there are calls for research on the best ways to educate for sustainability in the university learning environment. In a paper on Global Learning for Sustainability (GLS), Anderberg *et al.* (2009:375) conclude that there is a critical need for research and debate about the most effective practical implementation of GLS in terms of teaching strategies and ‘innovative educational approaches’. From a university policy perspective, Timmerman and Metcalfe (2009) also argue for description of effective L&T approaches. While Sharpe and Breunig (2009:310) identify the ‘dearth of concrete description’ of course curriculum as a key limitation for environmental education. The authors argue that ‘some professors are reluctant to identify classroom practices because they wish to avoid the kind of prescriptive dogmatism that many conservative pedagogies rely upon’ (Sharpe and Breunig 2009:310). However, the effect of this is the absence of discussion around effective classroom practices. As Sharpe & Breunig (2009:310) note:

Teachers can either take up existing, hegemonic practices or they can attempt to engage in counter praxis, experimenting with it through trial and error. As a result of this process of trial and error, new teachers are often left with a feeling of discontent... There is clearly a need for some concrete advice and for a set of discursive classroom practices to be formulated.

Given that ‘...a key barrier to the development and implementation of sustainability education is a lack of staff experience/knowledge and resources’ (Holdsworth and Thomas 2012:46), it is important that research on what is good practice L&T for sustainability is undertaken. This

is supported by research undertaken by Wright (2007) who found the top research priority of 35 surveyed ESD professionals was research on the impacts of L&T methods.

### 1.3 Research questions and aims

Given the current gap in empirical research on L&T in EfS, this research aims to:

1. Explore the characteristics of good practice L&T in EfS according to teacher and student experiences in EfS courses adding to existing theory;
2. Provide insight into the lived experience of L&T in EfS in HE as a resource for educators (and learners);
3. Add empirical evidence to support and/or challenge existing EfS theory of good practice;
4. Assist university educators in Australia and abroad to develop effective L&T practice for EfS;
5. Facilitate the uptake of EfS by adding to the existing evidence of good practice;
6. Reflect on the strengths and challenges of the research approach taken and make recommendations for future research on L&T in EfS.

In order to achieve these aims, this dissertation asks *what does good practice L&T for sustainability look like?* In order to answer this question, a number of sub-questions to guide the research methods were developed including:

- a. What kinds of L&T practices are used in EfS courses?
- b. How effective are these practices for learning for sustainability?
  - i. What are the teaching experiences of these practices?
  - ii. What are the learning experiences of these practices?
  - iii. What are the challenges faced in L&T using these practices?
- c. What is good practice L&T for sustainability according to theory and how does this compare with the empirical research undertaken for this dissertation?

The term ‘good practice’ is used here to mean effective L&T that supports the learning and development of capabilities so that learners can contribute to the process of sustainable development now and into the future. This will be explored further in Chapter Three. Also L&T practice includes elements such as learning objectives, structure, teaching strategies, assessments, and teaching evaluation which Ramsden (2003:119) argues need to be addressed

in order to ‘improve the practice of university teaching’. Practice is similarly important for Biggs and Tang (2007), who suggest L&T practices include L&T activities, intended learning objectives, assessments, criteria and processes to reflect on and enhance teaching practice. These are informed by pedagogy which can be defined as the ‘theories, beliefs, policies and controversies that inform and shape’ (Alexander 2008:3) these L&T practices. Alexander (2008:3) reinforces the point with the comment that “pedagogy connects the apparently self-contained act of teaching with culture, structure and mechanisms for social control’. Similar to Christie *et al.* (2012:7) who have drawn on the work of Jaeger 1945, in this dissertation ‘the term pedagogy will be used to denote the philosophical underpinning of education or a teaching method [and] The term teaching method will be used to describe the type of method used in teaching, such as a lecture or group discussion’.

#### **1.4 Brief overview of the research**

The dissertation sought to answer the research question and sub-questions through a qualitative inquiry of four university level EfS courses in Australia. Due to the limited extent of existing empirical research on EfS L&T practice, the research approach aimed to discover and better understand phenomena to induce theory, rather than to ‘test’ theory, similar to a Grounded Theory approach. After the research gap was identified and research questions formalised, research was undertaken on the four case study courses (discussed in Chapter Four) between 2010 and 2014 using a multiple case study or ‘mutlicase’ (Merriam 2014) research design. The research methods included teacher interviews, class observations, student surveys and focus groups. The data were then combined with existing theory of good practice L&T for sustainability found in EfS literature. Inspired by Grounded Theory, the use of literature in this research formed another data set that was compared and contrasted with the empirical data collected. The use of mixed methods allowed for the triangulation of data. Commonalities and differences were identified and new concepts and ideas from the empirical research that could add to existing theory were highlighted through the analysis.

Following this introduction, Chapter Two describes the methodology used to undertake this research including a description of the philosophical orientation taken, research strategy and design for this project, research participants, process, methods and the approach taken to data analysis. Chapter Three presents the literature review which firstly provides a context for EfS in HE and outlines the rationale for investigating L&T specifically in EfS arguing that there are important elements of EfS that are unique and require special attention when delivering a

course. Chapter Three then discusses what is important for course design in EfS according to theory providing an overview of the dominant characteristics of L&T for sustainability found in the literature including:

- Pedagogical approaches and L&T approaches advocated in the literature;
- Learning outcomes advocated in the literature (capabilities for sustainability);
- L&T activities for sustainability.

Chapter Four presents the results of the research for each case study separately with supporting qualitative data from interviews, observation and focus groups, and quantitative survey data provided in the appendices. A summary of results for each case study is provided at the end of each case study. Chapter Five then presents the discussion that combines results of the case studies and compares these with the literature to highlight similarities, differences and new concepts emerging from the empirical data. Chapter Five then outlines the limitations of the results and qualifications. Finally Chapter Six, the conclusion, summarises the research and makes recommendations for further research.

## 2.0 Chapter Two: Methodology

### Contents

- 2.1 Introduction
- 2.2 Philosophical orientation and research strategy
- 2.3 Research design
- 2.4 Case study selection
- 2.5 Research process
- 2.6 Methods
  - 2.6.1 Semi-structured teacher interviews
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  - 2.6.4 Observation
- 2.7 Data analysis

### 2.1 Introduction

In order to investigate *what good practice learning and teaching (L&T) for sustainability looks like*, a qualitative research approach was employed, inspired by Grounded Theory using a multicase research design. Data were collected on four case study courses using a mixed methods approach. Data were analysed using content analysis. This chapter will present details of the research methodology beginning with an overview of my philosophical orientation and how this influences the chosen research strategy. The chapter then outlines Grounded Theory as an approach for this research, before detailing the case study research design and data collection methods. Finally the methods of data analysis are presented and limitations and other considerations of the research are noted.

### 2.2 Philosophical orientation and research strategy

Bryman (2004:19) argues ‘questions of social ontology cannot be divorced from issues concerning the conduct of social research’. My ontological position is that what we (human beings) know about the physical and social world around us is socially constructed. What we each know to be true is based on how we interpret objects, symbols and relationships and this

interpretation is based on our own experiences, interactions, values and cultural understandings. The physical exists, yet what the physical and social mean to us is in the eye of the beholder. Therefore I seek to investigate individual and collective meaning making processes, rather than to uncover an objective reality. According to Bryman (2004), this position aligns most closely with a constructivist ontology. This ontological position also influences how I understand the learning process. From this understanding, we learn and construct meaning through experience; how we individually and collectively experience, accommodate and assimilate objects and ideas. Educational psychologist and theorist Biggs explains that constructivism in education ‘comprises a family of theories but all have in common the centrality of the learner's activities in creating meaning’ (Biggs 1996:347).

A qualitative research strategy sits best with a constructivist ontology (Bryman 2004) as the exploratory nature of this approach allows for deeper understanding of meaning making processes; how individuals make meaning, understand their reality and act in response to this interaction and learning. The choice of a qualitative strategy is also influenced by its suitability for exploring the research questions. Qualitative research is most useful for when ‘the concepts pertaining to a given phenomenon have not been identified, or aren’t fully developed... and further exploration... is necessary’ (Corbin and Strauss 2008:25) and ‘discover rather than test variables’ (Corbin and Strauss 2008:12) as is the case with this research focus which aims to induce theory to fill the current research gap.

This research was initially approached using a Grounded Theory methodology, based on a constructivist ontology and qualitative research strategy, and which explores and develops theories about social phenomena that are grounded in the data collected (Bryman 2004). In line with Grounded Theory, this research undertook an inductive exploration and analysis of social phenomena (Corbin and Strauss 2008) through the lived experience of education for sustainability (EfS) practitioners and learners. After identifying a research gap, this research explored the experiences of teachers and learners to better understand what good practice L&T for sustainability looks like according to the lived experience of the research participants. Literature formed part of the data collected to help theory induction also following a Grounded Theory approach (Charmaz 2011). Identified themes in the theory of good practice EfS were combined with the data collected in data analysis stages of the research to help make sense of the data collected.

Grounded Theory studies the processes of individual and collective meaning making. It stems from the symbolic interactionist school of thought and ‘focuses on the meanings of events to people and the symbols they use to convey that meaning’ (Baker *et al.* 1992:1356). As (Corbin and Strauss 2008:2) note, we respond based on the meanings that we ‘attach’ to interactions. Grounded theory is also informed by the philosophy of Pragmatism, which sees that ‘knowledge arises through... interacting and acting of self-reflective human beings’ (Corbin and Strauss 2008:2). Any knowledge generated by an individual is done so based on ‘the cultural matrix in which they live’ (Dewey 1938 in Corbin and Strauss 2008:3) and therefore collective knowledge ‘accumulates’. Like the interactions in a learning community, knowledge and meaning is created or expanded through interaction with others. This interaction occurs within cultural and institutional contexts and draws on existing knowledge and meanings, found in the content of the teaching material and within individuals.

Grounded Theory is not only a suitable methodology for answering research questions that aim to build from existing theory of good practice EfS and generate new theory, it also bears many similarities to systems theory and sustainability theory. According to Corbin and Strauss (2008) grounded research allows the researcher to explore the inherent complexity, uncertainty and interconnected nature of social reality. Complexity, uncertainty and interconnectedness are key elements of sustainability theory (see Chapter Three for further exploration), and the ability to deal with such elements in professional contexts is a key part of applied sustainability that has been identified in the literature. Grounded Theory locates data and concepts within larger social contexts and describes processes (the flow of information and meaning) (Corbin and Strauss 2008), all of which are key elements of systems thinking as described by Meadows (2008). Grounded Theory also views the researcher as part of the meaning making process (Corbin and Strauss 2008), or part of the system of meaning making.

These elements of Grounded Theory were used to inform the methodological approach taken in this research. The point of departure from Grounded Theory however lies in the data analysis stage of the research project due to time and resource limitations, a point that will be described later in section 2.7 Data analysis. A multicase study research design best suits the research implementation and analysis undertaken in this research, while still underpinned by the philosophical orientation of Grounded Theory.

## 2.3 Research design

Qualitative Grounded Theory informed the philosophical orientation underpinning this dissertation, while the research design followed a multiple case or multicase study approach as described by Merriam (2014), Stake (1995) and Yin (2003). Four university level case study courses (subjects) were selected and investigated as examples or case studies of L&T practice for EfS<sup>1</sup>. These examples involved explicit L&T of sustainability situated in their respective professional contexts. Case studies direct attention to what can be learned from a particular case (Stake 2005). Their value lies in adding depth and lived experience of EfS in praxis by investigating ‘phenomenon within its real life context’ (Stake 1995:13). My case studies follow what Geertz (1973 in Stake 2005:457) calls a ‘thick description’ method, which allows for the particularities and contexts of each case to be observed and discussed. Through case studies, exploration of learning experiences that occurred as a result of particular L&T practices can be explored. The teachers from the case studies were asked about their teaching activities and practices, while the students were asked about their learning experiences as a result of these practices. This latter point is important as Ramsden (2003:120) argues that any useful research into L&T needs to place the student’s experience of learning in the foreground, rather than the common approaches that ‘focus instead on methods of teaching and assessing students’. The multicase case design allows the phenomenon (L&T) to be studied with the real life context (a case study course within a university) and findings drawn and compared with other case studies with similar or contrasting characteristics (Yin 2003) to look for patterns between case studies or explain differences. In this multicase approach, case studies have an instrumental rather than intrinsic value in that the case studies are used to draw findings about phenomenon that may exist outside a case (Stake 1995).

The scale of the research is also important to understand. Layder (in Scott and Usher 1999) defines four different levels of educational research. These are context, setting, situational activity, and self. The levels range from investigating the broader social contexts of education down to the individual. The *context* or ‘macro social forms’ include investigating ‘class, gender, ethnic relations’ (Scott and Usher 1999:91). The *setting* level refers to the school setting or environment while the *situational* focus concerns ‘face to face interactions’. Investigating education on the level of the *self* focuses on biographical experience. All levels are important and require different research methods. There is already a growing body of research on the broader levels of EfS; for example institutional factors including culture and

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<sup>1</sup> Course names and location have been removed from this dissertation to ensure participant anonymity.



governance structures for encouraging EfS and in academic development. To understand what good practice L&T for sustainability looks like, we need to focus on the situational and personal levels of the education system. While all these levels interact with L&T processes, this research studied the ‘situational activity’ and also ‘the self,’ while keeping in mind broader influences on learning.

## **2.4 Case study selection**

The social complexity of researching in educational settings cannot be underestimated when developing a research plan (Wellington 2000). The ability to get access to a university course is a fundamental consideration in sampling in educational research. Gaining access:

...can seriously affect the design, planning, sampling and carrying out of educational research. Educational research is always the art of the practical... But we have to do something, and compromise is always involved. This is why opportunistic or convenience sampling feature so commonly in educational research.

(Wellington 2000:63-64)

Access was a key consideration when selecting case studies. Part of the selection criteria for case studies involved consideration of researcher access to teaching staff, other staff involved in the course development, students and the delivery of classes/workshops for observation. The ability to meet teaching staff face-to-face was considered to be of great benefit for the research. This approach to case study selection is also supported by Stake (1995). In selecting case studies Stake (1995:4) argues that ‘The first criterion should be to maximize what we can learn... which cases are likely to lead us to understandings’ which we can research given that ‘time and access for fieldwork are almost always limited. If we can, we need to pick cases which are easy to get to and hospitable to our inquiry’ with willing participants. A ‘...good instrumental case study does not depend on being able to defend the typicality of (the case)’ (Stake 1995:4).

Four case study courses, each taught in a different discipline, were selected. The number of four courses was decided on due to the research timeline for this dissertation, with one year originally devoted to data collection. Due to the semester based delivery of the courses, a maximum of two courses per semester was decided upon so that there was opportunity to observe classes without too much overlap between class times in the different courses. I used my existing networks to source university level EfS courses. The selection process can be

described as a convenience, non-probability purposive sampling technique (Wellington 2000), as sources were selected based on both practicality and on the selection criteria below:

- Access to staff and students and ability to observe classes;
- Extent of sustainability content or skills development in the subject and assessments;
- A discipline specific focus (situating sustainability in the professional context);
- Core course (students having no choice in whether to do the course);
- Interest and willingness of teachers, faculty and students to participate in the research;
- Examples from different professions to determine the effects (if any) of different disciplines on L&T for EfS.

A selection of courses with both a learner centred approach and a teacher centred approach to L&T (based on initial scans of course outlines and activities) was to provide contrasting cases to better understand to what extent the L&T approach influences perceptions of good practice. The selection of case studies from different disciplines offered insight into commonalities across the disciplines and discipline specific L&T needs and experiences within the case studies.

## 2.5 Research process

The research was planned around a number of stages. Table 2.1 presents an outline of these stages covering the research planning, data collection, and analysis process.

**Table 2.1: Research stages**

Research stages
1. Based on an initial literature review, a research question was developed based on identified research gap.
2. A research strategy, population and methods were then developed and chosen based on the initial research problem/gap.
3. Ethics approval was attained.
4. Teaching staff of potential case study courses were contacted to determine their interest and willingness to take part in the research
5. Relevant ethics documents and outline of research methods were emailed to teaching staff after they expressed preliminary interest in taking part in the research.
6. Copies of course guides and any other course related materials (i.e. reading lists)

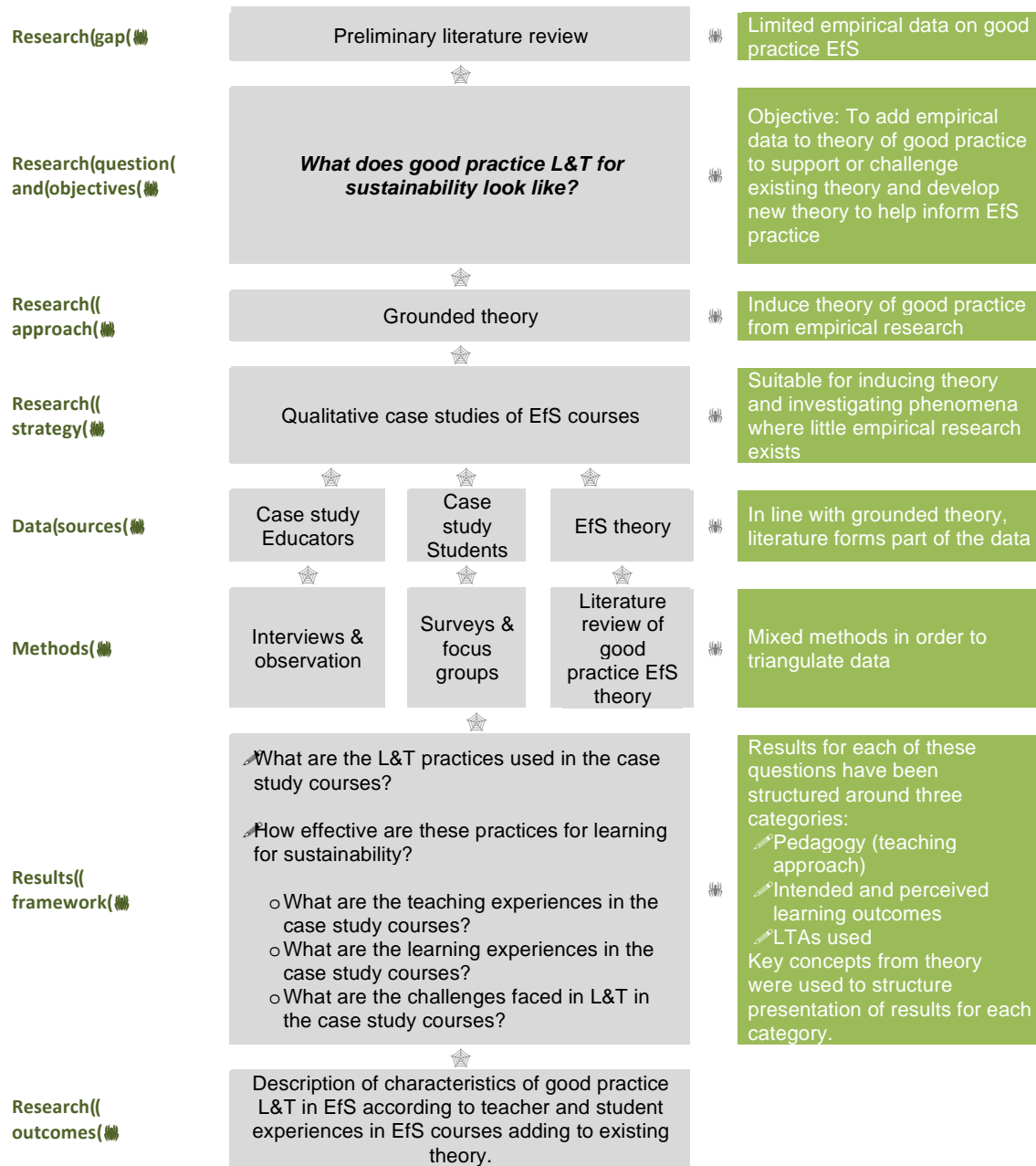
were collected and analysed in order to tailor specific research methods and plan research timelines with teaching staff.
7. Data from Case Study One and Two were collected based on co-ordination with teaching staff. This included teacher interviews, student surveys, student focus groups, document analysis of course guides and descriptions, observation of workshops/lectures.
8. Preliminary analysis was undertaken from data from case studies one and two to discover themes emerging to help refine scope of the dissertation.
9. Data from Case Study Three and four were then collected following the same procedure as case studies one and two.
10. Preliminary analysis was undertaken from data from case studies three and four.
11. The literature review was revisited and updated and used as another data set to add and compare with theory in line with Grounded Theory research strategy. Concepts from the literature were used to inform a theoretical framework to frame data.
12. Research focus was refined based on literature and themes emerging out of the preliminary analysis of the data.
13. Analysis of four case studies was revisited based on the refined research questions and theoretical framework (theory good practice L&T for EfS).

As can be seen in Table 2.1, the research process started with the research problem or gap and employed suitable research strategy and methods for investigating unknown phenomena. In line with Grounded Theory, literature was used as another data set in order to make sense of themes emerging from the research rather than the focus of the research in the initial stages. As argued by Charmaz (2011:304) grounded theorists ‘do not conduct a literature review to inform our analysis; rather we delay it until after we have formed these analyses’. Literature was added to the data and drawn on to provide a framework for finalising the scope of the research, research questions and presenting results in Chapter Three after preliminary analysis of the data was undertaken. The purpose of this approach is described by Glaser (1978 in Goulding 2002:90), ‘One must write as no one else has ever on the subject. Then explore the literature to see what new property of an idea he has offered, or how it is embedded with others’. The research has therefore been semi-iterative inspired by Grounded Theory approach (Wertz 2011).

The following flow chart in Figure 2.1 illustrates the research process undertaken and how this process links with the theory informing the research (Grounded Theory) and the research

objectives and outcomes.

**Figure 2.1 Flow chart of the research process**



## 2.6 Methods

In order to collect data on the four selected case studies, surveys of students as well as focus groups, observations and interviews with teaching staff were conducted. The use of mixed methods here intended to allow for the triangulation of data and complementarities to be observed (Sydenstricker-Neto 1997) that combined, allow for a rich data set for the exploration of lived experience in the case study courses. Yin (2003) also argues that the use of multiple sources of evidence (or mixed methods) is an important part of case study research to understand the case as a whole and to provide internal validity through data triangulation. Table 2.2 shows how the research questions align with the methods that were used in this research.

The selection of questions for the interviews, focus groups and surveys aimed to cast a wide net in line with Grounded Theory to explore the unexpected themes that may arise. Therefore, questions were broadly designed to gain insight into student and teacher experiences, approaches and understandings of sustainability and EfS, the pedagogical approaches and L&T methods and activities used in the course, the lived experiences of these approaches and methods, and the perceived outcomes of these methods.

**Table 2.2: Research methods**

Research sub questions		EfS Literature	Observation	Student surveys	Student focus groups	Semi-structured interview with teacher
What are the L&T practices used in the case study courses?			✓			✓
How effective are these practices for learning for sustainability?	What are the teaching experiences in the case study courses?			✓	✓	✓
	What are the learning experiences in the case study courses?			✓	✓	
	What are the challenges faced in L&T in the case study courses?			✓	✓	✓

What is good practice L&T for EfS according to theory?	✓				
--	---	--	--	--	--

✓ = Where a method aligns with a question

### Semi-structured teacher interviews

Semi-structured interviews with teachers from the case studies aimed to understand pedagogy, methods, and their perceived outcomes of these approaches. Challenges for L&T were also discussed to understand challenges of L&T practice and how this challenges or supports theory of good practice. The semi-structured interview is the most suitable method as it allows for flexibility and for the teacher to frame how they understand and approach their L&T practice (Bryman 2004). In line with post-modern interviewing techniques, the semi-structured interview allows for ‘multiple perspectives of the various respondents’ to be individually reported on, with ‘differences and problems encountered and discussed, rather than glossed over’ (Fontana and Frey 2005:709). Open-ended interviews allow space for interviewees to ‘demonstrate their unique way of looking at the world’ (Cohen *et al.* 2011:205).

The interview questions aimed to learn about the teaching approach underpinning the course and the experiences of this teaching approach in delivering the course (see Appendix 1.1 Teacher interview questions). The interviews were audio-recorded and teachers were asked about:

- Their understanding of the nature, role and value of sustainability education;
- Their pedagogical and teaching approach/es informing the course design and delivery;
- L&T methods used in the courses;
- The challenges and opportunities they have encountered in designing and delivering the course;
- Course specific questions about the nature of assessment pieces and questions arising from class observations.

These themes and associated questions were chosen in order to understand the teaching approach (and the interviewee’s understanding of sustainability education informing the approach), the experiences and challenges in delivering the course and the kinds of activities and assessments used in the course, especially the rationale behind the use of these activities

and particular challenges in L&T in the course. The qualitative data collected from these questions was then used to form a holistic picture of both what the teacher feels is good practice sustainability education and how they have approached and implemented their practice and their lived experience of this practice.

It needs to be noted that ‘gathering and representing people’s experiences is fraught with interpretive difficulties’ (Cousin 2009:73). According to Cohen *et al.* (2011:204), limitations with interviews relate to ‘error and bias [which] can stem from alterations to wording, procedure, sequence, recording [and] rapport’ during the interviews between participants. Because the interviews with each teacher in this research were semi-formal, and therefore questions and language varied, these considerations are important to note for the findings from the interview data. However, while variation of questions between respondents can be seen as problematic, it is important for allowing unforeseen points to be discussed and to tailor the interview to the unique experiences of the teacher (Cohen *et al.* 2011). My rapport with the interviewees also varied between case studies and interviewee’s understanding or interpretation of the questions and responses to the questions may also have varied depending on their knowledge of sustainability education and L&T theory. To address this, I consciously used ‘plain language’ during the interviews and asked questions in different ways where necessary to ensure that the required themes were covered by the interviewee during the interview. Data triangulation from the mixed methods approach was also used so that teachers’ accounts were compared with observational notes and perspectives from student participants in surveys and focus groups, providing both verification and additional context for interpreting and analysing interviewee’s responses. The interviews undertaken in this research can be described as joint meaning making ‘where the interviewer and the interviewee work together to develop understandings’ (Cousin 2009:73)

### **Surveys of students**

Online surveys were used to gain insight into the learning experiences of students from case study courses. This method aimed to capture a larger sample than the focus groups that were used to triangulate data from interviews with teachers and focus groups with students. This provided an easier means for students to contribute to the research who did not wish to participate in the face-to-face focus group sessions.

Surveys are most useful when collecting data on large populations (Cohen *et al.* 2011), however low response rates can be an issue with online survey research with student

participants, with hard copy surveys gaining higher responses rates than online surveys (Sax *et al.* 2003). However, an online survey was time efficient and interfered less with the teaching program in the case study courses and students were able to undertake the survey at a time of their convenience ‘which may increase the likelihood of participation’ (Sax *et al.* 2003:409). Students may not have access to the internet or regularly check their email (Sax *et al.* 2003) therefore follow up emails were sent to remind students about the survey as well as introducing the research and survey to students in class so they were aware of the research and the survey before receiving the email invitation.

To address the possibility of low response rates (and the qualitative nature of the research), the surveys predominantly collected qualitative data and the quantitative data that was collected was grounded in additional qualitative responses explaining the selection. The focus on qualitative data allowed for the exploration of individual experiences of the course and aimed to discover the existence of particular learning experiences, rather than ensure the generalisability of quantitative data.

All students undertaking each case study course were invited to complete the survey by email which can be described as ‘complete collection sampling’ (Cohen *et al.* 2011). These surveys were distributed using the online survey software Survey Monkey. The course surveys included 44 qualitative and quantitative questions (see Appendix 1.2 Student survey questions) that were divided into five sections in the following categories:

1. Basic information: Age, degree program, class attendance;
2. Course engagement: What was the level of interest and engagement that participants felt during the course about the course and sustainability?;
3. Overall learning: Did the participants thinking change as a result of the course? What knowledge and skills did they feel they gained, and what activities and content areas were perceived to help their learning and development?;
4. Skills for sustainability: Perceived skills that were developed and what helped this development;
5. Relevance to profession: Application and relevance of course content to chosen future/current profession.

The questions were designed to collect data on the student learning experience in the course by casting a wide net, asking questions related to the emotional experience of the course,



perceived learning outcomes of the course, perspectives on the teaching approach and L&T activities, the value, relevance, significance and impact of the course and learning challenges.

### **Focus group sessions with students**

Focus group sessions were conducted with students of case study courses. These focus group sessions were based on semi-structured questions and provided insight into student experiences and learning in the case study courses. Focus groups allow for a 'wide variety of different views to a particular issue' (Bryman 2004:348) and for participants to raise issues or express ideas and knowledge that they feel are important. According to Bryman (2004:346), in focus groups 'the accent is upon interaction within the group and the joint construction of meaning'. Questions were semi-structured and adapted for the different focus groups depending on the student responses (see Appendix 1.3 Student focus group questions). Generally however, each focus group was asked questions about:

- The value of the course both personally and professionally;
- Participant confidence in applying what they had learned;
- What participants found most and least engaging about the course and what aided their learning;
- Participant's relationship with their teacher;
- Particularly challenging parts of the course;
- What participants felt they have learned over the semester.

There is a number of factors that influence focus group data including the group dynamic, the focus group setting, participants' views converging and confirming during the focus group, and the trustworthiness of the data collected based on the sampling of the participants (Cousin 2009). These are all factors that influenced focus group data in this research. Some focus groups were quiet while others had some participants that spoke over others, so therefore group dynamic did have some influence on the data collected. In all cases, I drew on my previous teaching skills to draw out the experiences of those quiet members, so that participants had equal opportunity to contribute. The issue of students conforming to 'group talk' is also a consideration with the focus group narratives and directions collectively shaped. Again to address this, I asked specifically for counter opinions of people who did not agree if there was overall agreement with a question or repeated a question using different language to determine if there were alternative views. Of biggest concern for this research was the use of

the classrooms after or before class to conduct the focus group. Students may have felt more comfortable expressing personal views about the course in a different, less formal setting however the practicality of organising a different room, given the students' time constraints across the case studies, would have lowered participation in the focus groups further. The students felt that meeting for the focus group in their classroom before or after class was most convenient for them. To make students feel comfortable, I attempted to create a relaxed environment through my informal chatting with participants and also providing snacks. Finally, the limitations of the representativeness of the focus group samples needs to be noted. It was difficult to undertake purposive sampling (for example based on degree program, gender or year level) because of the low level of interest by students in general across the case studies in taking part in the focus groups. Student year levels and their degree programs were noted where necessary, however in most cases only the small number of students required for the focus group actually volunteered their time, so sample selection was not possible. This also brings into question how representative the opinions of the focus group participants were compared to the majority of students undertaking the course, given their interest in taking part in the research. There were, however, contrasting views seen in all focus groups and as with the survey data, given that the aim of this research is to 'discover rather than test variables' (Corbin and Strauss 2008:12), the low participation rate was not a significant limitation.

### **Observation**

'The purpose of observational research is to record group activities, conversations, and interactions as they happen and to ascertain the meanings of such events to participants' (Angrosino 2004:1). Observation is used for the purposes of this dissertation to triangulate data collected from teachers and students and to add context and general information about the L&T practices in the course. My role as a researcher can be described as a 'peripheral member researcher' who, according to Angrosino (2004:5), 'develop an insider's perspective without participating in activities constituting the core of group membership'. My role could also be described as an 'overt observer' with 'negotiated access to the group to observe it' (Cousin 2009:119). During observation of workshops and lectures my presence was made known to students, however, I remained an observer of the learning community rather than a participant in it, therefore the observational style was peripheral.

The researcher's presence in the classroom as a silent observer can affect the behaviour of the teachers and students in the class (Cohen *et al.* 2011), while the relationship that may develop between the participants and the researcher can also affect the researcher's views of the data

and participant behaviour (Cohen *et al.* 2011, Cousin 2009). However, as found in this research, establishing a relationship can also allow for deeper understanding of the experiences and perspectives of the research participants and the learning processes occurring in the classroom. These limitations of observational research related to data validity and reliability can be addressed to some extent through data triangulation (Cohen *et al.* 2011), which has been done in this research through the use of mixed methods.

The number of observed workshops and lectures differed greatly between case studies and were affected by time available, the delivery structure of the course and also the teacher's wishes. Data recorded during observation of workshops specifically focused on the following elements:

- Learning environment;
- L&T aids;
- Learning & teaching activities;
- Content/topics/themes;
- Teaching approach;
- Overall student response/behaviour;
- Questions that arose for me during the workshop.

While lecture observation focused on the following elements:

- Content/topics/themes;
- Teacher's approach;
- Overall student response/behaviour;
- Other questions or ideas that arose for me during the lecture.

Observational notes were recorded in each sitting using mind-mapping software (see Appendix 1.4 Observation note mapping example, for an example of the maps created).

## **2.7 Data analysis**

While Grounded Theory informs the philosophical orientation of this dissertation, the analysis of qualitative data is based on a multiple case study approach described by Stake (1995) and Yin (2003). The departure from Grounded Theory as a method rather than an orientation was

primarily due to the research limitations including time constraints. Analysis of data in Grounded Theory usually occurs simultaneously with data collection in an iterative process between data collection and the theories emerging from data. Data collection finishes when 'data saturation' is achieved, where theories emerging from the data can be confirmed, which 'involves staying in the field until no new evidence emerges from data collected through an ongoing process of theoretical sampling' (Goulding 2002:88). The use of four case studies with mixed methods and the inductive intention of the research strategy meant that a large amount of data was collected for each case study. Due to the time limitations of the research, it was not possible to 'stay in the field' (Goulding 2002:88) long enough to achieve adequate data saturation in order to base sound theory following the Grounded Theory analysis process.

Data analysis began with initial coding of themes and concepts emerging from the qualitative data guided by the research sub-questions. These themes and concepts were counted to determine frequency in line with a general content analysis coding scheme (Franzosi 2004). Results from the different methods within each case study were compared to triangulate data and differences in themes emerging from student perspectives and teacher perspectives were noted. Therefore the results presented in Chapter Four are descriptive of dominant themes emerging from the data as well as minor contradictory data, which may also indicate an area of interest to help answer the research question. This is inline with Yin's (2003) *pattern matching logic* technique of data analysis recommend for use with multiple case studies. The search for patterns within each case study helps strengthen the internal validity of each case.

Table 2.2 presents which methods were intended to collect data in order to answer the research sub-questions. Almost all teacher interview, survey and focus group questions asked these questions directly, so data that related to these questions directly were focused on for analysis. Due to the semi-structured nature of focus groups and teacher interviews however, data were drawn from wherever participants touched on themes related to these questions in the interviews and focus groups.

In order to make sense of the themes emerging from preliminary content analysis, a literature review of the theory of good practice L&T in EfS was undertaken and key themes that emerged from this review were summarised (see Chapter Three). This then formed part of the data set to help frame the results and themes that emerged from the preliminary data analysis. It was at this stage that the research employed both an inductive and deductive approach where theory emerging from the data was compared to the literature. This explored the lived

experience of the theory in the literature (where it was found in the case study) and then added to the theory based on the lived experience of the L&T.



## 3.0 Chapter Three: Overview of Education for Sustainability

### Contents

- 3.1 Introduction
- 3.2 The context for investigating learning and teaching in EfS
- 3.3 Dominant characteristics of learning and teaching for sustainability advocated in the literature
  - Teaching approaches
  - Learning outcomes advocated in the literature
  - Learning and teaching activities
- 3.4 Summary of important characteristics of learning and teaching in EfS

### 3.1 Introduction

In order to set the context for this research, this chapter firstly explores what is unique about education for sustainability (EfS) that requires specific investigation and outlines the important characteristics of EfS according to the literature including pedagogical needs and learning and teaching (L&T) approaches, learning outcomes and L&T activities. The chapter then concludes with a summary of these dominant approaches and methods advocated for EfS.

### 3.2 The context for investigating learning and teaching in EfS

Empirical research specifically on L&T experiences in EfS is needed because of a number of distinguishing characteristics of EfS in higher education (HE). EfS/education for sustainable development (ESD)<sup>2</sup> has been described ‘as a unique educational concept’ (Barth and Michelsen 2013:106), that ‘challenge[s] conventional modes of education and require[s] new methods for integrative learning’ (Fortuin and Bush 2010:20). Christie *et al.* (2012:3) argue

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<sup>2</sup> As defined in Chapter One, EfS includes the study of sustainability, and the development of capabilities to help people contribute to the evolving process of sustainable development. The latter element is why some choose to use the term ESD as opposed to sustainability, as this frames learning as a process. The terms used by the authors presented in this literature review have been repeated in this dissertation, as they have similar meanings for the purpose of this research.

that ‘sustainability as a concept is epistemologically, ideologically and methodologically unique’ because it is interdisciplinary, controversial, subjective and ‘requires values judgments’<sup>3</sup>. There also remains controversy over sustainability as a subject and ‘confusion over terminology’ (Cotton *et al.* 2007:580), so part of teaching sustainability involves also proving its relevance and legitimacy as a subject in a course of study. EfS is not owned by a particular discipline (UNESCO 2012) and according to Barth and Michelsen (2013:105), this indicates a change in educational paradigm because EfS can be integrated into curriculum ‘rather than yet another ‘adjectival’ education’. ‘ESD is an overarching paradigm that guides and transforms the core disciplines, second tier disciplines, and adjectival educations so that they can all contribute to a more sustainable future’ (UNESCO 2012:no page). Implementing EfS in HE challenges many common practices in HE. For example, according to Cortese (1999), EfS challenges current mindsets within educational systems which commonly reinforce a disconnect between humans and the natural environment, and supports notions of infinite growth and consumption through the ways in which subject matter is taught. Cook *et al.* (2010) argue that sustainability is a difficult path to take because the actions and effects of sustainability practice are unknown as sustainable development diverges from business as usual. According to Wals and Blewitt (2010:56) the ‘the emergence of ‘environment’ in HE’ in the 1970s and 1980s by sustainability education’s forerunner Environmental Education, ‘hardly resulted in the rethinking of teaching and learning’. However, due to the unique characteristics of sustainability education, it has the opportunity to bring about pedagogical change through a focus specifically on rethinking L&T practice (Wals and Blewitt 2010).

Teaching EfS is accompanied by a number of challenges including a focus on learning processes for sustainability rather than learning about sustainability, interdisciplinary collaboration and use of multidisciplinary frameworks, and making values explicit in L&T.

What makes something sustainable is context specific (Christie *et al.* 2012, Sterling 2003) and therefore there are no sets of rules or codes of practice that are ‘sustainable’. This ‘requires teachers to also see themselves as learners, and work with uncertainty and open outcomes’(Martin and Jucker 2003:7). The issues that EfS aims to address, including climate change, social inequality and the ‘food-energy-environment trilemma’ (Harvey and Pilgrim 2010) are complex and their exact nature and ways to address them are uncertain, therefore sustainable development is very much a ‘learning process’ rather than ‘about ‘rolling out’ a

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<sup>3</sup> I do not agree that making value judgments and subjective interpretation are unique to the study of sustainability. Based on a social constructivist epistemology, all reality can only be understood through subjective interpretation and therefore part of any course of study.



set of pre-determined behaviours' (Vare and Scott 2007:192). This means that capabilities for sustainability such as critically reflective practice and problem solving become key to this learning process, rather than merely learning about sustainability. Likewise, educators must also become reflective and open practitioners in order to teach sustainability, as highlighted by UNECE (2012):

Transformation of what it means to be an educator is necessary because education systems are composed of the people who work within them and a key to changing these systems will be educators who are able to change their own practice as critical reflective practitioners. The building of positive relationships between educators and learners is essential. This will require educators to present themselves as fallible human beings rather than people with all the answers. It also requires the ability to empathize with the views and situations of those they educate.

(UNECE 2012:17)

EfS challenges the 'purpose, content... method' of teaching practice 'and the role of teachers in the institution' (Martin and Jucker 2003:7). According to Barth and Michelsen (2013) pedagogy needs to be transformed to social constructivist models in order to meet the capabilities based learning goals such as reflective practice. The challenge, however, of implementing new pedagogies for sustainability is documented by Bawden, who argues that:

As educators begin to explore the challenge (of curriculum development for sustainability), they quickly come to appreciate that the design of innovative pedagogies for sustainability... raises a host of complex cognitive and normative issues that extend beyond the conventional foci of curriculum content and pedagogical practice.

(Bawden 2007:300)

Sustainability's defining characteristic is its systems or holistic framework to understand the world as a whole system. Systems thinking underpins other key elements of sustainability such as interdisciplinarity (Barth and Michelsen 2013, Sterling *et al.* 2010) and this 'requires a change in mindset for academics, who are generally accustomed to working within clearly defined disciplinary boundaries' (Cotton and Winter 2010:41). According to Sibbel (2009:79), EfS:

requires teaching by academics from many disciplines who collaborate to share ideas and make new connections within a flexible and dynamic theoretical base. It also requires them

to work beyond their own areas of specialisation to supervise students' work across disciplines.

There is a growing consensus that values have a key role to play in EfS, beyond just understanding sustainability (Cook *et al.* 2010). Interpreting and applying sustainability requires values judgments because choosing what actions best reflect sustainability is context specific. Barth and Michelsen (2013:107) argue that 'ESD has to consider the underlying values and support the learner's critical reflection on them'. In order for people to embark on an alternate, difficult and uncertain path we need to reflect on our values and why we need to change our current practices.

Explicitly stating values and focusing on building reasoning skills to evidence learners' and teachers' positions is a more suitable approach for the needs of ESD than attempting to remain values neutral (Cotton and Winter 2010). Therefore EfS/ESD also challenges a perceived value neutral or unbiased position towards teaching subject matter. However, 'sustainable development has... been criticized as overly value-based' (Dale and Newman 2005:353) and labelled by some as 'indoctrination' (Christie *et al.* 2012:3). Teachers in EfS face the challenge of deciding if and how to 'explicitly state values' given this context.

In summary, EfS in HE requires pedagogical transformation in order to support L&T that fully embraces the transformative potential of EfS. EfS challenges current mindsets and takes a systemic approach to understanding the world. EfS makes explicit the roles values play in shaping worldviews and practice requires L&T based on interdisciplinary collaboration and use of multidisciplinary frameworks. These characteristics are what define EfS as a new educational endeavour that requires specific empirical investigation to validate or challenge L&T for EfS theories advocated in the literature.

### **3.3 Dominant characteristics of learning and teaching for EfS**

What follows is an overview of the major pedagogical characteristics, L&T approaches and learning outcomes advocated in the literature on EfS and ESD. This overview is not exhaustive, however it aims to capture the dominant themes or core characteristics found in the literature review for this dissertation. Many characteristics are mentioned briefly in the EfS and ESD literature, so literature from general L&T theory has also been drawn on to provide richer descriptions of the characteristics and how they are theorised to support

effective learning for sustainability. As argued by Barth and Michelsen (2013:107) ‘ESD pedagogies are not completely new, but rely strongly on their historical roots...’. These historical roots are described by the authors to include (but not limited to) theories of social constructivism, problem based learning (PBL), social learning and situated learning. L&T approaches for EfS advocated in the literature have been informed by educational theories and practices developed through general educational research and other disciplinary education practice. Barth and Michelsen (2013:107) argue that ‘the unique contribution of ESD is to further develop such approaches and to systematically link them to challenges related to sustainability’.

The characteristics of EfS practice advocated in the literature can be presented and represented in many different ways due to the overlapping or interconnected nature of the characteristics, approaches and outcomes advocated. For the purposes of presenting a theoretical framework to combine with the data analysis in this dissertation, the dominant themes found in the literature have been loosely grouped into pedagogical and L&T approaches. This section will begin by exploring the dominant pedagogical and L&T approaches advocated in the literature on EfS and ESD. Learning outcomes advocated in the literature will then be presented and specific teaching activities advocated to achieve these outcomes are outlined. The pedagogical characteristics, L&T approaches and learning outcomes presented here will be used in Chapter Four to structure the presentation of case study results and explored and added to in the discussion in Chapter Five in light of the research results. The purpose of this approach is to provide a picture of the lived experience of some of these practices, adding to the existing theory.

### **Teaching approaches**

L&T approaches for EfS advocated in the literature are based on learner-centred approaches, transformative education, holistic and systemic learning, capability building and active and real issues learning. These are summarised in Table 3.1 and discussed below under the respective headings.

**Table 3.1: Dominant pedagogical approaches advocated for EfS**

**Dominant pedagogical approaches and learning and teaching approaches for EfS/ESD advocated in the literature**

- **Learner-centred L&T** founded on social constructivist epistemology (including self-directed learning with the teacher's role as facilitator and learning partner, not the 'expert')
- **Transformational learning** (including deep learning, higher order learning, learning as sustainability and reflexive learning).
- **Holistic and systemic learning** (including interdisciplinarity, transdisciplinarity and multidisciplinary approaches and the use of multiple perspectives from differing disciplines and collaborative teaching)
- **Capability building** (including focus on skills, competencies or capabilities rather than the acquisition of information)
- **Active learning** (including experiential, participatory and collaborative learning)
- **Real issues orientation** (mimics real life through problem or inquiry based praxis-orientated learning)

***Learner-centred learning and teaching***

Barth and Michelsen (2013:107) and Armstrong and LeHew (2013:4) argue that ESD is founded on constructivist learning that 'comprises a family of theories but all have in common the centrality of the learner's activities in creating meaning' (Biggs 1996:347). Cullen *et al.* (2012:46) argue that a '...constructivist view is a significant departure from the traditional conception of curriculum as dispensing a single reality or perspective of knowledge to learners'. According to Moon (2004:231), a constructivist approach to learning understands the learner as an 'individual [with] a unique view of the world based on her own processes of learning.' In this approach the focus is 'on the learners' construction of knowledge and the transfer of that knowledge within different contexts' (Cullen *et al.* 2012:46). It is this way of understanding the learning process as knowledge creation, rather than memorisation, which informs learner-centred L&T approach. Based on EfS literature, a learner-centred approach is the foundation of good practice L&T for sustainability (Barth and

Michelsen 2013:107, Christie *et al.* 2012, UNESCO 2012). Learner-centred approaches offer the learner ‘control over their learning’ which gives the ‘sense that the learning tasks have relevance’ (Cullen *et al.* 2012:20). Cullen *et al.* (2012:20) continue, ‘when teachers offer students choices and responsibility and contextualise learning to increase the sense of relevance, the result is intrinsic motivation for learning and learning environments that are conducive to creativity and innovation’.

Self-regulated or self-directed learning has been advocated in some ESD literature (Barth and Burandt 2010, Cotton and Winter 2010, Fortuin and Bush 2010) and sits within the learner-centred approach to L&T, where learners create and construct their own knowledge through the learning process. Barth and Burandt (2010) argue that self-directed learning in the ESD context is important for developing competencies (referred to as capabilities in this dissertation) and for learners to ‘construct their own knowledge base independently’ (Barth and Burandt 2010:660). With self-directed learning and a learner-centred approach, a teacher’s role then becomes a facilitator of, and partner in, the learning process. ‘Teaching about sustainability presupposes that those who teach consider themselves learners as well’ (Wals and Jickling 2002:227). According to Armstrong and LeHew (2013) in ESD the teacher should form part of the learning community. This is supported by the UNECE (2012:15) who argue that an effective EfS teacher ‘Is a facilitator and participant in the learning process’. They also argue that the teacher’s role is not the ‘expert’ in the learning process and that teachers should be seen as ‘fallible human beings rather than people with all the answers’ (UNECE 2012:17). The teacher should also focus on building positive relationships with learners (UNECE 2012) therefore making the learner-teacher relationship non-hierarchical, again situating the teacher as part of the learning community. UNECE (2012) argue that this positive relationship is enhanced if teachers present themselves as fallible.

### ***Transformational learning***

Following from a constructivist, learner-centred approach, a pedagogy that facilitates personal transformation through the learning process is also important for EfS. According to Armstrong and LeHew (2013:4) ESD should support ‘metamorphosis of the learner’s beliefs’ or ‘deep and transformational learning’. Cullen *et al.* (2012:47-48) explain that deep learning:

...grew out of the research of Marton and Saljo (1976) and described a way of learning that integrated new information into existing knowledge...When students learn something at a deep level, they have integrated it into their existing knowledge and have enriched or even

revised their understanding. Because this knowledge is fixed in relation to other knowledge, they can draw on it and apply it in multiple contexts.

(Cullen *et al.* 2012:47-48).

The difference between shallow and deep learning is whether the learner has ‘integrated [information] into their network of understanding, their long-term memory’ and ‘making connections between what [learners] are learning and what they already know’ (Cullen *et al.* 2012:48) rather than just ‘cramming’ information without making connections to existing knowledge. This learning is fundamental for transformation of learners understanding of the world and values which is argued by Sterling (2003) to be a key part of good practice L&T for sustainability. According to Sterling, transformational learning involves deep learning and epistemic learning and argues that ‘such a quality of learning is essential to the realisation of the postmodern ecological paradigm... that learning *within* paradigm does not change the paradigm, whereas learning that facilitates a fundamental recognition of paradigm *and* enables paradigmatic reconstruction is by definition transformative’ (Sterling 2003:279). Changes in learners’ behaviour and practices arise out of this deep learning through challenging or critically reflecting on values and views. In order for this ‘higher order’ learning to occur as Sterling describes it, ‘individuals must become aware of their current habits of mind and points of views, but more importantly, engage in examining, reflecting, and challenging their assumptions and premises for the mind-sets, and developing alternative perspectives (Ukpokodu 2009:1). Deep learning in EfS means that learners are not being taught what to think, but developing ‘the dispositions necessary to act successfully in different contexts’ (Barth and Michelsen 2013:111)

This is where it is useful to draw a distinction between different types of sustainability education using a typology developed by Sterling (2003) to describe the different kinds of learning arising from different approaches to sustainability education from transmissive to transformative. It is important to note that Sterling uses these categories to describe whole of university practices such as policy, not just situational L&T. For the purposes of this discussion, I will refer only to the situational L&T aspects of Sterling’s three categories.

- *Education about sustainability* involves just that, the transfer of knowledge about sustainability at a L&T level and is usually added to existing subjects that may also present ideas contrary to sustainability.

- *Education for sustainability* adapts content by ‘building in’ sustainability into subjects in ‘an attempt to teach values and skills perceived to be associated with sustainability...’ (Sterling 2003:285). Critical and meta-learning about assumptions and values are also part of this response.
- *Sustainable education or learning as sustainability* uses the principles of sustainability to inform L&T practice, particularly systems approaches (see below for an explanation of systems in sustainability). ‘Education is re-thought and re-designed – through a continuous learning process – to embody and reflect a whole systems approach and (what is understood of and by) sustainability’ (Sterling 2003:285). This approach is paradigm changing with learning ‘seen as an essentially creative, reflexive and participative process’ (Sterling 2003:285).

In this later approach, transformation is not only aimed to occur within the learner, but within the teacher and the teaching approach through reflexive practice where L&T are viewed as an on going reflexive process. Reflexivity is ‘whereby dominant assumptions are brought to light for examination’ (Sterling 2009a:2). Sterling (2009a) draws on a quote by Raskin (2006) to support this description, ‘The shape of the global future rests with the reflexivity of human consciousness – the capacity to think critically about why we think what we do – and then to think and act differently (Paul Raskin 2006 in Sterling 2009a:1). This is supported by the UNECE (2012) who claim that a good teacher in ESD is a critically reflective practitioner. Reflexive practice is also an important part of learning for transformation for students according to the literature (Bawden 2007, Mochizuki and Fadeeva 2010:397, Sterling 2003). Reflexivity as a learning *outcome* will be discussed further below.

### ***Holistic and systemic learning***

As seen in the work of Sterling (2003, 2009a) holistic and systemic learning is at the heart of EfS. According to Wals and Jickling (2002:228) ‘sustainability requires a foundational appreciation of holistic principles, critical system understandings, and practical systemic competencies’. When using Sterling’s (2003) learning as sustainability framework, systemic thinking both informs educational design and practice and is an outcome of the design and practice (or learning system). According to UNECE (2012), a holistic approach to learning is an important element of ESD allowing for integrative thinking, inclusivity, and dealing with complexities. The UNECE explain:

[Sustainability related] challenges are complex and require inputs from a range of disciplines to address them, including perspectives on natural, social and economic systems. Different cultures and world-views can provide valuable insights; at its most fundamental, sustainable development connects individuals and groups to other people, locally and globally, and to their natural environment. Integrative thinking implies ways of thinking and acting that reflect these interrelationships and the creative possibilities that they engender.

(UNECE 2012:17)

A key part of EfS according to the literature requires interdisciplinarity, transdisciplinarity and multidisciplinary approaches to learning (Armstrong and LeHew 2013:4, Fortuin and Bush 2010:20). This interdisciplinarity can be implemented in learning activities and also in the way that material or knowledge is framed. Armstrong and LeHew (2013) advocate the use of multiple perspectives from differing disciplines to inform L&T rather than only the teacher as the source of knowledge. Collaborative teaching is another way interdisciplinarity can be integrated into the approach to L&T (Tilbury *et al.* 2005).

### ***Capability building***

The literature presents a strong case for developing learner capabilities to respond (see Fisher 2006, Martin 2005, Sterling 2009a, Wals and Jickling 2002) as a core part of learning for sustainability. It has been argued that EfS should be about encouraging students to ask better questions rather than providing them with the answers (Warburton 2003). Due to the context specific and creative practice that is applying sustainability, a focus on competence, skills or capabilities is a preferred approach for ‘moving beyond treating ESD/EfS as though it were ready-made and existed “out there” to be implemented’ (Mochizuki and Fadeeva 2010:396). In other words, a focus on skills, competencies or capabilities<sup>4</sup> as the key learning outcomes of EfS, rather than the acquisition of information allows learners to use their own critical skills to apply sustainability in differing contexts. Capabilities that allow practitioners to think systemically and creatively about responses to sustainability challenges are key and help to empower practitioners to respond to complex problems (Stibbe and Luna 2009:156).

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<sup>4</sup> The language of competencies or capabilities depends on level and type of education and country (Thomas *et al.* 2013). Competencies and capabilities can refer to similar things. This dissertation draws on Hager’s (2006:42) definition of capability ‘as an overarching concept to reflect the clustering of attributes and skills... that a graduate deploys in a series of different situations’.



### ***Active, experiential, participatory and collaborative learning***

ESD literature advocates active and interactive learning processes (Barth and Michelsen 2013:107) with ‘high levels of learner engagement... and social interaction’ (Armstrong and LeHew 2013:4). One active learning approach is experiential learning which is advocated by Armstrong and LeHew (2013). A theory developed by Kolb, which sees that learners ‘create knowledge from experience rather than just from received instruction. Conflicts, disagreements and differences drive the learning process as learners move between modes of action, reflection, feeling and thinking’ (Bergsteiner *et al.* 2010:30). It is clear how this educational theory fits with the theory of transformative learning with deep learning arising from action-reflection cycles in an interactive learning process. Collaborative learning advocated in the EfS literature (Barth and Burandt 2010, Cotton and Winter 2010, UNESCO 2005) and is based on the theory that learners learn best from their peers and that through collaboration and interaction new knowledge is created (Pearse and Dunwoody 2013). The learning arises from collaboration and interaction with other learners therefore making collaborative learning an active learning process. Collaborative learning involves shared learning goals with individual learning outcomes and stands in contrast to traditional individualistic, competitive approaches to learning (Pearse and Dunwoody 2013) because knowledge, skills and experiences are shared in the learning process to achieve mutually beneficial learning outcomes. Collaborative learning is informed by theories of social learning which theorise that learning occurs as a result of social interactions (Dlouhá *et al.* 2013). Social learning theory emphasises ‘the importance of relationships, collaborative learning, and the roles of diversity and flexibility in responding to challenges and disturbances’ (Wals 2009:15).

### ***Real issues orientation (mimics real life through problem or inquiry based praxis-orientated learning)***

Cullen *et al.* (2012:49) argue that for conceptual change within a learner to occur ‘the previous belief must no longer be satisfactory, and the new belief must be intelligent, plausible and fruitful’ (Cullen *et al.* 2012:49). Therefore having a real issues orientation, as argued by Cotton and Winter (2010), is important for students to connect theory to practice and show that implementing sustainability can be plausible and even fruitful. This point is also emphasised by others, for example, ‘as sustainable development education aims to leave students with the ability to apply knowledge in a variety of unpredictable situations, practical problem-based learning is one of its requirements’ (Dale and Newman 2005:353). Learning

that mimics real life situating learning in professional and personal contexts as advocated by Armstrong and LeHew (2013), takes this real issues orientation a step further, demonstrating relevance and plausibility of implementing sustainability, not just through examples of practice but through the lived learning experience of the learners which also develops their capability to implement sustainability in professional practice. Clarifying this direction, Dale and Newman (2005:357) argue that ‘sustainable development is not a theoretical pursuit, but by its nature is rooted in praxis’. Likewise, Cotton and Winter (2010) also advocate praxis-orientated learning as part of good practice approach to EfS. Praxis is defined by Sterling (2009b:66) as ‘theory in action’ and is concerned with the integration of theory into practice and reflection on practice so there is continual learning.

Problem-based learning is an example of praxis-orientated learning because in this approach learners are given a problem and in line with constructivist pedagogy, explore the problem by drawing on existing knowledge, identifying their knowledge gaps, researching and applying theory and knowledge to formulate a response to a given problem. Students reflect on the process of learning through the activity in an iterative manner so existing knowledge and research are applied and subsequently reflected on, then decisions or actions modified until a suitable response is created (Allen *et al.* 2011). The aim of this style of assessment therefore is learning through practice or learning through applying knowledge and theory, therefore learning praxis (PBL as a L&T activity will be elaborated below).

### Learning outcomes

A number of learning outcomes are advocated for EfS in the literature. These are summarised in Table 3.2 and discussed below under the respective headings.

**Table 3.2: Dominant learning outcomes**

Dominant learning outcomes advocated in the literature
<ul style="list-style-type: none"> <li>▪ Sustainability literacy</li> <li>▪ Systemic and holistic thinking</li> <li>▪ Capability and motivation for lifelong learning</li> <li>▪ Critical thinking and reflection</li> </ul>

- Reflexivity
- Interdisciplinary skills and ability to work with stakeholders
- Foresighted, anticipatory and futures thinking
- Working with complexity and uncertainty
- Implicit development of values or value of learning and reflection
- Characteristics: empathy, compassion, self-motivation and sense of identity

There have been many studies over the past decade which attempt to map out learning outcomes for sustainability in the form of skills, attributes competencies or capabilities depending on the language used (Barth *et al.* 2007, Barth and Michelsen 2013, Brundiers *et al.* 2010, Cohen 2007, Dale and Newman 2005, Haan 2006, Hofreitera *et al.* 2007, Ison 2010, Mochizuki and Fadeeva 2010, Mogensena and Schnack 2010, Parker 2010, Parkin *et al.* 2004, Scott and Gough 2010, Segalas *et al.* 2009, Sterling and Thomas 2006, Thomas 2003, Wals 2010). There are many papers that present different lists of capabilities with similar themes. A literature review undertaken as part of this dissertation found that the following capabilities are most commonly described as learning outcomes in the literature on EfS, ESD and systems education.

### ***Sustainability literacy***

Sustainability literacy is a learning outcome advocated by a number of authors in the EfS literature (Armstrong and LeHew 2013, Dale and Newman 2005). Sustainability literacy is an umbrella term that can include all of the capabilities described in this literature review. According to Dale and Newman (2005:351) ‘Sustainable development literacy can be measured in terms of acquiring a set of critical skills, which... reflect the complex nature of social-ecological reactions’. In the context of ecoliteracy, Fisher (2005:133) defines literacy as having the ‘intellectual frameworks’ in order to understand our ‘metaresponsibilities’, our ability to understand the contexts and thinking underpinning or informing how people construct their worlds and ecological systems, and their responsibilities within those systems. For Fisher (2005:136), ‘a capacity to see the contexts behind things is one of the most liberating skills a person can have’. Based on these descriptions, sustainability literacy therefore involves an understanding of sustainability and related concepts, an understanding of how we come to understand sustainability and our responsibilities to the world around us,

and the ‘know how’ or ability to practise sustainability and act on those responsibilities in an informed manner.

### ***Systemic and holistic thinking***

Systemic and holistic thinking is advocated many times in EfS and ESD literature (ARIES and Australian Government 2009, Cohen 2007, Connell *et al.* 2012, Dale and Newman 2005, Morris and Martin 2009, Sterling 2009a, Sterling and Thomas 2006, Strachan 2009, UNECE 2012, Wals and Jickling 2002, Warburton 2003, Wiek *et al.* 2011). As the literature presented previously has shown, systems and holistic thinking are at the heart of EfS, informing pedagogy, L&T practice and learning outcomes. Weik *et al.* (2011:207) provide the following definition of systems thinking as a learning outcome.

Systems-thinking competence is the ability to collectively analyze complex systems across different domains (society, environment, economy, etc.) and across different scales (local to global), thereby considering cascading effects, inertia, feedback loops and other systemic features related to sustainability issues and sustainability problem-solving frameworks.

Systems thinking ties in with a big picture perspective noted by Sterling and Thomas (2006) and holistic thinking described by UNECE (2012).

### ***Capability and motivation for lifelong learning***

According to Scott and Gough (2010:3736), an important learning outcome of sustainability is a ‘capability and motivation for further learning’. In the context of lifelong learning, Foster (2002:38) argues that ‘learning from experience... is actually the hardest thing in the world. Since we want if at all possible to stay comfortably within our assumptions and basic patterns of understanding’. It is therefore important that learners have both the capability *and* motivation for ongoing learning. Pearse and Dunwoody (2013) argue that lifelong learners possess certain attributes that assist with ongoing learning. These include reflective, metacognitive, and collaborative abilities, value for learning, tenacity, divergent thinking and a sense of self-efficacy. Due to the challenge lifelong learning poses, capabilities such as these are important for not just practising lifelong learning (being reflective and metacognitive for example) but having the ‘tenacity’ and ‘self-efficacy’ to consciously engage in an ongoing learning process. The notion of lifelong learning is also part of systems practice. The link between the ongoing learning processes of systemic practice in addressing sustainability challenges and lifelong learning can be seen in the following quote by Morris

and Martin (2009). As described here, continual learning from action with a systems approach is similar to that of life-long learning:

Systemic practice can also be characterised as a process of social learning, whereby those involved change both their common understanding of their situation, and their behaviours that arise from this understanding. Learning thus becomes embodied in action and vice versa. This will change the situation, so that understanding and action need continually to develop together. Hence a final key characteristic of systemic practice is that it is iterative, never assuming that we have found the answer, because the questions associated with sustainability are always going to change. We must be properly prepared to recognise, and to be part of these processes of systemic change.

(Morris and Martin 2009:164)

The key link to sustainability here is the need for an ‘iterative’ learning process where ‘an answer’ is never reached. Life-long learning, ongoing learning, systemic practice all call for this iterative process of learning that allows one to continually adapt to a changing world.

### ***Critical thinking and reflection***

The development of critical thinking as an important learning outcome of EfS is advocated by many authors (ARIES and Australian Government 2009, Barth and Michelsen 2013, Hurlimann 2009, Jones *et al.* 2010, Parker *et al.* 2004, UNESCO 2005). ‘Critical thinking and reflection challenges us to examine the way we interpret the world and how our knowledge and opinions are shaped by those around us’ (Tilbury 2009:125). Analysing systemic cause and effect within and between systems, critically reflecting on values and perspectives within those systems, and justifying one’s worldview and decisions based on critical and systemic evaluation of problems, values and approaches are part of this critical thinking capability. Drawing on the work of Dewey (1933) and Mezirow (2000), Ukpokodu (2009:1) outlines how critical reflection is key to transformative learning.

[Students] have to alter their frames of reference by critically reflecting on their assumptions and beliefs and consciously making and implementing plans that bring about new ways of defining their worlds and understanding. The theory of transformative learning is concerned with how learners critically reflect on experiences including existing knowledge and beliefs and how they integrate new knowledge to reflect a change in experience.

(Ukpokodu 2009:1)

Here we can see that the notion of transformative learning, ongoing learning and critical reflection all refer to interlinked iterative learning processes because they require learners to continually learn through critical reflection and action cycles with the ability to examine, reflect and challenge existing assumptions in line with higher order learning as advocated as a learning outcome by Cotton and Winter (2010). Reflexivity is another learning outcome very closely tied with these notions.

### ***Reflexivity***

Reflexivity involves critical reflection and ongoing learning to facilitate transformation and is advocated by a number of authors (Bawden 2007, Mochizuki and Fadeeva 2010:397).

Reflexivity fits with both Vare and Scott's (2007) ESD 2<sup>5</sup> and Sterling's (2003) learning *as* sustainability and is based on the idea that there is no fixed end point which will be 'sustainable' or set knowledge or facts of what *is* sustainable. Because sustainability evolves with and from practice and construction of understanding through continual learning, skills in reflexivity, that is learning from practice and reflection, is key. This is further elaborated by Mochizuke and Fadeeva (2010):

The context dependant and social change aspects of sustainability make reflexive practice important as a learning outcome and a concept to inform the design and delivery of EfS. 'The notion of "reflexive competence" acknowledges a situated human agency and points to the need for continuous recreation of educational processes fitting to the unpredictable and unanticipated challenges of society and learners' interactions with them. An open-ended process of historically situated educational experiments – rather than acquisition of the fixed knowledge as a finished product – comes to occupy a central stage in this type of formulation of sustainability competence.

(Mochizuki and Fadeeva 2010:397).

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<sup>5</sup> Vare and Scott (2007) make a distinction between different approaches to ESD with ESD 1 and ESD 2. According to the authors, 'ESD 1 fits with the received view of sustainable development as being expert knowledge-driven where the role of the nonexpert is to do as guided...' (Vare and Scott 2007:193), while ESD 2 sees learning as an ongoing reflective and collaborative process and is based on the idea that '...sustainable development doesn't just depend on learning; it is inherently a learning process' (Vare and Scott 2007:194). The authors describe ESD 2 as incorporating and building on ESD 1. The rationale for the need for ESD 2 is 'because our long-term future will depend less on our compliance in being trained to do the 'right' thing now, and more on our capability to analyse, to question alternatives and negotiate our decisions. ESD 2 involves the development of learners' abilities to make sound choices in the face of the inherent complexity and uncertainty of the future' (Vare and Scott 2007:194).

### ***Interdisciplinary skills and ability to work with stakeholders***

With a systems perspective comes the need to respond to challenges in a holistic manner drawing on knowledge and skills from many disciplines. Many ESD and EfS authors advocate for capabilities in interdisciplinary practice (Barth *et al.* 2007, Cherry 2005, Parker 2010, Strachan 2009). According to Parker (2010:328). ‘...in promoting [interdisciplinarity] we are also promoting the need for inter-agency, inter-professional collaboration and partnerships...’. Understanding or considering multiple knowledges is also important for EfS and part of the part of the interdisciplinary concept (Parker 2010). Based on the interdisciplinary and holistic principles underpinning sustainability, the ability to identify and engage with interdisciplinary stakeholders as part of decision making and problem response processes is another important capability advocated in the literature (Cherry 2005, Dale and Newman 2005, Checkland in Ramage and Shipp 2009, Tilbury 2009). The ability to identify the stakeholders and their needs, which agents have the power to respond and who will be impacted and so on are necessary skills in order to formulate holistic and ethical responses to problems. Tilbury (2009) sees working with stakeholders as part of ‘participation’, which when working with stakeholders involves the ability to consult, make decisions, share risk, help build consensus and develop partnerships.

### ***Foresighted, anticipatory and futures thinking***

According to Wiek *et al.* (2011:209) ‘the concept of sustainability calls for long-term future orientation and envisioning... the anticipation and prevention of harmful unintended consequences, and the imperative of intergenerational equity...’. Foresighted thinking involves being able to analyse and plan for future scenarios and incorporate this into problem solving and decision making (ARIES and Australian Government 2009, Barth *et al.* 2007, Wiek *et al.* 2011). Similarly, futures thinking involves ‘envisioning’ the future and having the ability to work on current action to achieve the vision (Tilbury 2009, Wayman 2009). This learning outcome is part of the holistic approach to sustainability.

### ***Working with complexity and uncertainty***

Following on from systems thinking is having the ability to deal with complex systems and uncertainty, which is presented as an important capability in EfS literature (Morris and Martin 2009, Thompson *et al.* 1986, Tomkinson 2009). Mulligan (2008:20) argues that ‘The search for greater certainty about what the future holds leads us to the conclusion that we must learn

how to deal better with uncertainty and unpredictability'. According to Weik *et al.* (2011:207), 'The ability to analyse complex systems includes comprehending, empirically verifying, and articulating their structure, key components, and dynamics' of systems. Tomkinson (2009) argues that sustainability challenges can be referred to as 'wicked problems' which are problems that are difficult to define (complex) with causes that are equally difficult to pinpoint, they do not have clear boundaries, there is no right or wrong answer just better or worse responses and every response has flow-on effects, therefore there is no certain way you can resolve them, each wicked problem is unique and may be symptomatic of other complex problems. Therefore, given this description of the kinds of problems sustainability identifies and attempts to address, practitioners need to be comfortable with not finding easy and certain solutions and grappling with the complexity of these wicked problems in order to adequately respond to them.

### ***Implicit development of values or value of learning and reflection***

Implicit development of values or value of learning and reflection is a learning outcome advocated by many authors in different ways in the EfS literature. Development of values can be related to affective learning outcomes advocated by Cotton and Winter (2010) and Shephard (2008). Shephard (2008:88) describes affective learning as learning 'about our values, attitudes and behaviours. Common values noted as desired learning outcomes of EfS in the literature include:

- Values and ethics for social justice and equity (Cohen 2007, Parker *et al.* 2004, Sterling and Thomas 2006);
- Care for the environment/physical world (UNESCO 2005);
- Commitment to sustainability, and the belief that we can create change for the better (Arbuthnott 2009, Parker *et al.* 2004, Shephard 2008).

Sheppard (Shephard 2008) advocates that sustainability education should instil a number of values as part of affective learning. According to Wiek *et al.* (2011:209), 'the concept of sustainability is unavoidably value laden and normative, since it addresses the question of how social-ecological systems ought to be developed, so that they balance and even enhance socio-economic activities and environmental capacities'. Therefore, values based learning outcomes such as those listed above are necessary in order to meet the normative goals of sustainability. However, it is important to note that different pedagogical approaches to



sustainability education will have alternative interpretations of the notion of values as a learning outcome (Vare and Scott 2007).

For those approaches that are more in line with what Vare and Scott (2007) call ESD 1, a set of sustainability values can be learned or instilled. However, ESD 2 or ‘third wave’ approaches (as defined earlier) may view values for sustainability, or a sustainability sensibility, arising ‘organically’ out of the learning processes. Such an approach would see a focus on building skills in values reflection so that students are aware of how values shape understandings and practice, and use this to inform their own practices for sustainability. As Vare and Scott explain:

In ESD 1- dominated programmes, sustainability values and principles are explicit while the values of learning for learning’s sake may be implicit if stated at all. With ESD 2, the values of learning are explicit whereas sustainability values may be implicit.

(Vare and Scott 2007:195)

Rather than teaching values in transmissive models of sustainability education (ESD 1, learning about/for sustainability), values for sustainability will be developed by learners themselves through systemic, experiential enquiry and understanding of sustainability challenges. In the latter form of EfS/ESD, the value placed on reflexive learning (as described earlier) is key and learners are able to develop and ‘own’ the values that they have developed through their learning.

### ***Personal Characteristics***

There are a number of personal characteristics described in the literature that support learning for and application of sustainability that need to be nurtured or developed in EfS. These characteristics include empathy, compassion, self-motivation (Barth *et al.* 2007) and sense of identity (Parker *et al.* 2004). L&T activities should aim to support or develop these traits in EfS as part of developing practitioners capable of sustainable practice according to the literature.

### **Learning and teaching activities**

L&T activities advocated for EfS in the literature focus on authentic engagement with real life issues, interactive learning, understanding of complex phenomena and working through

complex problems, sharing perspectives and developing capabilities to apply sustainability through experiential learning and reflection on learning. These are summarised in Table 3.3 and discussed below under the respective headings.

**Table 3.3: L&T activities advocated for EfS**

Learning and teaching activities advocated in the literature
<ul style="list-style-type: none"><li>▪ Authentic assessment</li><li>▪ Inquiry based learning: Problem based learning, case studies, critical incidents and simulations</li><li>▪ Descriptive and visual conceptual tools: Mapping, diagrams and models</li><li>▪ Visioning projects: Future-focused visioning projects, scenario analysis and back-casting</li><li>▪ Situated learning: Place based education, field work and work based projects</li><li>▪ Interactive, perspective sharing activities: Group discussions, debates, role plays and stimulus activities</li><li>▪ Reflexive accounts</li><li>▪ Critical reading and writing</li></ul>

### ***Authentic assessment***

Authentic assessment is advocated in the literature on good practice EfS (Armstrong and LeHew 2013) . Authentic assessment aims to assess capability development and deep learning through experience in engaging with complex and real life problem responses (Newton 2008). According to Newton (2008:5-6):

Authentic assessment provides students with enduring understanding in a meaningful context that replicates the experiences of living in a complex, ever-changing society... authentic assessment prepares students to negotiate the challenges of everyday life, the complex world of careers and work, and the diverse needs of individuals and societies both now and in the future.

The idea here is to assess learning occurring through engaging in active learning and inquiry based learning such as PBL (described below) which tends to rely on authentic assessment (Allen *et al.* 2011).

***Inquiry based learning: Problem based learning, case studies, critical incidents and simulations***

These approaches have been categorised because of their focus on a particular problem or case and the inquiry based learning process that is supported through investigation of the problem or case. Problem-based learning (PBL) is an approach advocated commonly in the literature on good practice L&T for sustainability (Christie *et al.* 2012, Cotton and Winter 2010, Tomkinson 2009). PBL ‘is an iterative learning process’ (Cotton and Winter 2010:48) and a form of inquiry based learning whereby ‘new knowledge, abilities and attitudes’ are acquired ‘through students’ increasingly independent investigation of questions, problems, and issues, for which there is often no single answer’ (Lee 2012:6). PBL was developed in the medical sciences in the 1950s and 1960s where the main idea was that medical students work in teams and ‘learn by solving real or realistic problems, ‘Grapp[ing] with a multistage, complex medical case history, which offers an engaging and memorable context for learning’ (Allen *et al.* 2011:22). PBL draws on a number of L&T approaches including ‘active, collaborative, student-centred, and self-directed learning’ and uses ‘realistic problems and authentic assessments’ (Allen *et al.* 2011:26). The benefits of PBL is that it helps prepare learners to deal with complexity and uncertainty (Dale and Newman 2005) and respond to wicked problems (Tomkinson 2009) and it requires that students ‘call on an integrated, multidisciplinary knowledge base’ (Allen *et al.* 2011:22). PBL is also argued to help to develop lifelong learning skills and support transformation because it helps integrate new knowledge with existing knowledge (Allen *et al.* 2011).

According to (Christie *et al.* 2012:5) case studies support inquiry and gaining ‘holistic views’ on problems and issues. A more detailed description of case studies in the EfS context is presented by Sprain and Timpson (2012:538):

We define case-based approaches as those that use cases that represent diverse problematic situations in real life that can be studied and analyzed... Strong case studies are often reasonably complex to allow students to explore context and consider the interrelationships between different people and system dynamics.

These authors present a number of different kinds of case study approaches that vary in requirements and learning outcomes, for example ‘data cases’ where students are presented with data on an issue and they are required to make sense of the data with systemic thinking and meaning making, or ‘application case’ where students are asked to apply a technique to address a problem.

Similar to case study analysis, the syndrome approach described by Barth and Burandt (2010) supports systemic analysis of a known problem such as ‘dust bowl syndrome’ in agriculture, which is one example provided by the authors, and ‘seeks to identify functional patterns of human-nature interaction. It describes not only the actual global situation but offers possibilities of a systemic understanding of complexity’ (Barth and Burandt 2010:661). Students work in groups on the syndrome to create an ‘interdisciplinary and integrated knowledge base’ (Barth and Burandt 2010:661) and analyse cause and effects and sites for action to address the syndrome.

Similarly critical incident activity requires learners to focus on an ‘incident’ and discuss how to respond (Christie *et al.* 2012). This allows students to discuss the ethical dimensions of actions and also become aware of different perspectives and responses from their peers engaged in the activity (Cotton and Winter 2010).

### ***Descriptive and visual conceptual tools: Mapping, diagrams and models***

These approaches have been defined as descriptive conceptual tools because they support conceptual development and understanding of systemic interconnections, holistic thinking and complex cause and effect by attempting to visually map out learners' understanding of physical and non-physical phenomena. Concept mapping (Warburton 2003), systems mapping, multiple cause diagrams (Morris and Martin 2009) and modelling (Connell *et al.* 2012) are activities advocated in the literature to support learning about (or constructing) systems and mapping complex interconnections and causes and effects. These are all visual representations of systems constructs and can be used to make connections between elements in physical and non-physical systems, and map out or model current and future scenarios.

### ***Visioning projects: Future-focused visioning projects, scenario analysis and back-casting***

The focus of these activities is the visualisation of a past, current or future scenario and developing of plans in order to achieve these visions (or avoid unwanted visions). Future

focused visioning projects advocated by Connell *et al.* (2012) involve developing visions of what the world will look like in the future and what learners would like the world to look like, which can be done on a local or global scale. Learners then engage in action planning to achieve that vision including tools, barriers, information required. This L&T activity is designed to be an interactive group activity that involves a lot of free brainstorming of ideas and perspectives. Back-casting is similar to future focus visioning projects above because it starts with the future you desire and then works backwards to understand the steps required to achieve the vision. Back-casting involves developing alternative scenarios 20-30 years into the future and ‘from each alternative future created, you then work your way backwards from the future towards the present in stages, asking such questions as—what barriers did we overcome; who helped us; who did we need to persuade?’ (Martin 2005:168).

Another form of visioning project is scenario analysis which according to Barth and Burandt (2010) involves developing hypothetical situations, using systems approaches to map and analyse interactions and gain an understanding of possible current, future and past scenarios. ‘Scenario Analysis (SA) embraces a wide spectrum of procedures, methods and techniques to analyze systemic interrelations and to support systematic thinking about future developments, especially about complex, long-term and uncertain issues’ (Barth and Burandt 2010:662). Scenario analysis can be categorised as qualitative, quantitative, normative or exploratory. Each type of scenario analysis has different aims and uses. Quantitative scenarios serve the purpose of modelling while qualitative scenarios can tell a story. Normative scenarios focus on values and visions of the future and back-cast to discover how to achieve the vision or avoid unwanted future scenarios, while exploratory scenarios focus on the current situations and moving into the future.

### ***Situated learning: Place based education, field work and work based projects***

Situated learning L&T activities or L&T methods require learners to move outside of the classroom and engage in real settings such as the workplace or community. The learning arises from real life problems and projects rather than simulated class based activities as can be seen in case studies or PBL activities. The theory of situated learning was developed by Lave and Wegner (1991) who argue that learning and cognitive development occur when learners are situated in real contexts and become involved in practices of social communities. ‘Essentially, situated learning maintains that learning and cognition rely upon social interaction and authentic activity’ (Gebhard 2008:772). Building from the theory of situated

learning, field work supports learning about stakeholder engagement according to Christie *et al.* (2012) and work based projects (Tilbury *et al.* 2005) share similar learning benefits. All these approaches offer student real life social interactions and exposure to the complexities of implementing sustainability in real life settings, thus assisting to develop all the key capabilities for sustainability that are required in professional practice according to the literature reviewed here.

### ***Interactive, perspective sharing activities: Group discussions, debates, role plays and stimulus activities***

These activities are focused on the sharing of perspectives and gaining an understanding of differences in perspectives. They support learning from open discussion or getting students to think and share from different positions. 'Potential advantages of role plays are that they provide an opportunity for students to gain an in-depth understanding of another person's perspective and empathise with others' (Cotton and Winter 2010:46). Likewise group discussions and debates also allow for perspective sharing (Cotton and Winter 2010). Stimulus activities draw on the case study focused approach where a video or newspaper article is shown, however the point of difference based on the description provided by Cotton and Winter (2010) is that stimulus activities intend to promote general group or class discussion and perspective sharing on an issue.

### ***Reflexive accounts***

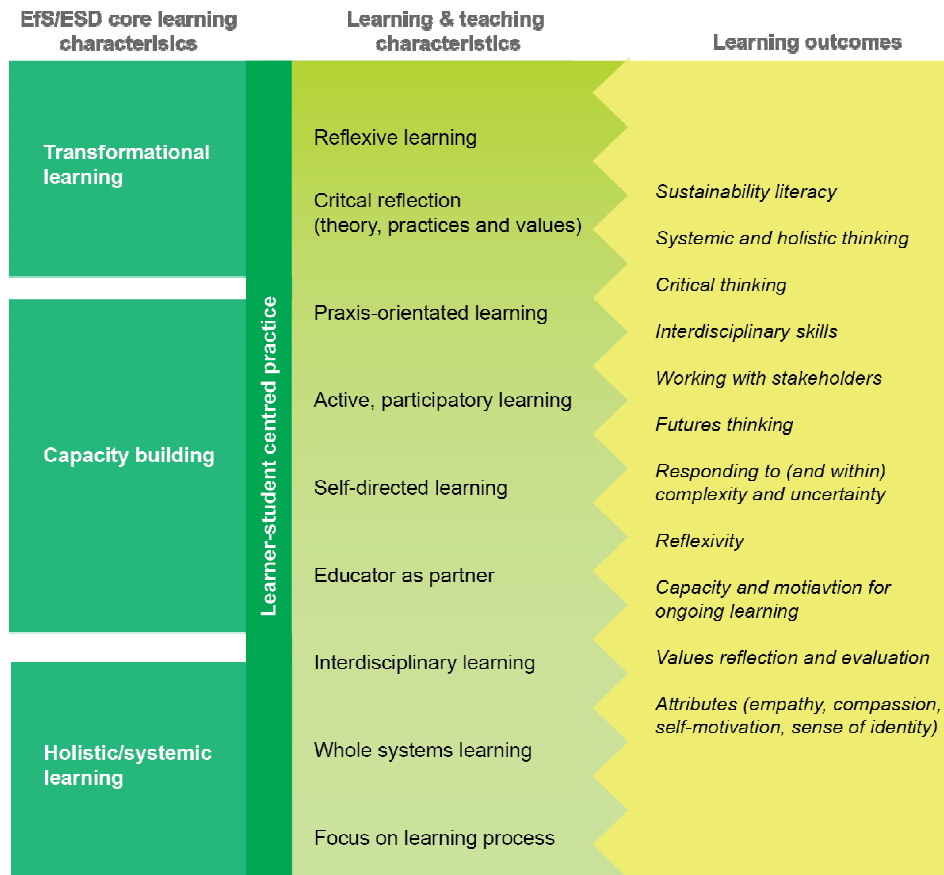
Reflexive accounts include activities which students are asked to reflect on their learning about sustainability and how their learning changes as a result of new knowledge (Cotton and Winter 2010). Reflective practice in professional development planning is also advocated by Cotton and Winter (2010) where students reflect on their learning in the context of career development.

### ***Critical reading and writing***

Understanding and awareness of different perspectives not only develops from sharing of views amongst learners, critical reading and writing allows students to develop arguments or counter discourses by deconstructing arguments and understanding values underpinning them (Cotton and Winter 2010).

### 3.4 Summary of important characteristics of L&T in EfS

**Figure 3.1: Interconnections between characteristics of L&T in EfS**



To conclude this chapter, Figure 3.1 provides an illustration of the dominant L&T characteristics and learning outcomes advocated in the literature of good practice EfS/ESD as presented in this literature review. The purpose of figure 3.1 is to demonstrate the overlapping and interconnected nature of the pedagogical and L&T approaches and methods that are advocated to support learning in good practice EfS. On the left of the figure are the underpinning learning processes that are important specifically for learning in EfS, including *transformational learning*, *capability building* and *holistic/systemic learning*. The characteristics of L&T listed in the middle column support these broader learning processes advocated. The L&T characteristics can be loosely grouped within one of the three broader categories. However, there is no unique relationship between these characteristics and outcomes, rather a number of combinations are possible. Specifically, most of the L&T approaches could be placed in any of the categories, for example according to the literature presented here, reflexive learning is important for transformational learning, capacity building and systemic learning, and a focus on learning processes is important for transformational

learning, capacity building and systemic learning and so on. The learning outcomes advocated in the literature of EfS and ESD can be a result of all of these L&T approaches and methods, for example reflexive learning can foster capacity for ongoing learning, values reflection and sense of identity and so on, or active and participatory learning could support all of the learning outcomes advocated in the literature reviewed here.



## 4.0 Chapter Four: Results

### Contents

- 4.1 Introduction
- 4.2 Case Study One: Sustainability in the Built Environment
- 4.3 Case Study Two: Sustainability in Planning
- 4.4 Case Study Three: Sustainability in Design
- 4.5 Case Study Four: Sustainability in Engineering

### 4.1 Introduction

In this chapter the results from each case study will be presented. The research question, *what is good practice learning and teaching (L&T) in Education for Sustainability (EfS)*, will be addressed by presenting qualitative and quantitative data collected from the four case study/example EfS courses. Based on observational and teacher interview data<sup>6</sup>, the results will first show to what extent good practice L&T for EfS, according to the theory (described in Chapter Three,) is demonstrated in the courses and how. Then, drawing on student views, the results for each case study will explore how effective this practice is for learning based on teaching experiences, student satisfaction with learning and impact of the course on students<sup>7</sup>. This will add empirical research to existing theory to help understand how theory can be put into practice and the strengths and challenges of teaching both ‘good practice’ and other approaches to EfS to better understand what is good practice.

The results from each case study will be presented separately and in the following structure:

- Introduction
- Pedagogical approach
  - Summary box of the pedagogical approach and student experience of this

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<sup>6</sup> The term ‘course’ in this dissertation (and case study university) refers to a single ‘subject’ which is delivered over one semester, and a ‘program’ refers to the degree as a whole made up of a number of courses.

<sup>7</sup> Learning outcomes and experiences described by student participants in the case study courses are based on their recollection and perception of their own learning and experiences and therefore are an indication of *perceived* learning outcomes and experiences.

- Description of pedagogical approach based on teacher interview and observational data
- How effective are these practices for learning for sustainability according to students?
- Intended and perceived learning outcomes
  - Summary box of the intended and perceived learning outcomes
  - Intended learning outcomes based on teacher interview and observational data
  - How effective are these practices for learning for sustainability: perceived learning outcomes according to students?
- Learning and teaching activities
  - Summary box of the L&T activities used in the course and the student experience of these
  - Description of L&T activities based on teacher interview and observational data
  - How effective are these practices for learning for sustainability according to students?
- L&T challenges described by teacher and student participants
- Case Study Summary
- Summary of the value of the case study for this research

## **4.2 Case Study One results: Sustainability in the Built Environment**

### **4.2.1 Introduction**

This section presents a summary of the results from research undertaken on Case Study One: Sustainability in the built environment. The section will help answer the research question *what does good practice L&T for sustainability look like*, by presenting data collected on pedagogical approach, intended and perceived learning outcomes, and L&T activities used in the case study course. For each of these categories, observational and teacher interview data will firstly provide descriptive detail followed by student survey and focus group data which will show how these L&T approaches and methods were perceived by students and the learning experience and perceived learning outcomes of the students from these approaches. Theory of good practice L&T for EfS will be used to draw out and frame elements of L&T practice in the data. This theory is also supported and/or challenged by the empirical data presented in the results.

### **4.2.2 Pedagogical approach**

The following box summarises the pedagogical approach of Case Study One and student experience of this approach based on the data collected.

### Summary of pedagogical approach for Case Study One

- Learner-centred (though not wholly self-directed learning with a lot of guidance and support from the teacher through activities)
- Multi-disciplinary (to an extent through guest speakers, videos, interdisciplinary make-up of the student cohort and feedback from planning students on FBD report)
- Transformative (L&T activities to assist reflection on practice, challenge and explore learners' assumptions and values)
- Role of values made explicit in L&T approach
- Praxis and real issues orientation (through assessments and case studies so that students can understand the links with practice and how they connect personally and professionally with sustainability)
- Positive student-teacher relationship with the teacher is seen as partner in learning journey
- Reflective and reflexive teaching practice.

### Summary of student research participant perspectives of pedagogical approach for Case Study One

- The learner-centred pedagogical approach was well received by student research participants including the positive student-teacher relationship. All participants found the teacher's approach to support their learning of sustainability a positive and engaging experience of the course.
- Praxis-orientated learning was also valued by student research participants who overall felt this was important for their learning about sustainability and demonstrating personal and professional relevance of the learning in the course.
- Little comment was made by student research participants about the transformative, values based and reflective parts of the course.

## Course overview

<b>Case Study One: Summary of course information</b> (See Appendix 2.1 Case Study One course overview for more detail)	
<b>Year level</b>	First year, core/compulsory for three degree programs in the built environment
<b>Course size</b>	205 students
<b>Duration</b>	12 weeks
<b>Course delivery method</b>	1 hour lecture each week and a 2 hour workshop each week. The students are spread across four workshops each week with approximately 60 students in each workshop
<b>Learning objectives</b>	<ol style="list-style-type: none"> <li>1. Define sustainability and to identify the differences between your definition and those of others;</li> <li>2. Understand and apply key sustainability principles in relation to your disciplinary practice;</li> <li>3. Define and understand the five types of capital (natural, human, social, economic and manufactured);</li> <li>4. Recognise, describe and reflect upon your personal and professional practice in relation to sustainability;</li> <li>5. The development of skills in evaluating current sustainability concepts, theories, methodologies and practices;</li> <li>6. Reflect critically upon different sustainability concepts, theories and methodologies as they relate;               <ul style="list-style-type: none"> <li>○ to your ability to make decisions on the basis of a personal and professional interpretation of sustainability;</li> <li>○ to your ability to identify good sustainability practice/management;</li> <li>○ to your understanding of what constitutes exemplary sustainability leadership and management;</li> </ul> </li> <li>7. Communicate effectively by clearly constructing arguments including presenting and defending positions, and to be able to constructively comment on the work of others;</li> <li>8. To apply knowledge in problem-based learning exercises;</li> </ol>

	<p>9. Research and critical analysis skills, including the ability to perform database searches, critically read and revise writing, develop lines of argument supported by appropriate evidence, reference correctly;</p> <p>10. Skills in participating in discussion groups, and ability to contribute to academic discussions.</p>
<b>Assessment</b>	<p>1. Article reviews (worth 20%)</p> <p>2. Ecological Footprint Report (worth 20%)</p> <p>3. Fisherman’s Bend Development group report (FBD report) (worth 40%)</p> <p>4. Fisherman’s Bend Development individual reflective narrative (worth 20%)</p>
<b>Relationship of the course to students' experiences of sustainability in other courses in their program</b>	<p>Students come into this course with little knowledge of sustainability beyond their existing awareness (through the media for example). At the time the research was undertaken, this was the only course in the students’ degree programs to focus on sustainability although sustainability may have been included as a topic in later courses in the programs. Based on the data collected, students experienced predominately teacher-learning L&amp;T approaches in their degree programs.</p>
<b>Research methods</b>	<p>See Appendix 2.2 Case Study One specific research methods</p>

***Description of pedagogical approach based on teacher interview and observational data***

Based on interview and observational results, Case Study One is a learner-centred course that features many of the L&T approaches and some activities advocated in the theory of good practice EfS found in the literature. This section will now summarise these key characteristics of pedagogical approach, L&T activities and intended learning objectives based on observation and interview results.

**Learner-centred**

Based on the observations of the teaching approach and types of L&T activities undertaken as part of the course, learner-centred learning and capacity-building was key characteristic. The teacher also describes their practice as learner-centred and based on their descriptions

facilitates ‘active, applied, problem-based, inquiry-based, service and experiential learning’ (Armstrong and LeHew 2013:4) through their course design. For the teacher, good practice L&T in their EfS course:

has to be about understanding the context upon which students come to the classroom, the values that you bring to those contexts, to understand the values that underpin your students’ perspectives and then ensure that the material that you present to those students allows them to challenge and explore their own assumptions...

Part of the learner-centred approach is described by the teacher as ‘...giving the students a point of entry’ in the L&T activities for students. In order to put this L&T approach into practice educators must:

...understand the topics as [they] relate to [the students’] own personal identity and relationships with whatever it is that they are dealing with in a professional and personal context... L&T strategies need to be about situation, thinking through the systemic implications of short term and long term impacts, understanding the ways in which [students’] values have been brought to that particular problem and then relate that back to themselves and but also other stakeholder groups.

The teacher also commented that:

...it was important for me to make sure that the material and the way I structured it and the topics reflected the cohort, and presented it in a way that gave them a point of entry that made sense.

The course is learner-centred in that students are encouraged to bring their own views and values to make sense of the content and assessments. However, based on observations, students are guided a lot by teacher support and feedback so learning is not wholly self-directed, which is advocated in the literature.

### **Multi-disciplinary**

Students were given a level of multi or interdisciplinary learning experience because of the interdisciplinary make up of the workshops and assessment groups, and to some extent the multidisciplinary collaboration in the major assessment piece through feedback from planning students in Case Study Two (doing an assessment piece in a different course and discipline) in which they had to respond to (although this collaboration was not face-to-face). Guest lecturers with different perspectives also helped to bring in a multidisciplinary and multi-values lens on the content areas. The use of media such as videos allows for students to

understand sustainability from multiple perspectives. This also means that the teacher is not the only source of knowledge and also caters to different learning needs of students. The teacher commented that the use of videos and guest speakers help to bring in different voices to show different values on the issues (aside from the teachers) and also to prove relevancy of the content and skills:

...we will use media watch episodes or we'll look at ads on television and they'll then have to look at what are the different assumptions and so on. So anything that I can't cover effectively because I don't have that lived value I'll use another medium to bring it out... to give the material legitimacy so it's coming from a respected, legitimate source like the Building Council of Australia.

### **Role of values made explicit in L&T approach**

As seen in the previous qualitative comments, the teacher throughout the interview stressed the role of values and the need for students and teachers to reflect on these. Observational data also shows that the concept of values and how values shape understandings and help inform practice was emphasised in workshops. The role of values in L&T was made explicit to students by the teacher through their observed openness about how their own values shaped their understanding of the content and their approach to issues when delivering content and guiding class discussion.

### **Transformative**

The teacher encouraged students to 'challenge and explore their own assumptions...', which in theory supports deep learning for personal transformation of understanding, values and practices. Particularly the eco-footprint assessment required students to reflect on their consumption patterns as they are today and then reflect on the values which inform these. This intended to have a transformational effect according to the teacher. Likewise the process of learning and applying theory over the semester to their problem based learning (PBL) major assessment, then reflect on their learning as a result could have had a transformational effect through a practice-reflection cycle. According to the teacher, EfS needs be approached from 'a multi-value perspective' to bring multiple perspectives into the understanding of sustainability which is done in the case study course 'primarily from an experiential learning perspective'. Experiential learning and use of multiple perspectives and values to understand material (in addition to learners' own perspectives) can also support transformative learning.



### **Praxis and real issues orientation**

Linking of theory and practice was undertaken continuously with students asked, through all assessments and activities observed, to apply theory to practice and reflect on what this means for future practice. Students worked within real issues contexts through PBL and case studies of contemporary issues and building approaches. Assessments and case studies are intended to provide real-life context for students and the PBL intended to situate learning in professional and personal contexts. According to the teacher 'even though you are in a classroom, you have to give them a context, because sustainability is nothing without context...'. L&T activities must allow students to explore complexity and link problems with practice, '...learning and teaching strategies that present problems, that get them to explore complexity as it relates to the scenario or situation... to think about the theory as it relates to the practice'. The teaching methods intend to provide context of the material and assessments for students so that students can understand the links and how they connect personally and professionally with sustainability therefore supporting praxis-orientated learning linking theory and experience. The teacher commented that the students 'respond to case studies that show them their responsibilities... that then shows how the theory is... related to them so it doesn't become airy-fairy stuff.' This real issues orientation also provides students with 'life experiences' that they may not have experienced yet:

The learning and teaching activities need to give [specifically younger] students different life experiences 'by putting themselves in someone else's shoes... providing them with life experiences or understanding the issues in life, without have lived a life.

### **Positive student-teacher relationship**

The role of the teacher was observed to be like educator as partner where the teacher explicitly stated they did not have all the answers so therefore they were part of the learning community with the students. A trusting relationship appeared to be built between students and teacher through much positive and nurturing support from the teacher in terms of feedback and assistance. According to the teacher:

I think [the students] value it when I listen because I tend to get a lot of students asking me for help with other subjects or other staff, so I think they find it beneficial to have someone they feel is open and that they can trust.

There appeared to be a relaxed and friendly relationship built between the teacher and students. The teacher felt that trusting relationships was fundamental to addressing the L&T challenges associated with EfS and PBL activities therefore fostering positive learner-

educator relationships. The level of engagement from the teacher with the students and their learning needs is also key to a positive learning experience for the students. ‘Part of the learning process is creating an environment where [students] trust you so that when you do ask them to take a risk they are willing to do so’. Expressing passion for course content was also important for engaging students in the learning according to the teacher:

...they respond well to my level of passion and commitment. I get a lot of students say, this is the stuff you really believe in isn't it? I think whether they agree with the material or not, they respond to a level of passion and belief from those people delivering it.

### **Reflective teaching practice**

The teacher commented that reflective and reflexive teaching practice underpin their L&T approach so therefore L&T is viewed as an ongoing reflexive process:

...central for me is about having [EfS] practitioners that are able to recognise their own pedagogies, their own way of thinking and reflecting and then translating those thoughts into practice that then go through an action-reflection cycle. So you have got an understanding of how you teach, what you teach, why you teach it, you then ensure that those philosophies or those ideals are then reflected in your learning and teaching methods and the way in which you construct your curriculum.

Teaching strategies are employed and the success of these are reflected upon using student feedback and teaching experience. ‘I constantly seek feedback from them around whether or not the methods in class are working. ... I will always change things if I don't think it worked by reflecting on my own practice.’ Changes are made to practice where needed and the ‘action-reflection’ cycle is undertaken again.

### ***How effective are these practices for learning for sustainability according to students?***

Based on the interview and observational data, the approach taken by the teacher is what the teacher feels best supported learning for sustainability. This approach is in line with theory which advocated the majority of the practices undertaken in the course.

A stand-out result from this case study is the overwhelming positive feedback about the teaching approach from the student participants. It is clear that all student survey respondents found the approach to teaching very important for their learning. Based on qualitative survey responses the respondents found the student-teacher relationship to be positive and supportive of their learning linking with the theory of good practice EfS which advocates positive

student-teacher relationships. For example, when asked about whether the student teacher relationship helped or hindered learning, some survey respondents made the following comments:

- [The student-teacher relationship helped], if the teacher had just stood up the front and talked, I would have been extremely bored. The teacher was very personable which made it a comfortable environment to ask question and interact
- [The student-teacher relationship] motivates me to create a more sustainability life and helps me to understand what is sustainability
- ...You could confidently ask and answer questions so you could take some responsibility for your learning
- This relationship was extremely helpful as I did not feel strange about approaching [the teacher] with issues...
- [The student-teacher relationship] harbored a further interest within the subject.
- [The student-teacher relationship] helped because the students knew they would be able to engage with the teacher to learn more and ask questions

The teaching style was described in four responses that commented on the teacher's passion and enthusiasm for the material and subject helping their engagement and also the teacher's knowledge and presentation style. For example 'the tutorials because [the teacher] was passionate about their material and made it engaging.' See Appendix 2.4 Case Study One survey respondents' perspectives on the teaching approach, for more supporting qualitative comments.

The focus group participants were also positive about the teaching approach. Based on participants' feedback, the students found the student-teacher relationship to be positive and supportive of their learning:

- The personal relationship you build with [the teacher] makes you want to do better because you don't want to let [them] down for all the help [they] give you.
- [They are] very passionate and believes in [their] work and [they] motivates because of that.
- [They] always helped spend time with you to get over hurdles.

The teacher was also said to be open to student ideas and gave the participants space in the course to make their own meaning in their understandings and application of sustainability according to focus group participants. For example, '[The teacher] encourages you to come up with your definition of every concept. The teacher stresses that the teacher wants you to

come up with your own' and, 'As long as you can justify your answers, [The teacher] is very open to people giving different answers and respects them as well.' Focus group participants also felt that student opinions were not judged by the teacher: '[the teacher] always states that [they are] open to opinion. You need to develop your own definitions...' The student research participants felt that the learner-centred approach in this regard was important and these factors made for a very positive student-teacher relationship and learning experience.

Praxis-orientated learning was also viewed as useful for learning by the survey and focus group results with these students valuing being able to put their own ideas and personal experience into their course work or that the work related back to their personal context and learning which they found engaging:

- Having a real life assignment was good. It made it easier to grasp the concepts. You could get information on the net about it. It felt like it had purpose. It wasn't make believe.
- You had a sense of ownership because it's happening in your local area and you wanted to make sure you did the right thing by it.

Case studies and real life examples made some respondents realise the importance of the learning in and about the course and subject. One respondent commented that the guest speaker also did this. This preference for praxis-orientated learning from some of the respondents supports the theory of good practice EfS.

#### **4.2.3 Intended and perceived learning outcomes**

The following box summarises the intended and perceived learning outcomes based on the data collected.

##### **Summary of intended learning outcomes in Case Study One**

- Reflective skills
- Application of theory and evaluation skills
- Critical reflection/analysis
- Constructing arguments

- Group work skills
- Research skills
- Systems thinking
- Working with stakeholders
- Interdisciplinary skills
- Foresighted thinking/anticipatory thinking
- Dealing with complexity and uncertainty
- Higher cognitive level learning
- Values reflection and learning in the affective domain
- Sustainability literacy

### Summary of perceived learning outcomes by student participants in Case Study One

- Perceived learning outcomes differ in many ways from intended learning outcomes with participants describing generic academic skills rather than skills specifically related to sustainability found in the theory.
- Participants felt satisfied with their learning of how sustainability links with construction practice thus understanding professional relevance and application is a key learning outcome of the course.
- The relevance of sustainability both personally and professionally increased over the course with 100% of respondents feeling that sustainability was relevant professionally and 84.6% feeling that it was relevant personally after the course
- 66.7% of survey respondents felt their thinking had changed as a result of the course including new 'awareness', 'understanding', 'realisation' and widened perspectives.
- Almost all of the survey respondents (93%) felt satisfied with their knowledge of sustainable development as a result of the course and their learning about sustainability
- 51% of participants felt confidence applying sustainability in their future professional practice after completing the course.
- Little comment was made by participants that indicate 'deep learning' such as a change of values or personal transformation as a result of the course. This however could be related to participants' ability to reflect on 'deep learning', rather than the absence of this as a result of the course.

### ***Intended learning outcomes based on teacher interview and observational data***

The data show that the teacher viewed capabilities as a key learning outcome of EfS and included many learning outcomes found in the theory of good practice in their course. Capabilities described by the teacher included values reflection, critical reflection and sustainability literacy. High level cognitive learning was also indicated by the teacher through learners' intended analysis and application of theory. For example the key learning outcomes in the course according to the teacher include:

...being able to recognise assumptions, being able to be critical, being able to problem solve, being able to recognise systemic links, (the fact that there are lots of different stakeholders in any decision that we make and their different needs need to be understood outside the needs of the student or person making the decisions), and then being able to recognise the conflict and the negotiations that will have to come about in terms with dealing with any of these problems in real life.

The teacher continued:

Systems thinking, critical and reflective practice, problem solving, identifying your own assumptions, identifying other peoples assumptions, challenging the status quo and not just believing what you see... to me is what sustainability education is all about.

The learning objectives outlined in the course also feature some of the key learning outcomes advocated in the literature, however these are more generic skills like critical reflection, rather than development of systems thinking, although these generic skills support capabilities for sustainability found in the literature (see Case Study One course overview above).

Based on observation and what is stated in the course guide, the assessment pieces (which were all undertaken in workshop activities based on assessment) focused on skills development for sustainability. According to the course guide, the following key skills aimed to be developed through assessment, and data from observations provide the basis of the comments about the development of these skills in the course:

- ***Reflective skills*** – reflection about personal values and application of sustainability to personal and professional lives was required or prompted by the teacher through many activities and assessments, for example, the ecological footprint calculator, PBL, activities

around values and definitions of sustainability in the early weeks, and video activity ‘slumming it up’.

- ***Application of theory and evaluation skills*** – Students were regularly asked in workshops over the semester to take theory that had been covered in the weekly content, apply it to a scenario, and then evaluate the application based on different principles of sustainability. For example in the main PBL assessment students applied theory every week to their scenario/case study and were asked to revise their application and theory again in light of new ideas and concepts that emerged over the course, for example how the concept of human capital affects the environmental concepts already applied to the site design.
- ***Critical reflection/analysis*** – through the application of theory and evaluation above students also could develop critical reflection skills.
- ***Constructing arguments*** – students were given the opportunity to develop these skills through the article assessment pieces and through the practice of continually being prompted to write down or discuss their rationale for decisions about sustainability in practice.
- ***Group work skills*** – the majority of activities observed were group work based.
- ***Research*** – students were required to undertake some of their own research particularly the ecological footprint report which required them to collect data.

Specific skills for sustainability outlined in the literature had the potential for being developed through various activities and assessments. The following describes how these may have developed:

Systems thinking skills may have been developed through the application of long-term thinking and triple bottom line methods of analysis required in the scenario based activities. The ecological footprint report also prompted students to make connections between issues like climate change and global poverty to their own life style and consumption patterns, encouraging a systems perspective.

Through identification of stakeholders as a requirement of the PBL activity students touched on the need to work with stakeholders. Interdisciplinary skills may have been developed through the group work components of activities with the make up of groups from the three different degree programs and also the major assessment that drew on feedback from planning students.

Foresighted thinking/anticipatory thinking may have been developed through the focus on future use of development. Futures thinking is implicit in sustainable design in future build projects.

To some extent the capability of dealing with complexity and uncertainty was developed through the scenario and how to build sustainability while meeting stakeholder needs for a new development. Evaluating and balancing needs were part of the major assessment and students actively debated how to balance competing needs in their developments in workshop time observed.

In terms of cognitive development, higher level learning was intended in the tasks which required students to go beyond knowledge and comprehension to apply that knowledge in their main assessments. They were also required to analyse the best approach to environmentally sustainable design (ESD) in their development based on the options available and make judgments about the best way to achieve ESD in their development proposals and were constantly asked (mostly as a large class) to justify their views or values which requires a level of synthesis and reasoning skills.

The role of values were made explicit with the teacher modelling the way their values shaped how the teacher understood sustainability regularly based on observation. The foundational activities on worldviews and definitions of sustainability in the early weeks of the course also set the context for sustainability as a values based exploration (see Appendix 2.3 Case Study One observation results). The teacher also made clear to the students that guest speakers were intended to provide a different view of sustainability in the built environment and prioritized different values to the teacher.

Affective learning was aimed to occur through this values reflection, and making value judgments in projects specifically through the PBL project. For example, the ecological footprint assessment supported development in the affective domain through reflection on the



role that the self and values play in consumption processes and how this affects the world around us. Students are asked to make values judgments when applying sustainability concepts in their PBL activity and reflect on why they made the choices they did.

Overall sustainability literacy was developed through the content and activities that not only showed students case studies on the need for change but required them to move through many small and large scenarios to explore rationales for change, approaches to change and implement changes in line with sustainability.

***How effective are these practices for learning for sustainability: Perceived learning outcomes according to students***

The teaching approach and learning outcomes that were described based on teacher interviews and observational data indicate a close alignment with the characteristics of good practice EfS in the theory. However learning outcomes perceived by students differ in many ways from the theory with many learning outcomes found in the literature on good practice not described or indicated by survey or focus group results.

Overall, students were satisfied with the course and were happy with their learning about sustainability. Based on the results, the course achieved elements of good practice EfS according to the theory including situating sustainability in the professional context thus showing relevance of sustainability to learners and changing respondents thinking.

Less mentioned by participants however, were learning outcomes related to skills for sustainability or changing of values. The majority of qualitative survey feedback related to greater understanding and awareness of sustainability and issues from the course, rather than mention of transformation of personal values or development of capabilities/skills for sustainability. The qualitative comments imply a level of sustainability literacy was gained in regards to understanding the rationale for change according to the perceptions of the students.

**Perceived changes in thinking and knowledge as a result of the course**

Based on the focus group results, the course did have a big impact on participants' understanding and perceived relevance of sustainability. The language used by students to describe their change in thinking as a result of the subject shows that they feel they have a broader outlook on their profession and sustainability as a result of the course. Two-thirds of

survey respondents felt their thinking had changed as a result of the course<sup>8</sup>, however again this related to ‘awareness’, ‘understanding’ and ‘realisation’, rather than transformation of the way they think, suggesting comprehension of sustainability and related concepts.

Almost all of the survey respondents (93%) felt satisfied with their knowledge of sustainable development as a result of the course and their learning about sustainability. Focus group comments suggest that participants’ thinking had changed through widened perspectives, giving students ideas on how to incorporate sustainability into their professional practice, and showing that sustainability is achievable. For example:

- It gives you a different perspective and understanding of looking at [the profession] rather than a capitalist approach which I would usually take
- It has definitely brought a lot of new ways of thinking. Especially eco footprint and how high my footprint was and it was something I never thought about before. But it certainly makes you look at the world differently and think of the future...
- Before this [course] I had this perception that sustainability is just being green, but after this course I have an idea that sustainability encompasses social capital and human capital and many other capitals than just being green. So it has widened my perspectives.
- The course hasn’t bogged you down with negative figures, doom and gloom. There can be a positive direction. It hasn’t been overwhelming and it has been reachable and attainable.

Results here suggest that learning *about* sustainability or comprehension (cognitive domain) and a level of sustainability literacy in terms of understanding a rationale for change were the main learning outcomes from the course based on participant’s perspectives. Descriptions of learning in the affective domain for deep personal transformation (values and worldviews) and also skills/capabilities development) advocated in the theory of good practice EfS were fewer in the results. This however could be a result of respondents’ ability to reflect on or awareness of their learning beyond comprehension (development of skills, values, practices), rather than the absence of their development in the course.

Only one survey respondent mentioned an activity about values in all the data collected from the surveys. The absence of qualitative comments from respondents about values or values

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<sup>8</sup> It is important to note that some respondents had previously stated that they already understood sustainability and felt it was relevant before beginning the course

based activities is interesting given the explicit mention of values throughout the course activities and assessments (based on observation and teacher interview data).

### **Perceived skills development**

Student participants' reflection on skills development in the survey further supports this analysis with many respondents noting learning of content/knowledge gained in response to a question about skills development, rather than skills (*frequency in brackets*):

#### *Academic skills*

- Writing (5)
- Communication (4)
- Article analysis (4)
- Research (2)
- Team work (2)
- Reading (1)
- Referencing (1)

#### *Knowledge*

- Sustainability (4)
- Environment (3)
- Environmentally Sustainable Design (2)
- Social & community sustainability (2)
- Regulations (2)
- Economics (1)
- Town planning (1)
- Awareness of issues (1)
- Sustainable technology (1)

This indicates that many respondents may not understand the difference between skills and knowledge. Academic skills were mostly mentioned by research participants, while skills that related to those outlines in the theory of good practice EfS were far less mentioned by student participants. Skills that related to those in the theory that were mentioned included (frequency in brackets):

- Skills in the implementation of sustainability into construction (4)
- Proactive thinking (1)
- Working with 'the complexity of peoples different needs... balanc[ing]... competing interests and views of stakeholders (1)
- Looking for alternatives (1)

So, from the data, either students were not aware or able to reflect on the skills for sustainability they had developed during the course, or they did not feel they had developed sustainability skills as a result of the course. This was also seen in the focus group when students were asked about skills they felt they developed. Only two participants mentioned skills related specifically to sustainability for example 'looking at new options, not just following the traditional, looking for alternative ways to save energy and money' and working with 'the complexity of peoples' different needs when it comes to construction. Trying to find

a balance between competing interests and views of stakeholders'. Generic skills such as writing skills were mentioned by some participants. This again may indicate a difficulty in reflecting on skills or unawareness of sustainability specific skills that the course aims to foster.

Just over half of survey respondents felt confident in applying sustainability in their future professional practice which links to the above results regarding little mention of skills related specifically to sustainability. Results show that research participants see relevance and how sustainability applies to their profession, yet feel less confident applying sustainability in their future professional practice. This could be largely due to the fact that reflection on skills is a skill in itself. Perhaps this could be better developed through the course so students understand the 'tools' they hold personally to make changes in their profession. This could also build confidence in applying skills for sustainability in professional practice.

#### **Perceived relevance and value of the course**

In terms of relevance and value of the course, a majority of survey respondents felt the course was relevant to their profession and there was consensus among the focus group that the course was relevant and valuable. The relevance of sustainability both personally and professionally increased over the course with 100% of respondents feeling that sustainability was relevant professionally and 84.6% feeling that it was relevant personally after the course.

#### **4.2.4 Learning and teaching activities**

The following box summarises the learning activities used and the student experience of these based on the data collected.

##### **Summary of course activities to facilitate learning for sustainability in Case Study One**

- Future-focused visioning projects (primarily the FBD report)
- Problem based learning (FBD report)
- Case studies (related theory and practice using videos or images)
- Concept mapping of opportunities for industry change

- Working in groups
- Group and class discussions (in almost all activities observed)
- Reflection built into activities
- Critical reading and writing (primarily in the first assessment)

### Student research participants' perspectives on effective activities for learning for sustainability in Case Study One

- Activities participants felt helped them to understand application of theory and different perspectives and also motivate them to make changes include:
  - Videos
  - Class discussions
  - Guest speakers
  - Assessments (ecological footprint and FBD reports)
- Activities that respondents found engaging were mixed with a number of participants that found learning about capitals engaging, and less participants commenting on learner-centred activities outlined in the box above.
- Student participants mostly focused on activities which support learning *about* sustainability rather than activities that develop capabilities for sustainability such as the processes in the problem base learning FBD report.

#### ***How effective are these practices for learning for sustainability according to students?***

The L&T activities that some student research participants felt were important for their learning about sustainability in the course were those that they felt helped them see the application of theory, see different perspectives and also motivated them to make changes or think over/analyse concepts. Some of the given reasons for these preferences were seeing application of theory, seeing different perspectives and also motivating a respondent to make changes or thinking over concepts. So, based on these results, the kinds of thinking the teacher intended with these activities such as application of theory, motivation for change and seeing different perspectives has helped students learn. The activities that trigger this according to these participants included:

Videos:

- Definitely the day [the teacher] shown us the video of the people who live in such unacceptable environment. That moment really struck me ... and made me realise how important this is.
- Seeing the videos which showed sustainability in practice.
- Watching videos was also great as it provides alternative viewpoints on topics.

#### Class discussions:

- Group brainstorming allowed you to expand your thinking on issues’.
- Having group discussions and listing peoples values on the board helped to gain a snap shot of the groups current overall standing.

#### Guest speakers:

- [The guest speakers] put the concepts [of sustainability] in practice.

#### Assessments (ecological footprint and FBD reports):

- [The feedback from planning students] outlined things to consider which I never thought of.
- [The ecological footprint report] taught me how everyday routines can negatively impact society. Once doing that, everything in managing sustainability kind of "clicked".

In terms of engaging tasks many respondents felt that learning about ‘the sustainability capitals’ was an engaging part of the course. One respondent felt that learning about the five capitals ‘showed how complex solving the environment crisis can be as its interlinked with all the other capitals.’ Activities that respondents found engaging were mixed. Eight qualitative responses found learning about capitals engaging, for example ‘learning about the five capitals and how they integrated together and how they impact society was quite fascinating’, with less responses commenting on learner-centred activities. Three students found the problem based FBD report engaging and some students commented on the activities that allowed them to apply knowledge or relate back to personal contexts, however overall there was no clear trend in responses. For example:

- The ecological footprint assignment was fantastic as it brought the sustainability agenda into a personal context.
- In depth analysis of the issues revolving around the fisherman's bend project [was most engaging].
- I like [the FBD report] cause I notice people have different leaning styles. Visual, aural, Kinaesthetic- Learn by doing. [the teacher] is quite good at blending all those things. With a map and groups work caters to everyone’s strengths.

Focus group participants felt that although the FBD report was large, there was value in it due to the way it was designed including the map component, as it catered to different learning needs. Participants liked the ‘real life’ aspect of the assessment which supports theory of good practice EfS. The teacher also found that students engaged most with the FBD report:

They really engage because of the [the FBD report]. Because they have been given a problem and the theory is then related to the problem with a set of questions, they totally engage with it. Because they either have to but also because they are being asked to take the theory and put it in their own perspective....

While activities that triggered a conscious change in thinking or learning or a ‘light bulb’ moment were described as learning of facts about sustainability issues or application of sustainability theory including learning about the capitals, or from watching videos and through doing the ecological footprint report (see Appendix 2.5 Case Study One survey respondents’ ‘light bulb’ moments).

From these results we can see some alignment between what students felt helped their learning for sustainability and what is advocated in good practice EfS according to the theory. Problem based learning (in the form of FBD report) and case studies (described by participants mostly as related to the videos) were mentioned, with videos being one of the most common responses for helping learning about sustainability and showing relevance and application of sustainability in professional practice. Group discussions were also mentioned as important for learning and specifically for seeing different views.

Interestingly, out of the data from the student survey and focus group, only one survey respondent mentioned an activity about values in all the data collected from the surveys. The emphasis on supporting values reflection through L&T activities and assessment was stressed by the teacher. The absence of qualitative comments from respondents about changes in values or values based activities is interesting given the explicit mention of values throughout the course activities and assessments (based on observation and teacher interview data).

To some extent student participants mostly focused on activities which support learning about sustainability and its applications rather than those activities that develop skills or capabilities for sustainability such as the processes in the problem-based learning FBD report or article analysis for example. Information, facts or content generally helped student participants

change their thinking or present a rationale for change while assessments were good for applying theory for some participants. Videos and guest speakers presented different views and helped participants see professional applications. So the combination of delivering facts and information about sustainability through engaging mediums such as videos and guest speakers was important for learning about sustainability and its applications in practice. Applying theory in assessments and developing skills for sustainability were less mentioned. However, what this shows is that both learning *about* sustainability and learning *for* sustainability (capabilities for professional application of theory and change), are important learning for students, which is in line with theory of good practice EfS.

#### **4.2.5 L&T challenges described by teacher and student participants**

Challenges discussed by the teacher and students differed in this case study. What is challenging for teaching is different to what is challenging for learning. However, there was cross-over when it came to the FBD report.

According to the teacher, the main challenge teaching the course is student resistance to sustainability content and to the PBL *process* in the FBD report. For example in the case of the PBL FBD report:

...there's always a level of frustration or rejection in the PBL process. And this is where I think it's good that we've got a level of trust. [I say] 'just go with it, do you trust me? I'll get you through this, you know I'll get you through it and you know I'll give you whatever you need to get through it. I guess there must be a level of trust there because they all just go with it.

High levels of teacher engagement with students according to the teacher help address this resistance, including openly showing their passion for the subject when delivering material and discussing the assessments, continuous teacher engagement with students, fostering a trustful student-teacher relationship and creating a safe learning environment. This shows that for the teacher, despite the challenges they faced in delivering the course, the concept of fostering a positive educator-learner relationship as advocated in the theory of good practice EfS is important for addressing these challenges. Taking this teaching approach however is something that the teacher also found to be challenging:

Doing assessment in class that requires skill development is exhausting--emotionally exhausting, physically exhausting. Putting yourself out there and trying to educate in areas



that you know they fundamentally disagree with like environmental concepts can be exhausting... large classes using student-centred models nearly kills me.

Student research participants felt little confusion during the course and felt that overall the course was clear. The challenges that students did experience were indicated to be overcome during the course, for example:

- I found that article reviews challenging at first, but after getting one on one help they became easy to complete.
- The only thing that was a little bit hard was the group communication at home but we overcame this by using the Wiki and making a facebook group.
- The task 3 Fishermens Bend project was quite challenging, but the lectures on the 5 capitals and the workshops helped a great deal.

Some participants in the survey and focus groups mentioned aspects of the course that they found challenging specifically in regards to the scale and complexity of the FBD report, which some participants commented that is difficult for first year students. For example:

- Understanding the scope of [the FBD report]: Mapping the site was just such a big task that it took a long time just to work out how we were going to go about it.
- The project was too big when we have other subjects to do [other student's agreed]. [the teacher] does give us lots of class time to do it all but designing a whole new suburb is a big task and I think a lot of people didn't know when to stop. How much detail to go into.
- [FBD report is] probably more of a 2nd or 3rd year task...

Other participants felt that there was enough support for the task to make it a valuable learning experience. The structure of the course, specifically workshops, and the 'interactive' and 'supportive' teaching approach seemed integral to the positive learning process and based on focus group feedback, useful for overcoming challenges associated with the PBL process. This supports the theory of good practice EfS and the need for a positive student-teacher relationship as advocated in the theory.

Based on observations, the highly supportive teaching approach in response to the L&T challenges described by the teacher and student participants does mean that although the course features predominantly learner-centred activities, students need a lot of support in undertaking tasks, particularly the FBD report, in order to have a positive learning experience and to not reject activities or the assessments due to size and perceived complexity in the first

year of a degree program. Therefore the student learning is not wholly self-directed in the PBL assessment as advocated for good practice by Barth and Burandt (2010). Finding a middle-ground where students are supported enough to feel confident to make decisions and engage in the PBL appears to be what the teacher is aiming for in their approach.

#### 4.2.6 Case Study One Summary

Case Study One employed a learner-centred approach and featured future-focused visioning projects, PBL, case studies, concept mapping, working in groups, group and class discussions, reflection built into activities and critical reading and writing. The pedagogical approach overwhelming fostered student engagement and positive experience in the course. The pedagogical approach is in line with theory of good practice L&T in EfS therefore the data from student perspectives supports that this is good practice based on course engagement and overall positive experience felt by students. Students' comments related specifically to the learner-centred approach to L&T, the positive student-teacher relationship and the praxis-orientated learning as important for this positive learning experience. Some students also found the teaching approach helped them engage with the learning in the course.

Students found different L&T activities important for learning about sustainability, engagement in learning, and skills development:

- *Learning about sustainability:* Videos, class discussions, guest speakers, FBD report and Ecological Footprint report
- *Engagement in learning:* Learning about one or all of the 'five capitals', FBD report and Ecological Footprint report
- *Skills development:* Workshops, group work and discussion, and assessments

While student participants' rated experiences of the course in terms of engagement, relevance, significance of sustainability and satisfaction with learning of sustainability were high on completion of the course, less data exist about perceived skills development. Survey and focus group participants had little to say about skills they had developed and, with a few exceptions, referred mostly to general academic skills and knowledge gained when directly asked about skills, rather than the higher order academic skills or skills for sustainability advocated in the literature. The data provides

little insight on the perceived development of these skills, and provides only limited comments from students about these. Learning about values was only discussed by one respondent despite observational and interview data showing that the need to reflect on values is repeatedly emphasised by the teacher through activities and assessments.

Based on student data, the course appears to have been effective at helping students develop awareness of sustainability and how it embeds in professional practice, understanding of the key concepts such as the ‘five capitals’ and provided a rationale for change and proven relevance of sustainability. Half of respondents felt they had developed confidence to apply sustainability in future professional practice but confidence associated with skills developed was limited. So, while students understand the relevance and significance of sustainability, based on their responses they are less confident in describing skills and applying these to professional practice.

### Value of Case Study One for this research

This case study is an example of an EfS course that uses most of the practices advocated in the literature on good practice L&T for EfS. What is interesting about this case study for the purposes of this research is that it has a very large cohort of students (205) with one academic delivering workshops and lectures in a learner-centred manner. This example shows how good practice theory can be implemented in a large first year foundational course. This example situates sustainability in the professional context in every aspect of the course and aims to build capability through learner-centred activities. Assessment is embedded in the course activities and all content is linked with assessments so that there is a high level of integration between knowledge, capabilities, and application in professional context and therefore relevance of learning for students to their degree program with useful learning outcomes. The use of many varied L&T activities is also note-worthy. The high student satisfaction with learning and understanding of sustainability in the professional context affirms the success of the course. This case study also shows that learner-centred EfS can be delivered in large early degree cohorts with positive learning experiences and perceived learning outcomes from the learners. Specific skills for sustainability and learning outcomes related to values were not discussed by respondents, but are advocated in the literature so there are key parts of the

theory that could be further explored in further research of this case study.

## **4.3 Case Study Two results: Ecological Principles in Land-Use Planning**

### **4.3.1 Introduction**

This section presents a summary of the results from research undertaken on Case Study Two: Ecological Principles in Land-Use Planning. The section will help answer the research question *what does good practice L&T for sustainability look like* by presenting data collected on pedagogical approach, intended and perceived learning outcomes, and L&T activities used in the case study course. For each of these categories, observational and teacher interview data will firstly provide descriptive detail followed by student survey and focus group data which will show how these L&T approaches and methods were perceived by students and the learning experience and perceived learning outcomes of the students from these approaches. Theory of good practice L&T for EfS will be used to draw out and frame elements of L&T practice in the data. This theory is also supported and/or challenged by the empirical data presented in the results.

### **4.3.2 Pedagogical approach**

The following box summarises the pedagogical approach of Case Study Two and student experience of this approach based on the data collected.

## Summary of pedagogical approach in Case Study Two

- Learner-centred
- Multidisciplinary learning (through cross-disciplinary FBD response project and multidisciplinary make-up of the student cohort from two different degree programs).
- Role of values made explicit in L&T approach (values reflection and analysis of how values inform practice and worldviews a key element of many activities and discussions).
- Transformative (L&T activities to assist reflection on practice, challenge and explore learners' assumptions and values).
- Praxis and real issues orientation (through the use of many case studies and real life examples to situate theory in practice. Problem based learning also facilitated praxis-orientated learning).
- Positive student-teacher relationship aiming to foster trusting learning environment where students feel their contributions are valued.
- Problem orientated learning/Problem and inquiry based learning through the weekly scenario assessment activities.

## Summary of student research participant perspectives of pedagogical approach in Case Study Two

- The research participants valued the learner-centred approach to L&T. All student research participants felt the student-teacher relationship to be positive and valuable for their learning experience.
- The approach allowed for multiple definitions of sustainability indicating a constructivist philosophy where knowledge and meaning is created through learning experience in the course.
- Multi-disciplinary learning, praxis- and real issues-orientation and problem-orientated learning were all found to support learning and engagement by survey respondents.
- Self-directed learning was indicated by some participants when they described undertaking and completing assessments, while other participants felt guided and 'babied' in the course.
- Some students indicated they experienced deep learning in the course through changes in values and thinking, while others felt they had not changed but learned more about

themselves. Both these perspectives indicate that the course fostered deep learning.

- There was also indication that the course work allowed students to experience emotions similar to what they perceived to be in a real work environment according to one participant.
- ‘Learning through teaching’ and ‘authenticity in teaching’ are new concepts that emerged through the student data that can contribute to the theory of good practice L&T for sustainability

### *Course overview*

Case Study Two: Summary of course information	
(See Appendix 3.1 Case Study Two course overview)	
<b>Year level</b>	First year and second year core/compulsory for planning students and an elective for architecture students
<b>Course size</b>	68
<b>Duration</b>	12 weeks
<b>Course delivery method</b>	1 hour lecture and a 1.5 hour tutorial each week with approximately 30 students in each tutorial
<b>Learning objectives</b>	<p>The course guide outlines the following learning objectives for the course overall:</p> <ol style="list-style-type: none"> <li>1. An awareness of the ecological and natural capital foundation of planning and design decisions that shape the natural environment in Australia;</li> <li>2. Basic knowledge of the principles of ecology, environmental problems arising from the working of modern urban-industrial societies and the decoupling of natural capital from other/secondary kinds of capital, environmental research methods, environmental risk assessment and the broad social, economic and regulatory frameworks in which environmental problems are resolved;</li> <li>3. A range of professional skills related to the development, analysis and application of content and professional knowledge in multiple scenario-based learning exercises;</li> <li>4. Research and critical analysis skills, including independent academic and professional research, critical reading and</li> </ol>

	<p>revision, multi-setting writing, academic debate, development of lines of argument supported by appropriate references, and</p> <p>5. Skills in professional engagement, collaboration and multidisciplinary team work within the built environment context.</p>
<b>Assessment</b>	<ol style="list-style-type: none"> <li>1. A workbook, including five scenario responses that are work shopped in groups during class time and a glossary of concepts related to the course content (worth 30%)</li> <li>2. The Fishermen’s Bend Development Application Response (FBD Response) (worth 30%)</li> <li>3. An end-of-semester scenario based learning test in class (worth 40%)</li> </ol>
<b>Relationship of the course to students' experiences of sustainability and L&amp;T approaches in other courses in their program</b>	<p>Students come into this course with some knowledge of sustainability gained through either a dedicated sustainability course in their first year for single degree students or integrated through design subjects for landscape architecture students. Students have also experienced a range of L&amp;T approaches from learner-centred to teacher-centred in their programs. Note that this case study is not a ‘sustainability course’, rather a planning course with sustainability principles and values embedded as part of professional practice.</p>
<b>Research methods</b>	<p>See Appendix 3.2 Case Study Two specific research methods</p>

***Description of pedagogical approach based on teacher interview and observational data***

Based on interview and observational results, Case Study Two was a learner-centred course that features many of the L&T approaches and some activities advocated in the theory of good practice EfS found in the literature.

**Learner-centred**

Based on observational data the L&T activities used and teaching approach embody learner-centred practice. In many workshops observed, the teacher draws on students' own knowledge to provide real life examples of the theory or ideas in practice by linking student experience with theory. While there is a lot of teacher guidance and prompting using questions to keep



students to the topic in class discussions, knowledge that arises from the class comes very much from the students' own critical and creative thinking about the scenarios and applications brainstormed together as a class or in groups.

The teacher emphasised their learner-centred approach, which for the teacher was about relating to where the students are at and facilitating learners' own exploration of values and reflection on their understandings and skills they feel they need for sustainability in practice. For example:

[The course is] about ourselves as beings and how our values, our belief systems, our choices manifest in terms of impact on the natural world and the implications of that for everything else... it's all about meaning. It's all about self-reflection and understanding yourselves and being able to really know who you are and what you need because until you do, I don't think you can really be sure that you are accountable and responsible in practice.

The teacher used the language of 'tapping into professional [students] expertise' to develop learning, implying they view the students as already having the expertise and their learning is based on drawing on this existing expertise, in line with learner-centred approach to L&T. Consideration of 'who the students are' is emphasised by the teacher:

...If you are learner-centred... a big component of what you do will relate to who the students are you can't be learner-centred any other way... the lived multi-dimensions of the course can't occur until you know who your cohort is. And that can mean you have to really reframe or tweak things...

The teacher commented that some cohorts need a lot of support to build confidence in tackling the PBL activities and understand their views are valued while other cohorts can get on with undertaking the problem based activities on their own with little positive encouragement and support. Taking risks is part of the learning process in EfS according to the teacher, therefore they see it necessary to create a space where students are comfortable taking risks, which then instils in learners a desire for learning because they are supported.

If people who are in a vulnerable place of learning are entrusted to you then that trust becomes sacrosanct.

It became about me thinking about how can I assist students... to be effective, to feel empowered that they could bring that more abstract vision of sustainability to fruition.

There's almost a non-verbal communication that there isn't anything you can say that will shock or anger me. I'll accept what you say because I've asked you to say it.

It should be noted that end-of-semester test and the glossary defining concepts assessments, could indicate a divergence from participatory, learner-centred approach to individual rote memorisation in the course. However, for the glossary, students are asked to define the concepts based on their own perspectives and choose concepts that are important for informing their thinking in applying sustainability. So provided students can justify their definitions with evidence, they are able to develop their own critical interpretations of the content presented in lectures to develop their definition of sustainability concepts. The test involves a repeat of the weekly PBL scenario where students are asked to respond to a problem. In addition to applying theory to explore and respond to the problem, students are also asked in the test to reflect on the problem response process they undertook and the skills and learning that arose from the process. So therefore, while this is an individual end-of-semester 'test', students are creating responses and justifying their responses through application of theory and reasoning rather than repeating information. It is assessing *ability* rather than *recollection* of course content (see Appendix 3.1 Case Study Two course overview: Assessment overview).

### **Multi-disciplinary learning**

The opportunity for interdisciplinary learning arose with the FBD response where students had to give feedback to the construction students in Case Study One from their planning perspective. Students were made aware of the different disciplinary lens and how these can affect design ideas and what is considered sustainable. This was not face-to-face dialogue with the planning students, with feedback passed on through a written assessment.

Multidisciplinary practice is described by the teacher as part of what the course is about. The rationale for multidisciplinary practice is to understand and work within the political dimensions of professional practice to understand different perspectives:

A big part of the course then had to become multidisciplinary practice... they've got to be able to work with people around issues that are really hot political potatoes and that would be as much of the skill they need as the knowing that those sites are of high conservation values.

### **Role of values made explicit in L&T approach**

The role of values was explicitly mentioned and brought into activities through questions prompting students to reflect on values and how these inform their motivations for learning

and their understanding and assumptions around professional practice and sustainability. Based on the teacher's comments, the teacher is explicit about the role values play in both professional decision making and the L&T processes that are occurring in class. Accountability is emphasised by the teacher in their teaching practice and modelled to students to demonstrate that the teacher is accountable to stakeholders (learners, the school, and the communities in which the learners will be working in etc) and aims to show how the teacher's values play a role in recognising these accountabilities. For example the teacher tells their students that:

I'm accountable to you [the students], but I'm also accountable to other stakeholders and sometimes those accountabilities are contradictory because you might wish me to spoon feed you, but I can't, in conscience I have to be accountable to your employers, particularly the vulnerable communities who [your learning from the course] will impact.

...you tell them straight up what you're responsible for and why and what your responsibility is to them... my job is to design a curricular that meets all my stakeholders needs and to make sure [the learners] can excel at it.

### **Transformative**

Students were explicitly prompted to explore and analyse their own and others' assumptions and values inform practice and understanding. Through the teacher's constant feedback and guidance, students are forced to explore their own assumptions and how these play out in their scenario responses. In this sense students have many opportunities for transformation through reflection on values and assumptions. What stands out about the teacher's description of their understanding and delivery of sustainability education is the emphasis on the opportunity for teachers and students to learn about themselves. Learning in sustainability education is about '...deep capability, deep learning, [and] learning about yourself...' Therefore this construction of sustainability education sits within the transformative learning approach advocated by Sterling (2003).

### **Praxis and real issues orientation**

Newspaper articles and videos as well as the weekly scenarios helped situate learning in the real life context. Based on observations, all theory and content in the observed workshops and lectures was presented and analysed in the context of a real case study or problem. According to the teacher, 'theory is... something we can no longer teach, ever, in abstract'.

### **Positive student-teacher relationship**

The teacher provided extremely positive feedback repeatedly to students in all workshops observed. For example, the teacher emphasised how good the students' work had been in the course and commented that they took this as evidence that the students had chosen the right program to suit their values, interests and skills. This kind of positive feedback appeared to support a positive learning environment and student-teacher relationship.

The teacher described their approach as building trust with students and demonstrating to them that they are valued. The teacher emphasised building a safe learning environment and building trusting educator-student relationships as key to their approach which facilitates values exploration and reflection in the class activities. This is done mainly through what the teacher tells students. For example, allowing students space to respond in class discussions and waiting for student responses rather than talking students through activities or answering the questions for them. This sets the expectation for students to contribute their ideas rather than waiting for the 'right answer' from the teacher:

It's like they're forced to recognize that I believe they know and I'm just going to wait because I believe they know. And they almost want to honour that belief or maybe that belief is like the teacher really believes we so we must know.

The teacher feels that because they wait for students to respond (which can feel like a long silence at times), students then feel more confident talking because the expectation is set that the students do have something to contribute. Their responses are acknowledged and discussed by the teacher who wants students to feel empowered to contribute their ideas to the class.

### **Problem-orientated and inquiry-based learning**

Problem orientated learning is a feature of the course with the workbook assessment partly made up of responses to scenarios undertaken in groups in the workshops. Almost all workshops involved a scenario based problem response based activity where students were asked to use the content and themes from each week to help them understand and respond to the problems the teacher had developed:

[There is] a lot of scenario work because I want them to... think about those concepts (...not decoupling environment and economy, recognizing the role environment plays in everything, thinking about carrying capacity, thinking about biodiversity, water, energy in

every sort of subset of their decision making and recognizing that beliefs we previously held of our community have got us into this situation) in professional situations. More and more I do all of what I teach around little problem based, mini enquiry based [activities] because most of the student I'm teaching now are going to be practitioners.

### ***How effective are these practices for learning for sustainability according to students?***

#### **Learner-centred**

It is clear that a learner-centred approach was taken by the teacher based on survey and focus group data. Both survey and focus group participants felt the teaching approach to support their learning which was repeatedly expressed in various ways created a positive learning experience. Survey respondents felt they were valued and commented that the student-teacher relationship was personal, rather than only being seen as 'students'. For example:

- [The teacher] is rare in that the teacher remembers your name and speaks to you as a person, rather than another student. This provides you with conversations that feel as though they come from a well progressed peer, rather than someone who just marks your work.
- [The teacher] is enthusiastic and pushed me to do my abest work. [They] got to know me as a person and I think having an equal based relationship allowed me to feel more comfortable.
- The Teacher was fantastic and very engaging with the class. Furthermore the teacher gave enthusiasm to students to complete work and discuss ecological issues as a group.
- The teacher did very well in relating to the level (both intellectually and socially) we were at... The enthusiasm and motivation of the teacher helped us as students get through class and even learn along the way... The teacher was extremely interested in how we learned, always offering to take drafts, always offering assistance when needed via email, in person etc. This approachable approach was much appreciated... [The teacher] was very fair in marking people according to their capabilities and ability to demonstrate what they have learned and how they express it... One of the best examples is the test. [They] allowed students to write in dot points, mind maps, diagrams, paragraphs etc. This appreciates that different people learn and "work" differently.

Focus group participants' comments indicate that the course was informed by a constructivist philosophy where students were given the opportunity to apply their own understandings to the concept of sustainability, with more than one meaning of sustainability and that meaning is created through learning. For example:

- There's more than one idea about what sustainability is. You can bring in a more personal idea of what you think sustainability is. I have felt that I can put my strengths into this subject...
- You can produce what you like as long as you can defend it.

### **Self-directed learning**

The data indicate that the teaching approach was learner-centred, however not solely independent. For example, one survey respondent commented that they were supported by the teacher and guided to the answers, for example 'It helped my learning as i was able to communicate confidently with the teacher without having fears of being shutdown or told to find out the answer myself. I was guided to the answer'. While one focus group participant said that students were 'babied' in the course, for example, 'I feel like the teacher babies us in a completely different way... Other teachers baby you and make you feel like an idiot but the teacher's nurturing and positive.' Despite this, self-directed learning was described and indicated in a number of focus group participants. It appears that focus group participants felt the learning in the assessments was 'self-guided' because they were given the space to explore the problems and concepts on their own, apply their own meanings, and respond to problems in their own ways. This was described as challenging by some respondents. However one participant said 'We've challenged ourselves. The more you challenge yourself the more you get out of it. It's not about teachers having to do it for us.' So while some students felt very guided and supported in their learning, they were also given the space to challenge themselves through self-guided assessment processes.

### **Multidisciplinary approach**

Overall, the multidisciplinary group work and FBD response assessment work was not commented on by survey respondents. Focus group participants did comment on the value of the multidisciplinary approach to assessment however. The value of this approach was indicated a number of times through focus group participants' comments about learning how to communicate with a different discipline and learning about how different disciplines approach and understand problems. For example, 'being able to understand where people are coming from and being able to adapt is important'. The FBD response was described by one participant as 'learning through teaching'. This participant found 'trying to effectively communicate what we know to people who have no idea of the concepts.' valuable. Another participant stated that you 'learn the skills to encourage', which indicates that the assessment develops ability to work constructively with others and also take a leadership role. While

another participant felt they took on a teaching role to communicate their knowledge from their degree to first year construction students in Case Study One with limited knowledge of sustainability:

- ...there was one side of figuring out what they were trying to do. But for me the biggest value in it was recognising that that they are limited and being able to distil what I knew in the simplest possible form [so that the first year construction students can] access and use it based on their limited abilities.

### **Supports deep learning for personal transformation of understanding, values and practices**

The survey data indicate that the course supported learning for deep transformation for a number of respondents who expressed a change in values such as one student who stated that the learning from the course ‘shaped my values and outlook on everything’. Other survey respondents made the following comments:

- Absolutely, through acquiring new concepts.
- I have a better appreciation for how our decisions today affect the future.
- Its taught myself to think in a more innovative manner and then work backwards from there, rather than constrain yourself from the outset by current notions or limits.
- It has made me deeply think and understand thoughts that were constantly in the back of my mind and has allowed me to further develop these into understandings that can be used throughout the rest of my career.
- Because I have been introduced to alot more ecological concepts, I will utilise these concepts for future reference when dealing with the rest of my course and professional life.

Another student explained that seeing with a sustainability framework, applying concepts in an interconnected way, became ‘second nature’ as a consequence of the course. Some focus group participants also commented that they learned to reflect on values and how values affect practice which indicates that the course helped make the role of values in practice explicit. However, some focus group participants also commented that they did not experience a change in values as a result of the course, just the skills in reflection and analysis of their values so that they understand themselves more. For example:

- It hasn’t changed the way I think. But make me explore the way or how I think and my ideas. Being more critical about how I’m thinking.

- I've had these values in myself and now they have a proper name and a theory to go with them. More visible.

### **Praxis-orientated learning linking theory and experience**

The survey data indicate that students undertook many praxis-orientated learning activities and that content was also situated in professional practice. This is demonstrated by survey comments that overall all assessments and content areas helped them see links between professional practice and theory. They also made many qualitative comments that implied learning about how theory can inform practice. For example, '[The course] has allowed me to find a greater sense of understanding between achieving possible future outcomes in our career and how we can bridge the gap between future and current initiatives'. This was supported by another student who stated the scenarios helped them see 'what influences our decision making'. Many comments from participants were related to learning by doing, skills development or learning for practice which indicates that the course focused on learning for sustainability. For example, 'the assessment structure is not focussed on a discreet set of knowledge. It's focussed on skills and processes. I like it.' This is further supported by another participant that stated, 'we don't have an exam to cram knowledge... We are learning skills to use in the future'. Participants' comments about learning experiences and outcomes were very much focused on abilities and experiences, rather than comprehension related learning outcomes like understanding and awareness of sustainability. For example, 'whatever you're doing can be great. When there is a fixed knowledge based you are always trying to hit a target...' This implies that the course focused on the learning *process* rather than a fixed learning outcome (or 'target'), which indicates learning from doing.

### **Real issues orientation**

Following from praxis-orientated learning, a number of survey respondents commented on how the course made sustainability real for them by linking with real issues which was primarily theory FBD response and the weekly scenarios. For example, 'strong links were drawn between theory and real situations' and, 'its real world stuff, which makes it more approachable.' Another focus group participant commented that 'through indentifying concepts and through the scenarios we are forced to see how the concepts apply and influence decision making'. So the learning activities 'force' students to see application of theory through their engagement in the practice of learning in the scenarios. Based on the comments, a real issues orientation was an important motivator for some students, for example:



- The scenario based learning gives an insight into real life situations occurring in Melbourne and gave a good opportunity to discuss with other people in different professions on how they would respond to these scenarios.
- The site plan analysis was the most engaging section of the course as a whole. It really tapped into my broader interest in sustainable development and afforded the opportunity to work on my critique skills.
- The Fisherman's Bend assignment [was the most engaging part of the course]. This was because it is what Urban Planners do when they graduate and work in the field. They look at proposals put forward and criticize it and also find what is good about it. It also allowed me to re-affirm the skills I learnt in the course by applying it to those student's maps.

One student made a connection between their emotional experiences of the course and what they would experience in professional practice. 'I have experienced the emotions one may feel when working in a similar environment, especially during group work.' This indicates that for this participant the course emulated real work environments and allowed them to be aware of the emotions that working collectively can bring about.

### **Educator as partner and positive student-teacher relationship**

It is clear from the survey data that a positive student-teacher relationship was fostered through the teaching approach. All the respondents expressed positive views of the teacher and their approach to engaging with students. They also made comments that indicated that respondents felt that the teacher was a partner, for example 'a well-progressed peer' and that there was an 'equal relationship' and that the teacher related to students intellectually and socially. Responses indicate that this built an environment where they felt supported to be innovative, confident in trying things out, communicating and being valued without feeling like they would be judged on being wrong. Additionally the level of engagement and passion the teacher showed engaged and motivated some students:

- learning from someone so passionate can make you passionate.
- The interactive relationship meant we could test things out etc. without the worry about getting it wrong for a marked task
- [the teacher's] feedback is personal and allows you to develop a specific understanding of what is working and what isn't in terms of your work progress.
- As [the teacher] was so welcoming and willing, asking for help was very easy.
- [the student-teacher relationship] helped because I was made to feel like my opinion mattered and was considered and valued.
- [the student-teacher relationship] helped build enthusiasm

- the enthusiasm [the teacher] gave for the course gave other students and myself the same enthusiasm

All focus group participants found the teaching approach positive and supportive of their learning also. Based on the participants' comments the student teacher relationship was positive and personal. The teacher was seen as a partner in the learning process, which was indicated especially through one student who observed that there was no hierarchy between the teacher and the students, '[The teacher] values what you have to say as well. It's not the typical student-teacher hierarchy.' Participants commented that '[the teacher] speaks to you on a human level' Another student described the teaching approach as 'honest' implying they felt the teaching approach to be authentic, that is the teacher was honest about their L&T practice, for example, '[The teacher is] straight forward, approachable, knows who you are, learns your name quickly. The students felt this teaching approach made them feel valued and that very positive feedback from the teacher boosted their confidence, '[The teacher is] really, really positive.. makes a point of really boosting your confidence' which 'leads on to more input from everybody'. For some participants, because of the personal approach taken by the teacher, 'you want to do your work' and 'you'd feel like you would let [the teacher] down if you didn't do your best'. This can be seen as important for tackling unfamiliar tasks like PBL processes.

### New concepts related to the L&T approach from results not currently found in literature<sup>9</sup>

- ***Learning through teaching:*** This was used to describe the FBD response where some participants felt they took on a teaching or mentoring role for the construction students when providing feedback on their work. Participants described a number of learning benefits from this approach related to communicating with other disciplines and also with people with little or no previous knowledge of sustainability. Aside from developing interdisciplinary communication skills which are described in the literature of EfS, learning about how to communicate about sustainability with people who are yet to learn about the ideas and concepts of sustainability could be

<sup>9</sup> Called 'New concepts' because they were not found in the literature of good practice L&T for EfS undertaken for this research, but may make an important contribution to L&T for EfS.

an important change agent skill for future professional practice.

- ***Authentic teaching:*** The participants' value for the teachers' authenticity, (described as 'honest' and 'straight-forward') was also notable. The data indicates that teacher authenticity is part of fostering a positive student-teacher relationship where the teacher becomes a part of the learning community.

#### 4.3.3 Intended and perceived learning outcomes

The following box summarises the intended and perceived learning outcomes based on the data collected.

##### Summary of intended learning outcomes in Case Study Two

Outcomes indicated by teacher interview and observational data:

- Capabilities for sustainability (working with stakeholders, systems thinking, futures thinking)
- Higher-level cognitive learning
- Critical reflection
- Implicit development of values or value of learning and reflection

Outcomes described in the course guide:

- Awareness of the ecological and natural capital foundation of planning
- Basic knowledge of the principles of ecology
- Research and critical analysis skills
- Skills in professional engagement, collaboration and multidisciplinary team work

New concept described by the teacher:

- Accountability (responsibility to stakeholders and understanding of ethical dimensions of practice)

##### Summary of perceived learning outcomes by student participants in Case

## Study Two

Perceived changes in thinking and knowledge as a result of the course

- Awareness of sustainability concepts
- Awareness of limitations of current practice
- How to think innovatively
- New understandings
- A change in values (the course 'shaped' values)
- Understanding how sustainability applies in practice
- Thinking about the future in decisions
- Affirmation of what students had previously considered/Ability to reflect on and understand how they think and their values

Skills development described or indicated by student participants:

- Critical reflection and analysis
- Application of theory to practice
- Reflection on values and self-reflection
- Group work skills
- Responding to issues/problem solving and analysis
- Seeing the interconnections/systemic thinking
- Thinking about the future in the practice
- Motivation and awareness of ongoing learning

Perceived relevance and value of the course:

- All student participants felt the course was valuable and relevant to their future professional practice and degree program.

### *Intended learning outcomes based on teacher interview and observational data*

#### **Capabilities for sustainability**

Developing capabilities rather than content knowledge was the main objective in workshop approach and assessments based on observation. The PBL approach taken to weekly scenarios focused explicitly on skills development and application of theory so, over the course of the

semester, development of skills and student learning about the skills they hold and are developing was explicit.

Through the problem based activities such as the weekly scenarios, FBD response, and the scenario based test in week 12, students developed skills in critical reflection on values, working with stakeholders and systems thinking by looking at stakeholder needs and values in problem responses and responding to the social, ecological and economic dimensions of problems, futures thinking with the repeated application of the concept of 'future proofing' to activities and what is needed in order to future proof from a planning perspective. In addition, the FBD response also developed skills in working with stakeholders where students needed to consider the project from a construction perspective and then provide feedback that was constructive and understanding of construction needs.

### **Higher-level cognitive learning**

This was encouraged through all activities in the analysis and application of theory to practice. Critical reflection on students' own values and how this influences decision making also gave students the opportunity for affective and high cognitive learning.

### **Critical reflection**

Critical reflection was encouraged through all activities on values, assumptions and practice. Students were asked to justify their decisions by evidencing their arguments, which required them to reflect critically on the decisions they made in scenario responses, the values and ideas that informed these. Reflection on decision making and skills drawn on by learners are a key part of the course which also sits within good practice L&T for sustainability theory. Reflection skills remain a focus of the course according to the teacher: 'what are the skills you need and how are you tracking with them and how do you identify them?' Therefore reflection on skills and how they are being developed are intended to be a key part of the activities for the course according to the teacher.

It's all about self-reflection and understanding yourselves and being able to really know who you are and what you need because until you do, I don't think you can really be sure that you are accountable and responsible in practice.

### **Implicit development of values or value of learning and reflection**

There was much opportunity for this throughout the course in activity questions, which prompted reflection on values as discussed above.

## New concepts related to the intended and perceived learning outcomes from results not currently found in literature

- **Accountability:** Developing accountability is a concept emphasised by the teacher. Understanding systemic accountabilities to stakeholders including non-human environmental stakeholders is a big part of the course according to the teacher. This takes a step beyond stakeholder skills described in the literature. This is linked with the exploration and understanding of ethical dimensions of the problems and the ideas of responsibility to stakeholders in professional practice. The teacher commented that:

...it's not just enough to know we have limited carrying capacity, it's not just enough to know that biodiversity plays a role through the human world being that's for its own sake. What do you do with that knowledge and how are you then accountable to the present community and to the great grandchildren of the present community and that's the focus...I think accountability is really fundamental... accountability means practice in a certain kind of way and that they recognize the role of their own meaning and values in decisions they take.

### *How effective are these practices for learning for sustainability: Perceived learning outcomes according to students*

#### **Perceived changes in thinking and knowledge as a result of the course**

The course prompted a change in thinking for all student survey respondents in various ways from generating awareness of concepts and limitations of current practice to learning how to think innovatively. Other respondents commented that they had new understandings and affirmation of what they had previously considered, while another said the learning from the course 'shaped' their values, indicating a deep transformation. Another student said they can see how sustainability applies in practice and another said they are thinking about the future in decisions as a result of the course (*see Appendix 3.5 Course influence on the way survey respondents think*).

However, when focus group participants were asked about changes in thinking as a result of the course, they commented that the course had not changed their thinking. Rather through their learning in the course they were able to reflect on and understand how they think and their values more. So for these students they were able to become more aware of how they think and the values they hold (see Appendix 3.6 Focus group responses regarding course influence on thinking).

### **Perceived skills development**

A large majority of survey respondents (81%) felt confident in applying sustainability in professional practice and only a small number said maybe, indicating that learning from the course was useful for applying sustainability in their future professional practice. Based on qualitative data, respondents felt that they had the opportunity to draw on or develop skills through the course. Those skills mentioned in qualitative responses included critical reflection and analysis and application of theory to practice. Reflection on values was noted by a number of students:

- The reflection parts of the course I think was a great tool to get people to think about why they chose to do things that way, and get thinking about themselves more, which I believe critical assessment of yourself is a very important skill to have.
- The reflection for me is invaluable stuff. I don't think we really get this stuff in uni and it allows you to get jobs and work through awkward situations because you can reflect on things in the past and how you've dealt with them. Reflecting on the skills that are needed and the skills that you are using.
- In our other subjects you reflect on your design and the site but you're not reflecting on your skills.
- The importance of acknowledging your own and others' values and bringing them to the fore. Understanding how they'll affect practice.

When students were asked specifically about skills they felt they had developed, they noted skills related to **critical analysis**, **group work** skills, **responding to issues**, and **self-reflection**:

**Academic skills****Skills in application of theory****Knowledge<sup>10</sup> and attributes**

- |  |   |   |
|--|---|---|
| <ul style="list-style-type: none"> <li>▪ <i>Critical analysis (1)</i></li> <li>▪ <i>critical thinking (1)</i></li> <li>▪ <i>Analytical skills (1)</i></li> <li>▪ <i>Group work/teamwork: teamwork (1),</i></li> <li>▪ <i>Group work (1)</i></li> <li>▪ <i>Accepting others input (1)</i></li> <li>▪ <i>Writing skills (1)</i></li> </ul> | <ul style="list-style-type: none"> <li>▪ <i>Leadership skills (2)</i></li> <li>▪ <i>Responding to scenarios (2)</i></li> <li>▪ <i>Self-reflection (2)</i></li> <li>▪ <i>Ethics analysis (1)</i></li> <li>▪ <i>Multi-disciplinary communication (1)</i></li> <li>▪ <i>Application of theory to real world (1)</i></li> <li>▪ <i>Problem solving (1)</i></li> <li>▪ <i>Decision making (1)</i></li> </ul> | <ul style="list-style-type: none"> <li>▪ <i>Confidence (2)</i></li> <li>▪ <i>Knowledge of sustainability (1)</i></li> </ul> |
|--|---|---|

So while little mention was made of specific capabilities for sustainability, the skills noted supported these in many ways. There is indication from various responses in the survey that systemic thinking was developed with one student for example commenting on seeing the interconnections, while a number of other students discussed being able to think about the future in the practice (these were indicated in student comments in the section ‘Supports deep learning for personal transformation of understanding, values and practices’ above). Values reflection was mentioned in another qualitative response: ‘[the course] has shaped my values and outlook on everything, not just things related to my profession’.

There are some clear correlations with the focus group data where students also described seeing interconnections, responding to issues (described as problem solving and analysis) and reflection on practice and values. For example:

- you can take these concepts and explain why you are doing things [in other courses].
- This subject relates to everything.
- Sustainability is not just one thing, it’s a range of issues and that goes into every subject.

Further, the focus group participants felt they had developed an understanding of multiple perspectives and multidisciplinary communication as indicated in previous comments about the FBD response in section ‘*Multidisciplinary Approach*’. One participant also indicated that

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<sup>10</sup> Note knowledge is not defined as a ‘skill’ in this dissertation however is included here given the large amount of student responses mentioning knowledge acquired in response to this question



they were aware of the ongoing learning process that ‘The education process doesn’t stop when you finish university’. Two focus group participants also commented that they developed skills in problem solving, for example ‘The scenarios helped with building problem solving skills’.

However, while the planning students from focus group one felt they had developed problem solving skills, the landscape architecture students felt they already had developed these skills and is how they naturally work so therefore they were not conscious they were ‘problem solving’ in the course. For example, ‘You address them before you even think about it. It’s second nature’. Another student attributed this to the good teaching approach, ‘that’s why [the teacher] is so good’ because the skills development becomes second nature through the course. So perceived skills development varied depending on the year level and degree program of the participants because of prior learning.

#### **Perceived relevance and value of the course**

All focus group participants found the course valuable and relevant to their professional areas. One participant commented that they felt ‘it’s one of the most relevant courses in the whole degree’. Qualitative survey responses showed that respondents already thought that the course content was important and therefore they were not influenced by the specific course as such in their future career, while others stated that they felt the course would influence their future practice. For example:

- I work with sustainability principles in all of the creative problem solving that I do, especially in my design studios.
- This course made everything simple and clear to me and therefore I will be able to use what i have learnt in years to come.

This is further supported by the data showing that 100% of respondents felt that learning about sustainability was important before undertaking the course. This number remained the same after completing the course. Clearly respondents already understood the relevance of the course before undertaking it. This may have an impact in terms of L&T strategies and the course learning outcomes.

#### **4.3.4 Learning and teaching activities**

The following box summarises the learning activities used and the student experience of these based on the data collected.

## Course L&T activities to facilitate learning for sustainability in Case Study Two

- Future-focused visioning projects (FBD Response and scenario responses)
- Problem based learning (FBD Response and weekly scenarios)
- Working in groups (FBD Response and weekly scenarios)
- Group and class discussions (in almost all activities observed)
- Reflection built into activities (prompted by teacher questions, scenario worksheet sheet questions and assessment criteria)
- Mapping and diagrams (opportunity to respond to scenarios using maps and diagrams, concept mapping weekly class discussions on the classroom white board)
- Case studies (focus of the weekly scenarios and analysed/used as examples in workshop discussions and lectures, FBD response was also a development case study)
- Critical reading and writing (weekly reading, workbook bibliography component of assessment and analysis of weekly scenarios and the Case Study One construction students' FBD reports and maps).

## Student research participants' perspectives on effective L&T activities for learning for sustainability in Case Study Two

Activities that were described as being important for learning included:

- Problem based learning (FBD response and weekly scenario responses)
- Group discussions and group work (brainstorming in a class and group work on the FBD response and weekly scenarios)
- Concept mapping (to structure class discussion and in weekly scenarios and test scenario)
- Case studies (examples in the course, weekly scenarios and FBD response)
- Future-focused visioning in activities (helped students to see professional relevance)

Based on observation, the main workshop L&T activities included critical class discussions, group work PBL/scenario responses, unpacking case studies, concept mapping class

discussions about activities and concepts on the white board and also developing responses to help shape the future development of FBD response. The teacher commented that they had changed their L&T approach so that students were doing less activities in each workshop in order to ‘go deeper’ into each activity.

*Problem based learning* was a feature of the assessment process in weekly workshop scenario responses and the scenario based test. *Mapping and diagrams* were regularly developed as a class during discussions to show the interconnection of ideas and concepts the class was discussing. Concept mapping and diagrams were also encouraged by the teacher as to explain a response in the test and weekly scenario worksheets if students wished to. Case studies were regularly ‘unpacked’ in class discussions based on articles and scenarios. Case studies were used regularly in lectures to demonstrate theory in practice or how concepts can inform practice/opportunities for change, while group discussions were a feature of workshop activities. Critical reading and writing was encouraged through weekly readings and discussion of these in the classes and the FBD response was somewhat a future-focused visioning project where students were asked to ‘future proof’ the development in their response, thinking about future use and how to apply sustainable design principles for long term sustainability of the development:

We do a case study on Fisherman’s Bend and the goal of that is to ask them to think about the social and ecological as an integrated practice and to really focus on what it means to really practice in an integrated way.

The teacher describes the task to students as:

- *Realising a vision in a multi-disciplinary team*, for example: ‘...here’s a chance to realise a vision, now what will you need to do to bring out the best possible vision you can’.
- *Learning how to draw on professional expertise*, for example: ‘how do you access and tap into professional expertise to really flesh out what out what you’re trying to achieve?’
- *Exploring the ethical dimensions*.
- *Reflecting on skills students are building through the assessment*. For example, ‘helping them really be able to name and describe what skills they have to demonstrate and how they can really show they’ve got them’.

According to the teacher, the L&T activities were based on the development of skills for sustainability and situated in a learner-centred pedagogy: 'I think the focus [is] more on what are the skills you need and how are you tracking with them and how do you identify them'. Skills for sustainability from the theory including systems thinking, values reflection, critical thinking, reflexive practice, interdisciplinary/multidisciplinary practice are intended to be developed through the L&T activities and assessment in the course. These are developed through scenario based activities that require learners to recognise the role their own values play in understanding each scenario, the ethical dimensions of the scenario including stakeholder accountabilities (including non-human stakeholders), and responding to scenarios drawing on multiple disciplines.

Therefore the L&T activities in the course are intended to build skills for sustainability that are recognised as good practice according to theory; this is done primarily through learner-centred scenario based activities. Skills development sits within the 'professional body of knowledge' thus making the skills for sustainability and the learning about sustainability situated within the professional context according to the teacher, which is in line with the theory of good practice EfS.

***How effective are these practices for learning for sustainability according to students?***

According to survey respondents all course content and assessments were rated as helpful for learning with test preparation and FBD response rated slightly higher than other activities. One survey respondent stated 'I found the whole course to be helpful, and I have trouble distinguishing between which individual elements are the most important'.

Problem based learning was the main vehicle for learning with survey respondents expressing positive views of their learning from both the weekly scenarios and the FBD response.

The scenarios helped with looking at the bigger picture and application of theory, communication & teamwork through group work and class discussion, communication to other disciplines through fisherman's bend assignment for property students.

The problem based assessments were rated as important for learning about sustainability in professional practice by survey respondents (see Appendix 3.8 Level of importance of L&T activities for respondents learning about relevance of sustainability to their future profession). The FBD response was described as valuable by focus group participants because of the interdisciplinary nature of the task and how it helped students to 'learn through teaching' and

to communicate with different disciplines and see how different disciplines understand the task. The weekly scenarios were useful for professional application of theory and learning through practice. 'Learning through doing' was seen as a valuable approach to learning in the course (see Appendix 3.7 Level of importance of L&T activities for respondents learning about sustainability).

One student mentioned the glossary as important for learning about interconnections:

A few weeks ago as I did my glossary I was able to see how a lot of the principles were inter-related... I began seeing how practically ANYTHING was able to be linked in with say the Triple Bottom Line, or Future Proofing. This made it so much easier to talk about each concept and theory. So rather than seeing the 10 or so concepts as something that needs to be individually memorised, they became almost second nature because they linked in...

Discussion was mentioned a number of times in qualitative responses as being important for learning. This was both class discussion and group discussions. Brainstorming in a class (which involves class discussion) was rated the most important activity for learning about sustainability by survey respondents. Bouncing ideas off others in the groups and also see things from different perspectives while working on the weekly scenarios in group was described as valuable for learning by focus group participants. For example:

- It's good to get other peoples ideas. Allows you to get new ideas that you haven't thought of before.
- Groups work and social/professional relations. To get the mindset of others. To bounce ideas off each other. It's good that you're developing all those skills.
- To step back and look at the world through someone else's eyes.

Concept mapping was used to structure class discussion according to one respondent who liked that the 'mind maps drawn on the board to link and push across key messages helped show how easy it can be'. Another student also noted that in the scenarios and test, students were able to concept map their responses which they felt helped to cater to different learning needs of students.

One student commented that there was a 'plethora' of case study examples in the course. This is also further supported by the real issues focus described by respondents in the weekly

scenarios and FBD response. Applying theory to case studies was rated the third most important activity for learning about sustainability.

Based on survey respondents comments, students were able to focus on future visioning in their projects and also found the learning relevant for what they saw as future sustainability practice. The concept of future proofing (that is applied in scenarios) was mentioned a number of times by survey respondents and one student stating that ‘designing and planning for a sustainable future is a major focus’ of the course.

#### **4.3.5 L&T challenges described by teacher and student participants**

The teacher found negative behaviour in the class increasingly difficult to accommodate in a constructive manner. In terms of teaching sustainability, the challenge of living learner-centred, good practice pedagogical values as an educator (creating safe learning environments, empowering learners, valuing different values and worldviews of learners where they are at and giving space to learners that reject the concepts and values of sustainability straight up) was expressed by the teacher. Based on the teacher’s description, this challenge was related to learner maturity in the way students conduct or express themselves, rather than the views learners were expressing.

Another challenge that the teacher describes is resistance to learning, however this was said to be overcome through activities that aim to foster trust between the teacher and the learners:

I was surprised at the extent of the resistance in the beginning and I was certainly surprised at by how quickly that resistance disappeared... something’s gone on between Week Two and Week Four where [students] decided they can trust me... If you said what do you think it’s attributable to, I would... say they know [I’m] for real, they know [I’m] authentic, [my teaching approach and delivery]’ is not a front.

Survey responses regarding challenging parts of the course were quite shallow or brief in terms of expressing what was found challenging and why. Survey respondents’ mixed responses indicated no clear trend in what they felt was challenging. Four responses answered ‘none’ or N/A and one respondent said the course was ‘easy’. Another two respondents said that ‘some concepts’ were challenging without further description of what these were four respondents mentioned FBD response, two mentioned the glossary and two the scenarios and one student mentioned ‘the reflection part’ as a challenge.

This differed from focus group comments where participants all agreed that reflecting on learning was challenging. For example: ‘The hardest bit of the course is to look back and know what I’ve learned. I found that really difficult to do’. Some focus group respondents also found the self-guided nature of the assessments difficult to manage and acknowledged additional effort and motivation was required to complete tasks, while other students mentioned the complexity of criteria and the applying theory in an interconnected way challenging. Some students found the course to be ‘idealistic’ and this was a challenge for real life application:

- The subject gets you thinking so much about the possibilities but its challenging scaling that back. There are always limitations.
- The course is somewhat idealistic. In the real world we are constrained by the planning schemes/regulations.
- The most frustrating part of it is that a lot of great ideas are thrown around that are not practical in today’s world. Maybe in 10 to 20 years time.

A notable point is that two focus group participants described learning challenges that they found in the course good for their learning. For example, ‘we’ve challenged ourselves. The more you challenge yourself the more you get out of it. It’s not about teachers having to do it for us’. This indicates that for these participants, being challenged is part of the learning process.

#### **4.3.6 Case Study Two Summary**

Case Study Two was characterised by learner-centred practice and featured many key L&T approaches and methods advocated in the theory of good practice L&T for sustainability including future-focused PBL projects, group work and class discussions, critical reflection, mapping and diagrams, case studies, and critical reading and writing. Learning through doing was something noted by participants which they found as useful and engaging, with skills development repeatedly noted through qualitative comments. The teaching approach was valued by all participants who found this to be a positive contribution to their learning experience. The teaching approach was found to help build confidence to approach the assessment tasks and make students feel valued.

Overall the students’ comments on the course indicated that skills development and reflective practice were key features of the learning experience for them and they found this to be useful

for learning. Although some participants felt that reflecting on learning was a key challenge, some students indicated they experienced deep learning in the course through changes in values and thinking, while others felt that while their thinking had not changed and that they learned more about themselves and how they think and their values. Both these perspectives indicate that the course fostered deep learning about values and ways of thinking and reflection on these.

Activities that were described by students as being important for learning support those activities advocated in the theory of good practice. These included:

- Problem based learning (FBD response and weekly scenario responses)
- Group discussions and group work (brainstorming in a class and group work on the FBD response and weekly scenarios)
- Concept mapping (to structure class discussion and in weekly scenarios and test scenario)
- Case studies (examples in the course, weekly scenarios and FBD response)
- Future-focused visioning in activities (helped students to see professional relevance)

Accountability was a concept not featured in the literature, but which the teacher emphasised as an important part of their teaching approach for sustainability in professional practice. While learning through teaching and authentic teaching approach were also new concepts mentioned by student participants as important for their learning which can be added to existing theory.

Some participants valued being challenged in the course. Being challenged can be viewed as a positive part of the learning process if students feel supported.



## Value of Case Study Two for this research

This case study sits in line with good practice according to theory with an explicit focus on the role of the self in decision-making, self-reflection on skills, values and accountability in professional practice. Data showed that students felt they had learned about themselves and their values through the course and for some students this influenced the way they thought about professional practice and changed their values. The problem based assessments and activities intended to develop capabilities and reflection on learning to foster deep transformation through praxis. Student satisfaction with L&T approach in the course is high with students commenting explicitly on many of the characteristics of good practice L&T for sustainability which they found to be valuable for learning. The data indicate that this case study is a good example of good practice in terms of transformative education, education as sustainability (sustainability principles modelled in the teaching approach), student learning in professional context and student satisfaction. Qualitative feedback indicates the participants had an awareness of the learning in the course and the skills for sustainability they had developed which may be attributed to reflection on learning undertaken as part of the assessments and L&T activities.

New concepts generated by the data. These are valuable in what they can add to existing theory which will be further explored in the discussion in Chapter Five:

- *Authentic teaching approach*
- *Learning through teaching*
- *Accountability*



## **4.4 Case Study Three results: Sustainability in Design**

### **4.4.1 Introduction**

This section presents a summary of the results from research undertaken on Case Study Three: Sustainability in design. The section will help answer the research question *what does good practice L&T for sustainability look like* by presenting data collected on pedagogical approach, intended and perceived learning outcomes, and L&T activities used in the case study course. For each of these categories, observational and teacher interview data will firstly provide descriptive detail followed by student survey and focus group data which will show how these L&T approaches and methods were perceived by students and the learning experience and perceived learning outcomes of the students from these approaches. Theory of good practice L&T for EfS will be used to draw out and frame elements of L&T practice in the data. This theory is also supported and/or challenged by the empirical data presented in the results.

### **4.4.2 Pedagogical approach**

The following box summarises the pedagogical approach of Case Study Three and student experience of this approach based on the data collected.

### Pedagogical approach in Case Study Three

- Learner-centred in that students are given the space to develop their own understandings of sustainability through their research and group work and then apply their own ideas of sustainable design.
- Praxis and real issues orientation with sustainability content and strategies wholly embedded in professional context and application of theory in practice.
- Educator as partner: The teacher described their role as non-expert and referred to part of their teaching practices in the classroom as facilitating learning.
- Self-directed learning with students required to create their own designs based on the sustainable design philosophies they created and the research they had undertaken independently of the teacher in groups and individually.
- Values reflection occurred in the course somewhat through discussions about global warming and the social and environmental impacts of the life cycle of a design product, however based on the data, this was not explicitly prompted by the teacher or required in assessments or other L&T activities.
- The teacher made an effort not to express their own values related to sustainability during the course and presented material in a 'this is what the world is talking about', rather than a personal way.
- New concept: Creativity. The course coordinator commented that 'Creativity is an incredible tool that our students have to be able to problem solve'.

### Student research participant perspectives of pedagogical approach in Case Study Three

- Based on student data, the course was somewhat learner-centred. The delivery of content in the course was largely seen as non-interactive which students expressed dissatisfaction with and data indicates that the course engaged learners' own knowledge and experience sometimes. However there was general agreement that the learning in the course is an important part of the degree program.
- There appears to be a contradiction in the activities which survey respondents would like to see in class (more interactive L&T) and the activities that respondents felt helped their learning about sustainability (individual assessment).

- A large degree of self-directed learning was indicated by students' comments
- Encouragement of innovative and creative thinking through the course was indicated by student participants
- Student participants felt that due to the complexity of sustainability, integrating it into a subject which also requires development of foundational skills and knowledge in textiles was overwhelming. The way in which sustainability is integrated in praxis in a course needs to allow time for students to explore sustainability in practice on a deep, transformative level.
- The responses indicate that real life examples and case studies (or more of these) of sustainable design would help students see the viability of sustainability in design practice and also validate their work.

*Course overview*

<b>Case Study Three: Summary of course information</b> (See Appendix 4.1 Case Study Three course overview for more detail)	
<b>Year level</b>	First year undergraduate core, compulsory course
<b>Course size</b>	37 Students
<b>Duration</b>	One semester
<b>Course delivery method</b>	4 hour weekly lecture/workshop, with lecture usually taking up half of the time. Some weeks later in the semester were dedicated to design or presentations so no lecture was given.
<b>Learning objectives</b>	Learning objectives stated on the course guide/handout: <ul style="list-style-type: none"> <li>▪ 'Research - examine, analyse and evaluate theoretical principles, emerging trends and issues pertinent to textile design and related design and textile industries.</li> <li>▪ Industry - examine and apply cultural, social and ethical considerations and responsibilities for fashion and textiles contexts; manage your learning as an individual and in collaboration with others.</li> <li>▪ Sustainable practice - examine, critique, and evaluate underlying principles and concepts of sustainability</li> </ul>

	<p>appropriate to textile design and the textile industry. Apply sustainability principles and systems to textile design contexts. ‘</p> <p>According to the online course guide ‘upon successful completion of this course, [students] will be able to’:</p> <ul style="list-style-type: none"> <li>▪ ‘Identify and analyse principles of sustainability for textile design.</li> <li>▪ Develop and evaluate ethical and sustainable design strategies appropriate for textile design practices.</li> <li>▪ Examine and reflect on the role of the textile designer’</li> </ul>
<b>Assessment</b>	<ol style="list-style-type: none"> <li>1. Re-Search: Group Design Project, includes Digital Research folder, Designed item, PowerPoint Presentation, Individual Evaluation Report.</li> <li>2. Re-Design: Research Project, includes individual Design intent, life cycle analysis, PowerPoint presentation.</li> </ol>
<b>Relationship of the course to students' experiences of sustainability and L&amp;T approaches in other courses in their program</b>	<p>Students come into this course with little knowledge of sustainability beyond their existing awareness (through the media for example). This course is intended to introduce students to sustainable design concepts and practice which is embedded into all courses in their degree program following this introductory course. This is based on the understanding that sustainable design is good design practice. Students undertaking this course generally experience learner-centred L&amp;T approaches in their degree program through predominantly hands on, design or practical focused courses.</p>
<b>Research methods</b>	<p>See Appendix 4.2 Case Study Three specific research methods</p>

***Description of pedagogical approach based on teacher interview and observational data***

Based on the interview and observational results, Case Study Three takes a learner-centred approach to learning about sustainability and features some key elements of good practice L&T for sustainability according to the literature including embedding sustainability in professional contexts and real issues, praxis-orientated learning, educator as partner or facilitator rather than ‘expert’, and self-directed learning.

## **Learner-centred**

Case Study Three is learner-centred in that students are given the space to develop their own understandings of sustainability through their research and group work and then apply their own ideas of sustainable design in their design intent. The course coordinator described the teaching approach taken in the course as student-centred. The coordinator says that teaching staff in the program are comfortable to stand up in front of a cohort of students and say ‘I don’t really know the answers, go do some research and come back and tell us... Most [teaching] staff see their role as facilitating learning’. The course teacher supports this observation describing their role as teacher a ‘non-expert’, different to how they taught other courses:

My approach is a little bit different with sustainability in that the other side of what I teach is really about facts and figures... so it is more straight delivery of information and there’s discussion about that in the class, but when I’m teaching sustainability I’m really focusing on trying to get the whole class to talk together and talk to each other so there’s two very different learning outcomes... it’s not about delivering facts, I don’t think that I have all the answers with sustainability.

The teacher also commented that they present sustainability ‘in a ‘this is what the world is talking about’, not in a personal opinion way’ which indicates that they do not explicitly express their values related to sustainability during the course. According to the teacher, students are encouraged to learn from each other and bounce ideas off each other and analyse concepts to create their own meanings of sustainability rather than be expected to take on existing ideas of sustainability:

...group work is really positive because learning from your peers is quite interesting because if I or the other lecturers are standing there delivering all this information there’s more of an assumption that there’s some sort of factual base to what we’re talking about. Whereas they become more analytical of what their peers are suggesting so as an approach to sustainability it means that they are then thinking about those ideas very analytically, and I think it’s valid as a tool to be questioning the information they are receiving as well.

## **Praxis and real issues orientation**

Sustainability in the course is wholly embedded in professional context and application of theory in practice. Students learn about the complexity and systemic interconnections through applying sustainability concepts and ideas in their design research and research intents. According to the course co-ordinator, ‘we’re not about sustainable design, we’re about design

and if it is good design then embedded in that is sustainability. It is about textile practice as a professional designer, [sustainable design] is just a given'. According to the course co-ordinator, 'It's the link between theory and practice', through application of skills and knowledge related to sustainability in practice, and making it relevant through very practical applications of concepts that makes learning for sustainability effective.

### **Educator as partner**

The teacher described their role as non-expert and referred to part of their teaching practices in the classroom as facilitating. This is in line with theory of good practice that advocates teachers be part of the learning process with students.

### **Self-directed learning**

Based on observation and the teachers' description of their teaching approach, there appears to be a high level of self-directed learning in the course. For example, in the first assessment, groups are required to assign roles for each member in the group in order for the group to direct and manage their own project and learning independently of the teacher. For the second assessment students are asked to individually research and write a design intent that appears to be largely self-directed with the teacher taking on a mentoring role. The teacher commented that in the second assessment students need to independently develop their sustainability philosophy to inform their design, inferring that students develop their own framework and understanding of sustainability and use this to inform their design. In both assessments it appears students develop their own ideas, definitions, applications and sustainable designs, independently of the teacher:

There's a lot of individual tutorial work that goes on across the bachelor program... for the research report there is a lot of work they have to do outside of class as well. So they have three weeks where they'll have an hour in class to work in their groups and that's when I can go around to each group and make sure and talk about things but apart from that most of the other work is developed outside of class.

The teacher's role is to suggest options for groups to take their ideas further or to help students explore possibilities and overcome hurdles in their design intent. For example the teacher commented that they 'facilitate discussions in groups through questions to keep [students] ideas flowing, help students avoid coming up with the obvious answers and ask questions which push them further'. Based on the data, a large part of the assessment tasks is undertaken outside of class time.



## **Values reflection and reflexive practice**

Based on observation and teacher interview data, there did not appear to be any explicit prompting of reflection on values or learning in the course. The teacher stated that discussions about global warming, to establish a rationale for sustainable design, 'leads into discussions about how the world functions so those conversations [about values and worldviews] happen pretty quickly' in the course. The teacher also commented that during lectures about the social and environmental aspects of sustainable design, students often have 'light bulb' moments where they become aware about the impacts of sweatshop manufacturing or environment degradation from textiles for example. Looking at the triple bottom line impacts of the life-cycle of a product influences students' values and awareness according to the teacher.

I think it's always interesting after delivering the lecture on cultural and social sustainability there's definitely light bulb moments... The students who have no idea how their clothes are made or have no idea that to make a t-shirt everybody wears that somebody has to be sitting at a machine making it and those sorts of connections. But also definitely in regards to environmental degradation worldwide as well there's definitely light bulb moments for the students there too.

Values reflection however is not a focus of the assessment work or L&T activities based on the data collected. The teacher also commented that they present sustainability 'in a 'this is what the world is talking about', not in a personal opinion way'. They also commented that:

I'm constantly just wanting to be aware of delivering the information, getting everybody to think about it to analyse it for themselves. So not to put my own agenda into that but when you're getting into talking about things like sweat shop labour and environmental things as well I guess that's a challenge to separate the emotional from the delivery of the information and the delivery of factual information. It's achievable but it's something you have to think about.

There also does not appear to be explicit requirements for students to reflect on their learning in the course assessments or L&T activities which indicates that there is no explicit reflexive practice. However 'examine and reflect on the role of the textile designer' is a learning objective stated in the course materials' which may have been undertaken implicitly through student assessments.

## New concepts related to the intended and perceived learning outcomes from results not currently found in literature

- **Creativity:** The importance of creativity was emphasised in the interview undertaken with the course co-ordinator. They felt creativity is something that is taken for granted in the discipline and that:

Creativity is an incredible tool that our students have to be able to problem solve... As a discipline we take [creativity] for granted sometimes. Creativity is significant. When you start to see students working around these problems and problem solving that's when you start to go okay some of their approaches and ideas... on the table, some of us wouldn't really even think about. That's an exciting thing to see when students are actually generating these concepts and really starting to problem solve.

This observation is significant for learning for sustainability given that addressing sustainability challenges is fundamentally about problem solving. The coordinator commented that as a discipline, the students and professionals 'are prepared to think differently'. That is because in 'the nature of design, quite often you can't know the answer. That's what creativity is about, it's going into the unknown and trialling things, you have strategies but ultimately it's what can you do with that.'

Creative and innovating thinking for problem solving is something not featured in the theory of good practice L&T for sustainability.

### *How effective are these practices for learning for sustainability according to students?*

#### **Course delivery**

Throughout the survey students expressed dissatisfaction with the delivery of content and clarity of assessment tasks. Boredom as a result of the content delivery was mentioned eight times in qualitative responses for number of survey questions, for example 'I found the content interesting, but the delivery boring.' One student commented that this could be

overcome by making the delivery more interactive. Dissatisfaction was expressed by five respondents in regards to teaching approach when asked about whether the teacher-student relationship helped or hindered learning, for example 'the delivery on the information could be a little dry at times'. When asked what they would like to see changed in the course, survey respondents made the following comments:

- Make assignments more relevant and clear.
- In theory the course is fantastic and relevant to industry, but it has to be executed in a much more engaging, professional and caring manner.
- More group work, more freedom, more encouragement and allowances for personal approaches. More dynamic lectures, guest lecturers and class excursions would be fantastic!
- more group discussions and interactive lectures.
- Variety of delivery of information and better direction about worthwhile key texts.
- needs to be more hands on and not skim the surface...

Focus group participants made little comment about the teaching approach and whether they felt their learning was supported adequately by the L&T approach in the course.

### **Learner-centred approach**

When survey respondents were asked if they had the opportunity to draw on their own experience and knowledge as part of the learning for the course, 65.5% of students said sometimes and 12.5% (one respondent) said no and 25% (two respondents) said yes. This data indicate that the course engaged learners' knowledge and experience sometimes and therefore there may be more opportunity to take the learner-centred approach further in the L&T of the course to ensure that students are able to bring their own knowledge and experiences into their activities and assessments. This would be in line with good practice L&T for sustainability and also encourage deep and transformational learning.

There appears to be a contradiction in the activities which survey respondents would like to see in class and the activities that respondents felt helped their learning about sustainability. For example survey respondents rated the individual final assessment as most useful for their learning yet suggested that the course be designed so that it is more 'interactive'. This may indicate that non-interactive activities and assessments (such as the individual assessment) can support learning, however do not foster a positive or engaging learning experience which

seems to be impacted by the lack of interactivity (see Appendix 4.4 Level of importance of L&T activities for respondents learning about sustainability).

### **Self-directed learning**

Self-directed learning was indicated in focus group comments such as ‘It’s up to us to do a lot of things’ in the course. In response to a question about being able to make their own decisions other students commented that they largely felt they could do this in the course. Similarly another student commented that in the course ‘you have to work out yourself what your position is so we are learning the kinds of things to make that decision, so where we place ourselves. I don’t think we come out all of us agreeing this is the way to go’. This comment indicates both self-directed learning and learner-centred approach in regards to giving students the space to make their own meanings.

### **Creative learning**

Encouragement of innovative and creative thinking through the course was indicated by student responses. Focus group participants felt that they were encouraged by the teacher to think outside the box in their assessment tasks:

- The group project was designing a lot of products, we were kind of encouraged by [the teacher] in our tutorial just to kind of do something crazy... it’s like a prototype. So we kind of took that on in a student way to design something so, it would never work but to explore something really different.
- [The teacher] was like make up a nano-coating that doesn’t exist.
- [The teacher encouraged us to] Explore these possibilities.
- [The teacher encouraged us to] Be really conceptual.

### **Workload impacts on deep learning for sustainability**

Interestingly, participants felt that due to the complexity of sustainability, integrating it into a subject, which also requires the development of foundational skills and knowledge in textiles design, was overwhelming. Participants’ comments do not challenge the idea of embedding sustainability in professional practice which is advocated by the theory of good practice EfS (this seemed to be taken as a given by participants), however, the way in which it is done has to allow time for students to really delve deeply into sustainability in practice:

I feel like we could separate sustainability and learning about [discipline content] because I feel that [this subject] has been two different subjects in one. So we've been trying to learn about sustainability while learning about [discipline content], and they cross over but it's too much.

Despite frustration at the workload, there was also general agreement that sustainable design is an important part of the program and that pressured work environments will be part of students' future careers as designers, so this part of the course design and delivery is part of what makes the program good:

There's a reason they work us hard as well, it's because it is a good degree. A part of me doesn't want it any other way, I get pushed to my limits and it's interesting what you can achieve.

#### **Real life examples and case studies to validate sustainable design ideas**

All focus group participants expressed scepticism about the realistic application of sustainable design in their future professional practice and suggested that more examples from industry would help students see realistic opportunities for implementing sustainable design. The responses indicate that real life examples and case studies (or more of these) of sustainable design would help students see the viability of sustainability in design practice and also validate their work:

- ...we haven't had any experience in industry... I do hear... that some of the best students... end up in these really disheartening, depressing jobs as low end designers for big companies, [where sustainability] is a bit token, so there's a lot of promotion and thinking in sustainability issues [in the course] but I don't think we have first hand experience, it might just be utopia - the way we learn about it.
- We haven't had any actual examples of people coming in, like... how a sustainable company sustains itself.
- ...I hope we learn about that...
- For a company to be all sustainable it's just not possible.

#### **4.4.3 Intended and perceived learning outcomes**

The following box summarises the intended and perceived learning outcomes based on the data collected.

### Intended learning outcomes in Case Study Three

Outcomes indicated by teacher interview and observational data:

- Sustainability capabilities/competencies (described as skills)
- Strategies to implement sustainability in practice, primarily life cycle analysis
- Motivation for ongoing learning to adapt to changing nature of sustainability in future practice
- Seeing opportunities for change, rather than limitations
- Whole systems thinking and approach to design

Outcomes described in the course guide:

- Examine, critique, evaluate and apply sustainability principles and systems to textile design contexts
- Develop and evaluate ethical and sustainable design strategies appropriate for textile design practices.
- Examine and reflect on the role of the textile designer

### Perceived learning outcomes by student participants in Case Study Three

Changes in thinking:

- Learning about the possibilities of sustainable design (seeing opportunities for change)
- Learning about new technology
- Gaining important knowledge to make sustainable decisions in design work
- Confirmation and understanding of existing ideas related to sustainability
- Awareness that there is no perfect implementation of sustainability (seeing systemic complexity and the challenges of balancing impacts in sustainable design)

Perceived skills development (based on four survey respondents' comments):

- Group work,
- Research and writing skills

Perceived relevance and value of the course

- All student participants felt the course was relevant and should stay a part of the degree program
- The data indicate that students could clearly see the professional relevance of the course
- Four of five survey respondents felt confident in applying sustainability in their professional careers
- The data indicate that student participants had learned *strategies to implement sustainability in practice* described as an intended learning outcome by the teacher.

***Intended learning outcomes based on teacher interview and observational data***

**Sustainability capabilities/competencies (described as skills)**

Both course coordinator and teacher felt that a key learning outcome in sustainability education needs to be skills development to apply sustainability in professional practice. Skills described by the teacher include the ability to analyse what is best sustainability practice at a given time in a particular context. Students should feel empowered through good decision making processes, that they have the capabilities to make the best choices about a design. ‘The ability to analyse what the best practice is at the time that they are creating a design’ is a key skill for sustainability in practice.

...to get students to recognise that it is important, that we should be thinking about it. Secondly to make them feel like it’s approachable and to give them the skills to be able to approach it and try to nut out the complexities of it within their design work.

This is done through the course by applying triple bottom line and life-cycle analysis to evaluate design impacts and then attempt to mitigate these impacts through the design outcome. Life-cycle analysis is described by the teacher as a ‘key part of enabling the student to feel that they can break down systems and analyse the differences and the impacts of each decision they are making’. The teacher later added that ‘looking at sustainable design holistically’ is an important learning outcome’ however the ability to ‘break things down so that you personally can make that approachable’ is also important.

Systems thinking is also a framework and learning outcome described by the coordinator and teacher with the course encouraging students to think in terms of whole systems and then

break these down into parts in order to implement changes. The emphasis on life-cycle analysis also is indicative of this approach to sustainability.

According to the teacher, the development of students own sustainable design philosophy based on evidence is an important outcome of the second assessment people:

...its about them now feeling confident to develop their own philosophy so in that design piece of writing they are writing their own philosophy as to how they approach the design of the t-shirt they are coming up with so they will write about ideas they explored, maybe hurdles they come up against, and also there's the require though that it is still presented very professionally and in a way that we would write a research paper so that they still have to reference other people's work to support their own ideas. It's not that in depth look into other peoples work it's that change in style of writing so that they are using other peoples work to validate their own as opposed to just straight research.

### **Motivation for ongoing learning to adapt to changing nature of sustainability in future practice**

The teacher commented that an important learning outcome for the course is for the students to understand that sustainability is an ongoing learning process because what is sustainable is context specific:

...it is not about me standing up there saying this is what sustainability is and this is what you have to do in order to be sustainable, that they can realise that they need to keep thinking about it and that what is sustainable now, may not be in five years and that within their own practice it is something they need to keep wanting to learn and wanting to embrace.

According to the teacher, sustainability practice is 'a skill that you need to keep working on and keep as a part of your design practice, there's not a set of rules so to speak'.

### **Seeing opportunities for change**

The teacher feels that some students focus on limitations or what sustainability can prevent them from designing rather than the opportunities for change. A learning outcome according to the teacher then has to be related to the ability to see opportunities for change rather than limitations or be discouraged by the complexity of sustainable design. This is encouraged through the sustainable design strategies explored in the course. According to the teacher, in



the course they are ‘trying to break down that thought that ‘well we can’t do anything about it so why do anything at all’. But it’s hard work trying to break that down with some students.’

***How effective are these practices for learning for sustainability: Perceived learning outcomes according to students***

**Perceived changes in thinking and knowledge as a result of the course**

In response to the question about whether the course had influenced respondents thinking, half felt that their thinking had changed as a result of the course. These changes in thinking were described by respondents as awareness of impacts and professional role in change, and a greater commitment to sustainability in professional practice. One student commented in response to a question about course experience that they ‘have learnt a lot and have a completely different view to when [they] started the course’. This indicates that thinking had changed from the course for some respondents. Other students commented that their thinking had changed in the following ways:

- to be more aware of impacts.
- I felt before that it was difficult to incorporate sustainable practise into the industry but i now feel that it will become increasingly integrated into the textile industry in the near future and that i as a textile designer i have an important role to play in that process.
- I have a greater commitment to the issues that the industry faces and can place these issues in context.
- begin to actually think about how economical and sustainable materials are within products.

Some focus group participants also felt their thinking had changed in the course and others felt that they were already thinking about sustainability and the course made this ‘more solid’. Other focus group participants described a change in awareness about the possibilities of sustainable design as a result of the course: ‘I didn’t know how possible [sustainable design] could be’ and ‘‘It feels more possible, that you can actually go and do something’<sup>11</sup>. This learning outcome is in line with the intended learning outcome of strategies to implement sustainability in practice described by the teacher. Other focus group participants commented that:

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<sup>11</sup> These responses contradicted other focus group comments questioning the realistic implementation of sustainable design in the industry due to the lack of financial viability of sustainability design in practice.

- I definitely had those views when I first started the course but it has made it a lot more solid.
- It could turn into being transformational I think, as time goes on probably all of us will come out slightly different to how we came into the course because we are being exposed to it all the time.
- I think we're all saying it is deep inside us.
- How to effect the wider population and consumer.

Learning about new technology was mentioned a couple of times by participants and learning about the impacts of consumerism both personally and as a society was also mentioned as a learning outcome. One participant felt that they were gaining important knowledge to make sustainable decisions in their design work.

Another interesting learning outcome of the course for focus group participants appears to be that there is no perfect implementation of sustainability. For example:

- ...in the fashion industry it's called the fashion paradox. If you are doing something sustainable you are always going to be doing something that isn't .
- You can't be perfect.
- We realised that when we did our design brief... everything has a 'but'. So you just had to do the best that you know.
- I think that anyone who attempts to run a sustainable business properly has to cut down on the profits far more than those big companies that use sweat shops in India or Sri Lanka to produce so I think what we are learning about is a little bit utopic and whether that is really sustainable in the real world I don't know.

This and similar comments indicate that these participants are in fact taking a systemic approach and looking at impacts of simple sustainable design 'fixes' that also have systemic impacts. The complexity of sustainable design means that a truly sustainable design is not achievable. The participant who describes sustainable design as 'a utopia' actually indicates that the students are engaging with sustainability in a critical manner and reflecting on sustainability in professional practice, which is part of deep learning and engagement with the theory.

### **Perceived skills development**

Perceived skills development varied in survey respondents' comments. Group work, knowledge and research and writing skills were mentioned briefly, however only four students responded to this question, so more data are needed to determine perceived skills

development in the course. Focus group participants did not comment on skills when asked if they felt they had developed these in the course.

### **Perceived relevance and value of the course**

Survey respondents all felt the course was relevant and should stay part of the degree program. Students could see the professional relevance of the course and mentioned learning or knowledge gained in relation to industry as a result of the course many times in qualitative comments. One student stated that ‘The connection was clear’ (however they felt that improvement could have been made to the course content), and other comments included ‘I think sustainability will become more important over the next few years’, ‘the industry is going to change to adapt to the environment’ and finally ‘sustainable design will have a strong impact on the future of the industry’. Focus group participants also all felt the course was important part of their learning in the textiles design program indicating again that students could see the professional relevance of the course, for example ‘We are actually going to need this as a designer (as a world), we need to know the information to get employed. It’s going to be a vital part of our future’.

Four of five survey respondents felt confident in applying sustainability in their professional careers and one answered maybe, which indicates that the course supported learning of professional application of sustainability and strategies, which is a key learning objective in the course. The data indicate that these respondents had learned strategies to implement sustainability in practice described above by the teacher (see Sustainability capabilities/competencies section above). This was also supported by focus group data. In response to a question about how important sustainability is, one focus group participant said ‘I didn’t know how possible it could be’, another said that ‘It feels more possible, that you can actually go and do something’. This comment again indicates that a learning outcome of the course is confidence, that is empowerment of students through their learning about strategies to implement sustainable design in practice.

#### **4.4.4 Learning and teaching activities**

The following box summarises the learning activities used and the student experience of these based on the data collected.

### Course L&T activities to facilitate learning for sustainability in Case Study Three

- Group work (in the first assessment undertaken in and out of class)
- Case studies/examples in lectures to present sustainability theory and application in professional contexts
- Group discussions
- Class brainstorming
- Future-focused visioning projects through the design projects that focus on future and end-use of design products because of the life-cycle analysis framework used
- Group and individual presentations

### Student research participants' perspectives on effective L&T activities for learning for sustainability in Case Study Three

- Individual assessment
- Guest lecturers from industry
- Group work
- Research

Based on observation and teacher interview, group work is the main course L&T activity which is undertaken inside and outside of class time for research into a sustainable design product. In addition is the individual work inside and outside of class time on the final assessment piece. According to the teacher, group work is intended to take the focus away from the teacher as the source of knowledge so that students learn off their peers. The group work is intended to make the complex tasks manageable so students do not feel overwhelmed and so that students can bounce ideas of other group members. Group work empowers students because there are more ideas to work with; '...they have so many more ideas to work with which is more empowering as well for them rather than them being on their own...'

Case studies and examples are part of the lecture content. Lectures also include some discussion time arising from student questions. Class brainstorming about understandings of

sustainability to set the context for group work at the beginning of the semester was also undertaken according to the teacher:

The first thing that I do with the class is that we have this big brainstorming session about sustainability and what they know about sustainability and they work in groups to brainstorm those ideas and think about what sustainability means for them and what they all know about it and then groups are formed from that they work in to develop the rest of the project...

Through students applying life-cycle analysis to their two design assessments they are prompted to think about the future and the end use of a product. Therefore these assessments could also be described future-visioning projects.

Group and individual presentations are another course L&T activity with groups presenting their research and ideas for a sustainable design product around mid-semester and students individually presenting their design proposals at the end of semester.

***How effective are these practices for learning for sustainability according to students?***

According to survey data, working on assessments alone out of class time was the most important activity for learning about sustainability. Activities with the whole of class such as games, working on assessments and sharing work were rated least important. However, interestingly, discussion as a whole class was rated second most important for learning so students got something out of talking as a class but not other activities with the class. This may be due to less sharing of work with the class, than general class discussions, so the frequency of these activities in the course could affect students' responses to this question. The responses also indicated that various group-based activities were useful for learning as well as reading in workshops. Therefore responses were mixed as to whether respondents prefer individual learning activities or group activities for learning about sustainability (see Appendix 4.4 Level of importance of L&T activities for respondents learning about sustainability).

In terms of learning about how sustainability applies to students' future professional practice, responses varied. For example, two out of six students felt that life cycle analysis and the individual second assessment were unhelpful. However, the other four respondents felt these were helpful or somewhat helpful. The topics that most helped students learn about

professional relevance related directly to design including Topic 2: Sustainable textiles design approaches and Topic 3: Sustainable design and development (see Appendix 4.5 Level of importance of L&T activities for respondents learning about relevance of the sustainability to their future profession).

When asked about what helped students' learning in the course, participants agreed that the group work component was the most important for their learning about sustainability.

I found all of those group projects we did extremely interesting and people researched so much stuff and got so much information and we all got to read it or listen to it. I think that was one of the most important things that we have done.

The group work component was discussed most favourably out of the course. Students liked the sharing of information between the different groups at the end of the assessment so they could learn about a variety of different concepts, technologies and ideas.

It's good that as groups we can focus on one aspect and then have access to everybody else's things so we weren't overwhelmed, although the subjects [design concepts i.e 'up-cycling'] themselves were quite overwhelming.

One participant commented that they would have liked more tutorial time for group work:

I think Textile Tech could do with more tutorial time. Like with the group work it felt like we only had a couple of minutes for that and we didn't have much time to discuss it.

Two respondents felt that research was the most engaging activity for learning. Interestingly, participants did not discuss lectures, content areas or activities aside from the group work for the first assessment.

In terms of activities that supported skills development one student commented that the 'Research project helped to develop [their] research and writing skills, and lectures helped [them] to gain knowledge of sustainability', while another student commented that 'The design intent paper made me aware of the context of my work'. One student commented that the group work helped maintain their interest in the course and drive to complete the project.

#### 4.4.5 L&T challenges described by teacher and student participants

The teacher observed no resistance to learning about sustainability in their student cohort, an observation supported by the survey and focus group data. While the teacher acknowledged that students felt challenged, they did not experience any students questioning the rationale for learning about sustainability or including it in their program:

I haven't had anybody challenge the idea of sustainability but I guess there's sometimes resistance but just in that 'oh god it effects everything' but maybe that's a realisation point as well that it really effects everything we do. But not any resistance to challenge the idea that we don't need to think about it.

The teacher put it down to the obvious ethical issues and environmental impacts the industry has, and also the way sustainability is integrated throughout every course in the degree so there is already a strong rationale for the subject.

The teacher indicates that part of the learning process for some students in the course means feeling overwhelmed when beginning the assessment tasks:

it's rewarding to see students who are a bit overwhelmed at the beginning but maybe by the end of semester they have created this great t-shirt and they've really thought about it and they've been able to embrace all these different design approaches too.

The teacher believes that 'the holistic nature of sustainability' makes it challenging for students and that learner maturity has an effect on how students respond to the complexity of sustainability. For example:

It's that idea that you can have a really good idea for a material that you want to use but if you manufacture the end product in a really rubbish way then that totally discounts what you're choosing to use as a material. It's getting their head around the fact that they as a designer are really responsible for that whole of life-cycle and thinking about sustainability at every point.

The teacher observed that students with previous experience in HE or mature-aged learners and 'who is really on board with wanting to learn... they like the fact that it's a bit more challenging'. The overwhelming nature of the complexity of the task is something students

have to work through as a learning challenge according to the teacher which is done by many students well through the course of semester. Group work is noted by the interviewee as one way to overcome this learning challenge 'because they have to participate because their peers are putting the pressure on them to'.

The teachers' comments imply that some students experience a conceptual challenge with seeing their design as part of a larger system and taking a whole systems approach when designing, that is feeling overwhelmed with the complexity of the task. The teacher comments that this challenge also relates to the time constraints on students in completing tasks, that they feel it is too much to work on in the time they are given.

Complexity as a concern was supported by focus group participants' comments with general agreement from all six students that the course was too overwhelming in terms of workload. This hindered deeper engagement with sustainability and application to designs according to participants because the participants felt they did not have the time to engage fully with the complexity of sustainability. Focus group commented regarding this aspect included:

- It's incredibly intensive and time consuming and everyone gets' pretty stressed and where talking about sustainability issues like balance, I think probably everybody's [student cohort] life is out of balance, so how you tie in teaching subjects with real life .
- ...sustainability is such a massive topic, and we all generally care about it so we want to know more about it and personally I feel like I'm not doing enough because I don't have enough time. I want to know the inside and out of how you do this but I don't have enough time.
- It makes it difficult to think about sustainable design.
- It does feel that I have to devote my whole life to this course if I want to do well.
- We do a lot of what you probably think is totally irrelevant stuff in the course, it's all about presentation and the way things are going to look and we might spend as much time on that as we do the nitty gritty. And I think... there's areas that we really want to penetrate further but we just don't have the time we're just fiddling around.
- I think it's the workload, that it is conflicting. You want to learn more but you're torn because you have all this other stuff that you have to do.

Some participants argued the problem was a result of too much integration with general skills and content in their discipline area within the course, and also the workload in the other three subjects they undertake in the semester. One participant commented, 'It needs to be integrated



in a way that's actually effective for us... because of all this other stuff we are doing it is still quite stressful and difficult to take the time to get into it'. They implied that a stand-alone sustainability course, rather than sustainability and textile techniques and theory would be more beneficial for their learning about sustainability. There was no clear trend in what survey respondents found challenging in their assessments or concepts and theory.

One student said that the course is 'idealistic' and indicated that despite trying to achieve a sustainable t-shirt design, they did not know if it was worthwhile because they do not know if it is possible 'in the real world' to market and sell:

[the course is] idealistic. Like the T-shirt we are all designing. Me, personally I'm trying to do as many sustainable things as possible but I don't even know in the real world if that is possible for me to do as a designer.

Therefore this may mean that while this student is learning about sustainable design they also feel disheartened because they do not feel their design is realistic. Another student said that the course is 'theoretical'. The effect this has on deep learning for sustainability and a positive learning experience needs further investigation, likewise pedagogies that support critical reflection about realistic application of sustainability in practice while empowering learners through real life examples.

The teacher commented that a teaching challenge they experienced was not expressing personal values or their own agenda when delivering content which is something they felt was important for 'getting everybody to think about [sustainability] to analyse it for themselves'.

#### **4.4.6 Case Study Three Summary**

This case study presented sustainability solidly embedded in professional practice, with all students seeing the importance of learning about sustainable design and the professional relevance of sustainable design. Students learned about sustainable design while developing foundational skills and theory in textiles, so sustainability was presented as part of professional practice. Learning outcomes described by the teacher and supported by the student comments include learning about strategies to implement sustainability in practice, seeing opportunities for change and whole systems thinking and approach to design (which was indicated by students' comments that there was no

such thing as a 100% sustainable product due to the systemic impacts of every product). Creativity is a new concept for problem solving in sustainable design that is not mentioned in the literature on good practice L&T for sustainability. The course is learner-centred in that students are encouraged to develop their own ideas and applications of theory and sustainable design philosophies through the assessments and a large degree of self-directed learning takes place with the teacher taking on a mentoring role to help students where needed. However, the level of learner-centred L&T is brought into question with students from this case study suggesting that more interactivity in course delivery is needed. The data indicates that the course engaged learners' knowledge and experience sometimes, and therefore there might be more opportunity to take the learner-centred approach further in the L&T of the course to ensure that students are able to bring their own knowledge and experiences into their activities and assessments. This may arise through the use of more interactive activities as suggested by the student participants. Students valued the collaborative learning in the group project and suggested more time be spent on group work in the course.

While the course situates sustainability in professional practice, students felt it lacked real world examples of viable sustainable design practice to validate what they were creating in the course. Students questioned how realistic and viable sustainable design is in reality while industry is focused on profit and consumer demand. Participants feel their learning experience would be enhanced with real life examples of practice or case studies of sustainable design in practice. Responses indicated that this would validate the work they were undertaking for the course.

### Value of Case Study Three for this research

Case Study Three is a good example of learning for sustainability embedded in learning about good disciplinary practice. This is based on the idea that good design practice is sustainable design practice. Students from the course understood and discussed sustainability only in the context of professional practice and according to the teacher and students there was no resistance to learning about sustainability in the course (as seen in other case studies). The teacher chooses not to express their own values explicitly in the course and they take a 'non-expert' role due to the contested and changing nature of sustainability. Case Study Three also explicitly encourages

creativity and innovation in problem solving for sustainability and, based on intended and perceived learning outcomes, builds student confidence through learning about practical strategies (such as life-cycle analysis) to implement design in professional practice. The use of creativity as a tool to problem solve sets this course aside from the other case studies. The course is learner-centred in that students are encouraged to develop their own ideas and applications of theory and sustainable design philosophies through the assessments and a large degree of self-directed learning takes place with the teacher taking on a mentoring role to help students where needed. The course differs from good practice theory however, in that there is no explicit requirement for values reflection, reflexive practice or PBL (based on observation and interview data), and there is one assessment based on collaborative learning and one on individual learning. Despite this, all students felt that learning about sustainability was an important part of their program and some student participants indicated deep critical engagement with sustainability.

*New concepts generated by the data:*

These are valuable in what they can add to existing theory which will be further explored in the discussion in Chapter Five:

- *Creativity in problem solving*



## **4.5 Case Study Four results: Sustainability in Engineering**

### **4.5.1 Introduction**

This section presents a summary of the results from research undertaken on Case Study Four: Sustainability in Engineering. The section will help answer the research question *what does good practice L&T for sustainability look like* by presenting data collected on pedagogical approach, intended and perceived learning outcomes, and L&T activities used in the case study course. For each of these categories, observational and teacher interview data will firstly provide descriptive detail followed by student survey and focus group data which will show how these L&T approaches and methods were perceived by students and the learning experience and perceived learning outcomes of the students from these approaches. Theory of good practice L&T for EfS will be used to draw out and frame elements of L&T practice in the data. This theory is also supported and/or challenged by the empirical data presented in the results.

### **4.5.2 Pedagogical approach**

The following box summarises the pedagogical approach of Case Study Four and student experience of this approach based on the data collected.

### Pedagogical approach in Case Study Four

- Teacher-centred approach to L&T in the course and delivery of information to students about sustainability in engineering.
- The teacher advocates ‘getting straight to the point’ in EfS, situating sustainability in the professional context and educating students on opportunities for change in the industry.
- The course highlights and investigates realistic opportunities for change for sustainability (e.g. emission reduction technologies) within the current economic paradigm. Students have to then research these existing change opportunities for their assessments.

### Student research participant perspectives of pedagogical approach in Case Study Four

- The teaching approach differed considerably from the good practice approaches advocated in the EfS literature based on student descriptions of the teaching approach.
- Overall student participants had positive comments about the student-teacher relationship and their experiences with the teaching approach in the course indicating a preference for more teacher-centred approaches to L&T.
- Despite the course being delivered in a teacher-centred manner, student participants felt it was interactive compared with other subjects in the students’ degree program because there was much opportunity for class discussion and debate during the lectures.

### *Course overview*

#### Case Study Four: Summary of course information

(See Appendix 5.1 Case Study Four course overview for more detail)

Year level	
	Second year core/compulsory (and some third year elective students)

<b>Course size</b>	68 Students
<b>Duration</b>	12 Weeks
<b>Course delivery method</b>	2 to 3 hour combined lecture/workshop each week for the duration of the semester
<b>Learning objectives</b>	<p>The hard copy course guide outlines the following learning objectives for the course:</p> <p>Knowledge of:</p> <ul style="list-style-type: none"> <li>▪ Sustainability of air transport systems</li> <li>▪ Climate change and the aviation industry</li> <li>▪ Policies for climate change and how it affects the aviation industry</li> <li>▪ Reduction of climate change within the industry</li> <li>▪ Fuel technologies</li> <li>▪ Noise reduction technologies</li> <li>▪ Technical and professional skills</li> <li>▪ Analytical and communication skills</li> </ul>
<b>Assessment</b>	<ol style="list-style-type: none"> <li>1. Class Quiz 1 –1 hr, 20% of course grade, undertaken in week 4</li> <li>2. Individual Assignment 1, 15% of course grade, due in week 5</li> <li>3. Group presentation –10 minutes per group, 10% of course grade, due in week 6</li> <li>4. Group presentation, 15 minutes per group + report, 15% of course grade, due in week 10 or 11</li> <li>5. Class Quiz 2 –1.5 hr, 25% of course grade, undertaken in week 12.</li> </ol>
<b>Relationship of the course to students' experiences of sustainability and L&amp;T approaches in other courses in</b>	<p>Some students come into this course with some knowledge of sustainability from a first year course in engineering and sustainability that features problem based activities in applying sustainability to a project. Other students come into the course with no prior learning of sustainability in their program. It should also be noted that for some students, including those that participated in this research, this course was compulsory, however</p>

<b>their program</b>	for others it was an elective course. Based on the data collected, students generally experience teacher-centred L&T approaches in the programs.
<b>Research methods</b>	See Appendix 5.2 Case Study Four specific research methods

*Description of pedagogical approach based on teacher interview and observational data*

**Discipline specific approach to sustainability with a focus on realistic opportunities for change**

Based on the teachers' account of their course, sustainability education is about raising awareness and getting students to understand how sustainability issues link to their profession. Key to student learning about sustainability in the course according to the teacher was getting straight to the point about opportunities for sustainable development in the industry. The course is delivered on the premise that the industry has acknowledged that its operations have environmental impacts and contribute to global warming. Due to fact that the industry has acknowledged its contributions to pollution and global warming, the existence of these impacts are taken as a given rather than debated in class. When designing the course, the teaching staff identified key opportunities for change in the industry and the students investigated these further through the course. The teacher indicates that this is to show students that there are opportunities for change in the industry:

I would say [teachers in EfS] have to get straight to the point and identify the areas that their specific industry can work with, because at the end of the day no airline is going to curb their economic growth for sustainability, it's just not going to happen. Basically [students] have to recognise that... at the end of the day they are dealing with businesses that are profit driven and they take sustainability into account but not at the risk of their growth or the growth of their business... The advice I would be giving anyone else teaching this specific subject is get straight to the point and see where sustainability can be applied... and that's why we have identified specific areas that we discuss, for example biofuels, which is a hugely promising venture for the future.

Based on the teacher's comments, the course assumes that the current economic paradigm will continue and sustainable development within the industry must work within this paradigm in order to pursue realistic opportunities for change. Due to this approach to



implementing sustainability in the industry, the course teaches about elements of the industry where environmental impacts can be reduced without impacting the economic bottom line of the industry. The teacher commented ‘that’s why we have identified specific areas that we discuss’ so that these technologies can be applied within the current economic paradigm in aviation industry’. According to the teacher, the course is about:

...educating the students on the current trends in sustainability in the aviation industry and then what the future trends might be to continue a sustainable development of the industry.

### **Triple bottom line approach to sustainability**

When the teacher was asked about how their students learn best about sustainability they discussed how sustainability as a concept is introduced over the course. The teacher introduces a broad definition of sustainability that was then explored in relation to social, environmental and economic responsibility in the sector in line with a triple bottom line approach. According to the teacher, in the course ‘sustainability is broadly defined’ because ‘you can’t have a specific definition for sustainability’. However students are introduced to ‘a generally accepted definition of sustainability’ in the course that is ‘the long-term maintenance of responsibility, including corporate responsibility, by the industry for our planet’. This is then looked at from a ‘social context and an environmental context and the economic context’.

### **Active teaching approach**

The teacher described their teaching approach as ‘active’ aiming to get students engaged. They do this through delivery of a mixed workshop where they lecture and encourage questions about the content. This was confirmed through workshop observation in week five (see Appendix 5.3 Case Study Four observation results). The teacher felt that some of the content naturally lends itself to be more engaging for the students, for example debating global warming, however some of the content due to the technical nature was difficult to deliver in an engaging way:

[I] always try and engage the students, especially opinions, but it also depends on the content of the lecture. For example if I was debating climate change... it was more engaging, whereas if I was talking to them about the technical, for example aircraft design and weight reduction, it was a much more technical presentation and it was more lecture style.

### *How effective are these practices for learning for sustainability according to students?*

Survey data indicates that respondents had a positive and satisfying learning experience in the course overall. Five respondents experienced ‘understanding’, ‘enjoyment’ and ‘satisfaction’ in the course, while three respondents experienced ‘boredom’, ‘anxiety’ and ‘confusion’. Eight of 10 respondents felt that overall, the effort required in both completing assessments and participating in class activities in the course was ultimately rewarding. Qualitative comments about the teaching approach indicated a positive relationship between the teachers and the students in the course. The teaching staff were described as approachable and helpful:

- it was very different between our two lecturers we had. one the professor was very lecturing, we listen he teach, yet very engaging. however our main lecturer, was always open to discussion and always asking our options aswell and really engaging us throughout the lectures
- both teachers were approachable both before and after class for clarification of any uncertainties.
- The teacher was very helpful and approachable.
- Lecturers were very willing to pass on information to us students. They were friendly and engaging as well.
- Didn't have personal relationship however as a whole they were satisfying.

Focus group data supports the observation that the course is teacher-centred. Focus group participants described the learning in the course as learning information through lectures and researching existing technologies and writing about what other people were saying. The participants also described the lectures as the delivery of information with the opportunity to raise questions and debate material, which gave students the opportunity to share ideas and opinions. For example:

- A lot of the ‘lecture time’ it is like a lecture, but we can always ask questions whenever we want and when one question starts... there’s always a discussion.... Especially when we were talking about global warming... cause some people are passionate against it and other people are passionate for it and [the teacher] was like ‘ok you guys can discuss it, just go for it’.
- it’s an informative subject. All our assignments have been go out and research strategies. In the first assignment... it’s like go out and get information and evidence for that information, it’s not like lets create biofuels ourselves, it’s nothing like that...

This L&T approach was supported by participants, for example one student commented that ‘for me I like the facts’ which indicates that this student liked to learn about facts through the teacher-centred approach. Another student added that the course is not about thinking about ‘completely different solutions’ and another said, ‘It’s nothing about us being creative, it’s all finding information, understanding that information and taking it in.’ One student felt that this is good because ‘everything has been done’ (sustainable technologies developed) ‘we are living in the intelligent world but people are doing something like updating...’ So therefore this participant felt that the course is to update students on what is being done to move the industry towards sustainability. However, participants also felt a hands-on project would help their learning (see learning and teaching methods below). Interestingly, despite this course being largely teacher-centred, one student commented that ‘there’s more interaction in this course than other subjects’ which indicates that the style of teaching students are accustomed to in the degree program is very much non-interactive learning. This is a key consideration when deciding how best to meet the learning needs of a student cohort in EfS.

#### 4.5.3 Intended and perceived learning outcomes

The following box summarises the intended and perceived learning outcomes based on the data collected.

##### Intended learning outcomes in Case Study Four

Outcomes indicated by teacher interview and observational data:

- Awareness of sustainability in relation to aviation industry (sustainability is defined as long-term responsibility to the planet from an environmental, social and economic perspective).
- Professional skills: critical and analytical thinking and communication

Outcomes described in the course guide:

Knowledge of:

- Sustainability of air transport systems
- Climate change and the aviation industry
- Policies for climate change and how it affects the aviation industry
- Reduction of climate change within the industry

- Fuel technologies
- Noise reduction technologies
- Technical and professional skills
- Analytical and communication skills

#### Perceived learning outcomes by student participants in Case Study Four

- Student participants gained:
  - Awareness and understanding of sustainability in aviation (including concepts such as future generations, responsibility and respect, welfare and environmental impacts).
  - Knowledge of measures to make changes for sustainability in aviation (such as composites and other efficiency measures).
  - Research and study skills
  - Moral responsibility
- The course helped students see the importance of sustainability and gain an understanding of the professional applications of sustainability
- Perceived opportunities for change in the industry differed with some student participants arguing that change for sustainability is not possible and others seeing opportunities for change.

#### *Intended learning outcomes based on teacher interview and observational data*

The learning outcomes for sustainability education were discussed in the context of the course. The learning outcomes were knowledge based and framed as educating the students or instilling knowledge. The delivery of information was emphasised through the interview. The main learning outcome from the course was for students to be educated on what the aviation industry is doing to curb the effects of global warming and environmental pollution:

...scientific evidence strongly points to the fact that global warming and other environmental pollution [are] mainly human induced and therefore [the course focuses on] what is being done to curb the effects of this pollution and what is the aviation industry doing in particular to curb the effects.

When asked about skills, the emphasis was placed on awareness building about sustainability in relation to the profession rather than developing 'sustainability' skills, for example problem solving, systems thinking or decision making. Critical, analytical and communicative skills were mentioned in terms of general skills; sustainability skills were about awareness.

In terms of sustainability skills, we just want them to be aware of... every aspect of sustainability in relation to the aviation industry, whether it be reducing fuel burn in aircraft or looking at the Australian carbon tax in relation to the aviation industry... In terms of general skills obviously we want them to develop analytical and critical type thinking, obviously effective communication skills and your typical technical and professional skills through their assessment work.

The teacher felt that the students' response to the course was positive: 'so far it has been fairly positive and they have said they have learnt something, they have gotten something out of it and they've said that they had some minor recommendations as to where and when to offer the course' in the program.

Based on the observational data, students would have gained knowledge of technology to reduce environmental impacts through the lectures and student presentations and research into the technologies. Students may have also developed academic skills such as research, writing and referencing skills, as well as presentation skills (much of the teacher feedback on student presentations related to presentation skills). The ability for students to analyse the level of sustainability of a technology, operation or design using sustainability frameworks during presentations was not observed. The presentations observed did not go into detail about 'sustainability' or associated principles. This does not necessarily mean that what students are talking about will not achieve sustainable outcomes in the industry, however this may indicate that through the course students gained knowledge on what technologies are 'sustainable' without actually developing the skills to critically assess what is sustainable on their own, for example, using sustainability concepts, tools or frameworks like triple bottom line, systems mapping or life-cycle analysis. Further research is required to verify this observation however (see Appendix 5.3 Case Study Four observation results).

***How effective are these practices for learning for sustainability: Perceived learning outcomes according to students***

**Perceived changes in thinking and knowledge as a result of the course**

Most survey respondents felt that their thinking had changed as a result of the course. Qualitative statements indicated that thinking or perspectives had been broadened and more understanding gained as a result of the course.

- it has broadened my scope at looking at the environment and its issues. also that aviation is all good and has a lot still to learn and that there is opportunities available to do something new and innovative.
- Given me another perspective to consider issues from
- The subject did provide a new view of the impact the aviation industry has on the environment and gaining knowledge of renewable resources and light-weight designs are quite interesting and its good to know of these basic development in the aviation industry.
- I learnt to be more understand about the environment, in aviation especially.

This was supported with data from the focus groups where students described changes in thinking including increased awareness and understanding of sustainability and measures to reduce sustainability related impacts of the industry. One student described their understanding of sustainability as looking at the industry ‘without compromising future generations’. They described sustainability as ‘a problem of responsibility’ and that ‘when you do something you need to think about the environment’ and described sustainability as a ‘global approach’ to looking at negative impacts. Another student said the number one learning outcome they had in the course was ‘awareness’; ‘That you have to consider [sustainability]’ and if you don’t there are ‘repercussions’ and negative impacts on the environment. One student stated that through the course they learnt a lot of measures for reducing impacts from industry:

Just learn a lot of measures. There’s a lot of ways that aviation can be improved so there’s operational, construction and engines. So we learn a lot about the actual measures. First we learn about the impact and then we learn about how to stop it.’

### **Perceived skills development**

The skills described by the four respondents who answered the question regarding skills development in the course, varied greatly. The skills mentioned included: ‘Problem solving, resourcefulness, researching abilities, studying abilities’, ‘non calculation based investigation skills’, ‘moral responsibility’ and ‘more science knowledge’. Comments about understanding and knowledge gained through the course were common in survey responses, whereas skills related learning outcomes were only mentioned three times in all survey responses. This

indicates that students gained knowledge based learning outcomes from the course. This was also supported by focus group data with students discussing knowledge and awareness gained, rather than the development of skills.

### **Perceived relevance and value of the course**

Respondents' opinions on the relevance of the learning of the course to their future profession were mixed. One respondent commented that they did not feel the course was relevant because the course content did not relate directly to their degree program, while another respondent indicated that they see the links between sustainability and their profession clearly and the learning would put them in a good position in the workplace. This indicates that the course was relevant for some and not for others depending on their program and interests.

- I think that sustainability in aviation will be a key component of the industry going forward, and having a background in the subject matter will be important in understanding the key problems and challenges and the ways and means to tackle these issues will put me in good stead in the workplace.
- it was useful knowledge to know in the field we are in, be it if we start working in airlines or airports... this subject gave us even more in depth knowledge to it and how the aviation industry is dealing with this problem.

Some respondents indicated that they do not feel sustainability in the industry is possible and therefore the course is not relevant, for example 'as aviation is still mainly economically driven i don't know if this course will really help' and, 'aviation management does not seem to require in-depth knowledge in how to bring upon more sustainable technology to the aviation industry'.

Focus group comments about the relevance and opportunities for sustainability in the industry were similar to survey responses. Focus group participants also disagreed with each other about the opportunities for change in the industry with some students arguing that sustainability in the industry is not possible, for example 'ultimately aviation cannot be sustainable because it's relied so heavily on fossil fuels', while others seeing opportunities for change in the future and career opportunities in sustainability. For example 'if I work for an airline... in the future they will put a title in 'sustainable manager' or something like that'. This student commented that this is something they would like to do:

I really notice how handy it will be to have had this course so when we get out there and people start talking about [sustainability] or if we get environmental person in we will be

able to be like ‘yeah, I know a little about that’, like we don’t know a lot – we are not studying it as a major or something- but we got a background and baseline now and because it’s so specific to aviation we’ve been able to go quite in depth.

Survey responses about whether respondents think the course should continue to be part of the degree program were mixed reflecting these comments above. Three students (42.9% of respondents) said the course should be part of their program, while the same number answered ‘only with some changes’ and one answered it should not.

Some survey respondents indicated that they do not feel sustainability in the industry is possible and therefore the course is not relevant, for example ‘as aviation is still mainly economically driven i don’t know if this course will really help’ and, ‘aviation management does not seem to require in-depth knowledge in how to bring upon more sustainable technology to the aviation industry’.

#### **Course impact**

The course had a slight impact on survey respondents in terms of perceived professional and personal relevance of sustainability as a result of the course. After the course 85.7% of respondents felt that sustainability is relevant both personally and professionally, however before the course most respondents also felt this. Given the small response numbers it is difficult to determine a clear trend for this case study.

When asked about whether the course has helped students see opportunities for change one participant stated that, ‘It’s quite interesting, both our lecturers are quite passionate about [sustainability] and I think that passion has rubbed off a little.’ This indicates that the course has helped this participant become passionate about sustainability in the industry.

#### **4.5.4 Learning and teaching activities**

The following box summarises the learning activities used and the student experience of these based on the data collected.

##### **Course L&T activities to facilitate learning for sustainability in Case Study**

##### **Four**

- Videos (YouTube)



- Class discussion encouraged
- Informal lectures
- In class quiz assessments
- Student presentations

### Student research participants' perspectives on effective L&T activities for learning for sustainability in Case Study Four

- Student data indicates that respondents preferred the delivery of information or teacher-centred approach to L&T.
- Discussion with the whole class, listening to the teacher explain/demonstrate in the workshops, speaking one-on-one with the teacher and working on assessments alone out of class time (individual homework) were most important for their learning about sustainability.
- The respondents rated working on assessments in small to medium groups in the workshops least important.
- Videos were an important L&T aid for focus group participants to validate what they had been learning in the course and demonstrate real life application of technology and theory.
- Focus group participants felt their learning from the course would benefit from a 'hands-on', creative project.

The teacher describes their approach to teaching as 'active' and attempts to engage students and support discussion about opinions in lectures and also uses multimedia:

I try to be engaging as possible and obviously use multimedia and YouTube and video content and trying to change it up a little as opposed to me talking at them for two hours. So I would say it is a mixture of workshop and lecturing [in class time].

The teacher actively encourages class discussion/questions and answers through lectures and describes their lecturing style as informal. The teacher feels through this approach they engage students who are willing to learn and are interested in the subject matter, however they feel that students who 'are just interested in having a pass' in the course remain unengaged.

...you get positive and quite lively discussion with the engaged students that are actively interested in the subject matter that have an opinion or generally enthusiastic about learning

but then you get the apathetic students that are just interested in having a pass and not having to repeat the subject.

Learning outcomes are achieved through assessment in the course according to the teacher. These assessments include the class quizzes. There is also an individual research report where students research a given topic (see Appendix 5.1 Case Study Four course overview for detail of assessments). The teacher comments that the ‘really switched on’ students in the course learn a lot from the research and presentations and the ‘exceptional’ student presentations help teach other students about sustainability in the industry. Based on the teacher's comments, they feel that students who have been engaged and develop good class presentations help to excite other students that are less engaged with learning. Both engaged students and non-engaged students ‘learn a lot’ from ‘exceptional’ presentations.

***How effective are these practices for learning for sustainability according to students?***

This preference for delivery of information approach to L&T is indicated again with student respondents rating discussion with the whole class, listening to the teacher explain/demonstrate in the workshops, speaking one-on-one with the teacher and working on assessments alone out of class time (individual homework) most important for their learning about sustainability. ‘Working on assessments in small to medium groups in the workshops’ was rated least important by the respondents, again indicating that the respondents prefer a teacher-centred approach to L&T where information is delivered by the teacher rather than learning from peers (see Appendix 5.4 Level of importance of L&T activities for respondents learning about sustainability).

In response to a different question, one student stated that they found group work the most engaging: ‘The group report and presentations was what I found the best about the subject, because when you're in a group discussing about only one small section of a topic I found that it was easier to understand.’ This indicates that group work was good because it helped this student focus on a small section of a topic so ‘it was easier to understand’. This again is different from the learning advocated by good practice EfS that encourages big picture thinking and engagement with complexity.

Learning about specific technologies or operations was found to be most engaging by five respondents. Three respondents noted lectures and topics as most engaging. One student said group work and another said the whole course was the most engaging in their program because it was so relevant. This indicates that respondents preferred the delivery of

information or teacher-centred approach to L&T, which is not in line with the theory of good practice.

Videos were mentioned as the most engaging and useful for focus group participants. These participants commented that videos were engaging and helped validate or legitimise the theory they had learned in the course. The videos also helped students see professional application of theory and what is possible in aviation:

- I pay a lot more attention to videos, if you always have a straight boring lecture, you just sit there... but once the videos come on everyone just props up again and the awareness is back.
- it's all well and good hearing the theory but then when you get a video from airbus saying we've done this to our engines and now therefore this, and you're like 'ok, that puts it in perspective.
- but once it gets shown you're like 'oh that's interesting
- Yeah and it gives you that sense of confirmation
- [videos] actually bring you closer to the topic to make it real. You're not hearing it from it a third party...
- The more you hear it the more you remember it as well so the more the videos I watched or the more I read the more it stayed in my mind
- videos allow 'getting validation of it from an industry body, because as far as we know they [the teachers] could be talking out of a text book but when you actually get a video saying this is what NASA is doing or this is what Boeing has done than it makes you realise what is actually happening.

While focus group participants supported the teacher-centred approach to L&T in the course, they commented that they would also like the opportunity to do a 'hands-on' project to help their learning in the course, as this would be more engaging and fun. They said they would like the opportunity to be creative and innovative in the course.

...at the moment we've just done theory and reading from the books but... maybe you actually got to think of a project, (like at the moment it's very reference focused, like you've got to go find information that's already out there), but maybe if we got given the chance to come up with something ourselves and get the creativity flowing it would give you more pride in your work rather than getting someone else's work and putting it in a word document, if you actually did something and thought wow, I thought of that then it would actually be more useful.

Students discussed a ‘hands on’ project they did in another course where they were asked to build a plane. All focus group participants felt that this was a good learning experience. For example:

...that project where we built the plane I found that really engaging because I really wanted to build the aircraft well whereas when it’s just a report and you know it’s someone else’s information that you’re just gathering from various different sources it is not as rewarding.

Students also felt there could be more opportunity to be innovative in the course, for example ‘you could just have creative ideas like put solar panels all over the aircraft --it’s a completely stupid idea when it comes down to the facts and figures-- but I think that would be fun’. Another student provided the following rationale for supporting innovative thinking in the course: ‘Every idea would have been told it was student in the first place like who would have thought you could get aviation fuel from plants, someone thought of it and it developed from there.’ Other students commented on the value of learning from the trials and errors of a practical project like the model plane where you test out ideas and make changes.

#### **4.5.5 L&T challenges described by teacher and students participants**

The teacher described a number of teaching challenges in delivering their course including engaging disengaged students and addressing resistance to learning specifically about sustainability by students who question the relevance and value of sustainability in their discipline. The teacher said that they ‘would say that about 30% of the students are engaged’ and the other students ‘are present and they are listening, because they do have questions for me or they do give me an indication that they were paying attention’ however these students are not ‘actively engaged’. Active engagement is described by the teacher as actively debating issues and being ‘knowledgeable and enthusiastic’ about the course.

I would like 100% student engagement and I know I can’t have that and I guess that’s just my view as a younger lecturer or whatever that is I know I can’t get everybody to care about this as much as I do.

The teacher commented that they ‘hope [the students’] attitudes change, but at the end of the day it is a personal attitude thing and that quite frankly is hard to work with’. The teacher also commented that clear communication of technical information, so that students understand, is

a challenge and feels that through repetition, information about technology presented in the course will become clearer.

Learning challenges expressed by survey respondents were mixed. Two respondents mentioned group work as a challenge with one of these students attributing the problems with group work to 'uninterested students' so like the teacher, students also felt challenged by students who were disengaged in the subject. Another two respondents commented that there were limited guidelines for assessments that was a challenge, 'no guidelines were laid out, so it was particularly hard to decide on which direction the report should answer'. Focus group participants did not comment explicitly on learning challenges or indicate any learning challenges during the focus group discussion.

#### **4.5.6 Case Study Four Summary**

With the exception of situating sustainability in the professional context, the course does not feature elements of good practice according to theory. The course was focused on the transfer of knowledge about sustainability from teachers to students and therefore teacher-centred, rather than student-centred. Students were required to research information rather than create new knowledge. Students preferred the teacher-centred L&T methods and commented that the course is more interactive compared with their other subjects in the degree program and that gives an indication of the student expectations and L&T style of the discipline. These existing L&T practices and student expectations need to be taken into account when developing EfS. Despite the point above, focus group participants felt that a 'hands on' project would make the course more engaging and fun as well as support their learning for sustainability.

Overall, students had a positive learning experience with the course and gained an understanding and awareness of sustainability in the industry and existing measures that can reduce environmental impacts. Focus group participants indicated they gained broad understanding of sustainability as result from the course including responsibility to society and environment, respect for impacts on society and environment and also taking into account future generations. Videos appear to be a key L&T aid to validate what students had been learning about sustainability in the industry in the course and demonstrate real life application of technology and theory. Student participants also found videos to be more engaging than learning from lectures.

The course highlights and investigates realistic opportunities for change for sustainability (e.g. emission reduction technologies) within the current economic paradigm. Students have to then research these existing change opportunities for their assessments. The teacher felt that students need to learn about 'realistic' opportunities for change within the current economic paradigm. While some students were optimistic about change in the industry, other students felt that sustainability was not possible because of the nature of the industry (reliance on fossil fuels) and the profit motive. The teacher expressed a challenge in engaging unengaged students in the class (about 70% of students according to the teacher). Based on the teacher's comments, the teaching approach seems to engage students who already have an opinion and interest in sustainability yet not those that are not interested in learning in general or learning specifically about sustainability. The question remains, is it possible and if so, how to engage students with no interest or previous knowledge of sustainability in manner that suits the learning style of the student cohort so that they feel a desire to engage in the learning.

## Value of the Case Study Four for this research

Case Study Four is based on the delivery of information to students with assessments focused on researching and presenting existing practice. Rather than exploring opportunities for paradigm change in the industry, the course takes a realist view of the opportunities for change in the industry given the current economic paradigm<sup>12</sup>. From the four cases, this course is situated more towards a teacher-centred approach to L&T. Students had an overall positive experience with the course, liked the teacher-centred teaching approach (delivery of information) and expressed a preference L&T activities that leaned towards teacher-centred approaches. Data indicate that students gained an understanding and awareness of general definitions of sustainability and measures to address sustainability in the industry, although they felt more room could be made for the development of new ideas through creative, 'hands-on' projects.

This case study is important for the research because it shows that the L&T approach students are accustomed to in the degree program is a key consideration when deciding how best to meet the learning needs of a student cohort and implement good practice L&T for sustainability according to the theory. The data indicate that the depth of student participant learning in the course is not in line with good practice EfS (for example, development of capabilities for sustainability including problem solving, reflexive practice, experiential learning, values reflection, and so on were not indicated by the data), therefore the question arises as to how a cohort of students who indicate a preference for teacher-centred L&T can be supported to engage in deeper, transformational and capabilities building learning in EfS.

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<sup>12</sup> The approach limits students' ability to develop their own critical evaluation of change opportunities in the industry, be creative in problem solving, learn through experience or look for opportunities to bring about paradigm change. The nature of sustainability is defined and the target areas for change (that do not affect the financial bottom line) have been set, students are required to research these and talk or write about them.





## 5.0 Chapter Five: Discussion

### Contents

- 5.1 Introduction
- 5.2 Building on the theory
- 5.3 Emerging concepts and practice
- 5.4 Qualifications

### 5.1 Introduction

This dissertation asks *what does good practice learning and teaching (L&T) for sustainability look like* and aims to describe characteristics of good practice L&T in education for sustainability (EfS) in higher education (HE) according to teacher and student experiences in EfS courses in order to add to existing theory. L&T practices include pedagogy (teaching approach), intended and perceived learning outcomes and L&T activities used. The research undertaken did this by investigating the L&T practices used in the four case study EfS courses<sup>13</sup> and how effective these practices were for learning for sustainability, based on teachers and students experiences in the courses.

Chapter Three outlines the major pedagogical characteristics, learning outcomes and L&T methods advocated in the literature. These included:

#### **Pedagogy or L&T approach for EfS involves:**

- **Learner-centred L&T** founded on social constructivist epistemology (including self-directed learning with the teacher's role as facilitator and learning partner, not the 'expert')
- **Transformational learning** (including deep learning, higher order learning, learning *as* sustainability and reflexive learning)

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<sup>13</sup> The term 'course' in this dissertation (and case study university) refers to a single 'subject' which is delivered over one semester, and a 'program' refers to the degree as a whole made up of a number of courses.

- **Holistic and systemic learning** (including multidisciplinary, interdisciplinarity and transdisciplinarity approaches, and the use of multiple perspectives from differing disciplines and collaborative teaching)
- **Capability building** (including focus on skills, competencies or capabilities rather than the acquisition of information)
- **Active learning** (including experiential, participatory and collaborative learning)
- **Real issues orientation** (mimics real life through problem or inquiry based praxis-orientated learning)

The literature review argued that there is significant overlap and interconnection between these identified approaches, for example, all sit within learner-centred practice and are interdependent to support learning for sustainability; active learning supports capability building or real issues orientation supports systemic understanding and so on.

**Learning outcomes associated with an EfS pedagogy cover:**

- Sustainability literacy
- Systemic and holistic thinking
- Capability and motivation for lifelong learning
- Critical thinking and reflection
- Reflexivity
- Interdisciplinary skills and ability to work with stakeholders
- Foresighted, anticipatory and futures thinking
- Working with complexity and uncertainty
- Implicit development of values or value of learning and reflection
- Characteristics: empathy, compassion, self-motivation and sense of identity

**Learning and teaching activities to achieve EfS learning outcomes involve:**

- Authentic assessment
- Inquiry-based learning: Problem-based learning, case studies, critical incidents and simulations
- Descriptive and visual conceptual tools: Mapping, diagrams and models
- Visioning projects: Future-focused visioning projects, scenario analysis and back-casting

- Situated learning: Place-based education, field work and work-based projects
- Interactive, perspective sharing activities: Group discussions, debates, role plays and stimulus activities
- Reflexive accounts
- Critical reading and writing

This research was informed by a Grounded Theory approach to explore the lived experience of EfS in practice and gain insight into L&T experiences - what worked and what did not, for learners and teachers, and what L&T challenges were experienced. The data collected was then presented in the major categories of pedagogical approaches, intended and perceived learning outcomes and L&T activities.

In the results presented in Chapter Four we saw that all of the case studies situated learning for sustainability entirely in professional or disciplinary contexts. In the case studies we saw elements of good practice *according to theory* to varying degrees, with Case Study One, Two and Three very much in line with good practice theory and Case Study Four featuring some elements of good practice. While the data largely supported the theory of good practice, the different pedagogical approaches of the case studies show that what is good practice varies in lived experience and L&T needs, and perceptions of good practice vary to some degree between disciplines and student cohorts. Please refer to the summary sections at the end of each case study in Chapter Four for an overview of the results from each case study course.

In this discussion we will look at the results in light of the theory presented in Chapter Three to explore commonalities and differences between the research results and theory, and add to the theory with new insights gained from this research. The discussion will firstly look at the commonalities and differences between the research and the theory in the major categories of pedagogy, learning outcomes and L&T methods, exploring and building on the existing theory. As a consequence, this discussion will demonstrate both how the case study teachers put the theory of good practice into practice, and explore the effectiveness of this practice according to teacher and learner experiences<sup>14</sup>. Further, the discussion provides practical examples of L&T practice, and also builds on theory of good practice. The discussion will then explore new concepts and emerging theory that can be added to existing theory described in Chapter Three.

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<sup>14</sup> Learning outcomes and experiences described by student participants in the case study courses are based on their recollection and perception of their own learning and experiences and therefore are an indication of *perceived* learning outcomes and experiences.

## 5.2 Building on the theory of good practice

Many of the approaches advocated for good practice in the theory were seen in differing degrees in the four case studies. Some approaches advocated by the theory were very important for student engagement in learning processes and perceived learning for sustainability according to students. This section will now describe the similarities and differences in the results from each of the case study courses with the elements of good practice L&T according to the theory presented in Chapter Three.

### Learning and teaching approach: Learner-centred

Blumberg (2009) defines ‘five dimensions of learner-centred teaching’ which have been summarised in Table 5.1. The purpose of this summary is to provide a context for the L&T approaches used in the case study courses, from a theoretical perspective, to guide the discussion and to provide insight into how these different approaches can be modelled or put into practice in an EfS context.

**Table 5.1: Five dimensions of learner-centred teaching**

Dimension of learner-centred teaching	Description
1. <i>The function of content. The degree to which students:</i>	<ul style="list-style-type: none"> <li>○ Are presented rationales for their learning of content, to solve real problems, learn about discipline specific methodologies, use inquiry-based thinking used in the discipline</li> <li>○ Engage in reflecting and transforming content to make meaning</li> <li>○ Use disciplinary ‘organising schemes’ to help structure content</li> <li>○ Can use content for further analysis and ongoing learning</li> </ul>
2. <i>The role of the instructor, where the instructor:</i>	<ul style="list-style-type: none"> <li>○ Creates a learning environment</li> <li>○ Explicitly aligns course objectives with L&amp;T and assessment methods</li> <li>○ Uses appropriate L&amp;T methods for learning goals</li> <li>○ Uses interactive based methods</li> <li>○ Articulates learning objectives</li> <li>○ Encourages and supports students' motivation for learning</li> </ul>
3. <i>The responsibility for learning. The degree to which learners develop:</i>	<ul style="list-style-type: none"> <li>○ Responsibility for learning</li> <li>○ Learning to learn skills for the present and the future</li> <li>○ Self-directed, lifelong learning skills</li> </ul>

	<ul style="list-style-type: none"> <li>○ Self-assessment of their learning</li> <li>○ Self-assessment of their strengths and weaknesses</li> <li>○ Information literacy</li> </ul>
4. <i>The purposes and processes of assessment</i>	<ul style="list-style-type: none"> <li>○ Assessment is built into learning</li> <li>○ The use of formative assessment in order to provide ongoing feedback on learning</li> <li>○ Teacher assessment is combined with peer and self-assessment for triangulation</li> <li>○ Authentic assessment</li> <li>○ Timely feedback</li> <li>○ Evidence based justification for learners' responses</li> </ul>
5. <i>The balance of power</i>	<ul style="list-style-type: none"> <li>○ Teacher encourages learners to explore aspects of the content independently</li> <li>○ Alternative views are encouraged</li> <li>○ Opportunity for students to re-submit assessments to gain 'mastery'</li> <li>○ Open-ended assignments where students can take their own directions or answers</li> <li>○ Flexibility on policies, assessment, L&amp;T methods and deadlines based on agreement with learners</li> <li>○ Encourages students to take advantage of opportunities to learn</li> </ul>

Five dimensions of learner-centred teaching paraphrased and summarised from Blumberg (2009).

This discussion will now attempt to best describe the case study courses using the dimensions of learner-centred teaching in Table 5.1. However, it needs to be noted that further research is required to confirm where courses sit on some of the categories with teaching staff. This none-the-less provides a general picture of the courses in terms of learner-centred teaching. The result of this review is that, based on these five dimensions of learner-centred teaching, Case Study One, Two and Three were predominately learner centred, while Case Study Four was teacher-centred leaning (see Table 5.2).

**Table 5.2: Comparison of case studies with learner-centred approach**

	Learner-centred	←	Transitioning	→	Teacher-centred
1. Function of content	CS 2, CS 1, CS 3		CS 4		

2. Role of the instructor	CS 2, CS 1	CS 3		CS 4
3. Responsibility for learning		CS 2, CS 1, CS 3		CS 4
4. Purposes and processes of assessment		CS 2, CS 1, CS 3	CS 4	
5. Balance of power	CS 2, CS 1	CS 3		CS 4

CS = Case Study

The following provides the rationale for the placement of the case study courses in the rubric.

### ***1. Function of content***

Case Study One was learner-centred based on the use of content in the course through application, student ownership and interpretation and exploration rather than ‘acquiring knowledge’. For example, theory was presented to students in lectures and workshops which students were then asked to apply and make sense of in their assessment tasks. Learners were asked to develop and evidence their own definitions of sustainability and related concepts that they could use to inform their assessments. Almost all theory presented, based on observational data, was explored through application in real-life professional contexts in activities and assessments and in doing so, students were given a rationale for the content knowledge. The application of content knowledge in practice equipped students with skills for ongoing learning through research and application of knowledge in future practice.

Case Study Two and Three had a similar approach to the ‘function of content’ dimension, although their assessments differed<sup>15</sup>. However, Case Study Four leaned more towards a

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<sup>15</sup> Case Study Three student focus group participants did comment that they felt the teacher gave them a lot of room to explore sustainability in their design practice in a creative manner, however they felt restricted in what they were able to present in the final product, thus they felt they were required to meet predefined notions of ‘what sustainable design is’ at the end of their assessments.

teacher-centred approach. Although there was some opportunity for debating some content such as climate change in lectures, content was delivered to students in lectures with little opportunity for students to apply content to solve problems and develop their own ideas about how sustainability can be applied. The teacher commented that the students were *taught* what technologies were feasible for promoting sustainability in the industry, rather than allow students to explore this for themselves. This was to show students, from the beginning, that sustainability is possible, however this potentially also meant that students did not develop skills for ongoing learning; for example, being able to assess for themselves what is, and is not, 'sustainable' in their industry, why and how. The written and oral assessment tasks were based around research and memorisation of technologies and operations that were provided by the teaching staff.

## ***2. Role of the teacher***

The role of the teacher was very similar in Case Study One and Two, which could be characterised as learner-centred in this dimension. In both case studies the teacher was seen as a friend and partner in the learning journey based on student data. The teacher provided support, guidance and feedback and facilitated interactive activities and assessments in workshops where students learned from peers and made sense of the content. While the teachers expressed their own views and values on sustainability, based on observational data, this was done to model values reflection, assumptions and providing evidence to support views. Different learning styles were accommodated through a mix of activities such as lectures, videos, group discussion, critical reading, writing, group work, concept mapping, discussing, one-on-one time with the teacher, guest lecturers and so on. Learning objectives and rationales for assessments and activities were presented on lecture and workshop PowerPoint slides, described by the teachers and also in the course guide.

Case Study Three was also learner-centred learning with the teacher facilitating practical and interactive assessment activities in class, specifically for the first group assessment. The explicit presentation of learning goals and objectives was however limited and student data indicated that lectures were not interactive and that the course needed to be more interactive. The students felt that the teacher was not supportive or interactive enough. The teacher commented that they presented themselves as 'a non-expert' and attempted to present sustainability in a 'this is what the world is taking about' manner in order to diminish their

own authority when talking about sustainability and give students the space to critique and develop their own ideas.

The role of the teacher in Case Study Four appeared to be teacher-centred based on the teacher's comments and student experience. The course was predominately lecture based and the teacher's focus was to convey content clearly so that students could understand, with discussion or questions and answers in lectures occurring to clarify material. Based on the course materials provided to students there was little rationale provided which linked course activities and assessments with learning objectives and course delivery catered to one learning style. Case Study Four's teacher commented that 70% of their students seemed disengaged in learning in the course, thus the teaching approach seemed to engage mostly students who were intrinsically motivated to learn.

### ***3. The responsibility for learning***

All case studies placed responsibility for learning predominantly in the hands of students when it came to assessment tasks. Case Study One however provided far more guidance on how assessment tasks could be completed, almost leading students at times through the problem based learning (PBL) process and other assessment activities like article analysis (more about self-directed learning as good practice in the context of PBL and sustainability is discussed later in this section). However, in terms of building student capacity for ongoing learning or taking responsibility for ongoing learning in future practice, Case Study One, Two and Three all featured activities and assessments to help students build ongoing learning skills including research, self-management, and application skills. Case Study Four again was more teacher-centred with students learning skills in research, however not in relation to problem based activities where students need to apply knowledge and develop higher order skills.

Peer feedback as part of learning was seen in Case Study Three and Four through group presentations, and self-assessment was seen in Case Study One and Two in the form of reflective components of assessments where students reflected on their own learning. Case Study One and Two also used feedback in the Fisherman's Bend Development (FBD) response (in Case Study Two) and FBD report (in Case Study One) from students in each of the case studies to support interdisciplinary learning. Learning from peers in all the case studies could have happened through group work.



#### ***4. Purposes and processes of assessment***

Case Study One, Two and Three integrated the assessment process with the learning process with assessments completed in workshop time and making use of interactive learning. The assessments in these case studies were also formative. Case Study One allowed students to submit drafts as a hurdle requirement, while Case Study Two featured weekly assessment scenario responses that the teacher would provide written feedback on and return to students over the semester in preparation for the end of semester test. Students in Case Study Three drew on what they had learned and developed in their first assessment in their final individual assessment. In all three case studies the teacher seemed available to provide ongoing feedback to students when they required it. Case Study One, Two and Three allowed students to develop their own answers and provide evidence for these which was assessed, for example developing learners' own definitions of sustainability and related concepts. None of the courses of the case studies included formal peer assessment or self-assessment of learning. Authentic assessment, that is assessment which assesses capability development and deep learning through experience in engaging with complex and real life problem responses (Newton 2008), was seen in Case Study One and Two which employed PBL as the basis of assessment, and Case Study Three which involved the assessment of a design and application of sustainability to that design. In all three of these cases (one, two and three) assessment was intended to be based on real world tasks that are required in the professional context in line with authentic learning as defined by Blumberg (2009).

Data was not collected on the extent to which students were allowed to re-submit assessment tasks in order to 'gain mastery'. This was not course policy in the case studies, however may have been done by teachers on an individual basis without the researcher's knowledge. Likewise, comment cannot be made on the 'timeframe for feedback' element (if students were given timeframes for teacher feedback), as this was not observed.

#### ***5. Balance of power***

As in the other dimensions of learner-centred practice, the balance of power varied across the case studies. To a large extent Case Study One, Two and Three allowed students to explore and determine course content through their assessment tasks; they were able to develop their own creative responses to building, planning and design challenges through applying their own evidenced understandings of sustainability. Through research and group discussions, students took content in their own directions in their assessments. Following on from this, students were able to express alternative views with their responses based on their own

understandings and evidence to support these understandings. In this way, assignments were open-ended and allowed for more than one answer. Content in Case Study Four was largely predetermined and students were asked to research this further thus leaning towards a teacher-centred approach in this regard. Data from this research cannot provide light on the flexibility of the teacher in terms of deadlines and assessment policies to meet student needs or 'mastery grading'. This was not course policy, however may have been done by teachers on an individual basis without the researcher's knowledge.

An element of the learner approach is learner-directed learning, which was seen in varying degrees by the case studies and overall seemed to be something that students enjoy. However, consideration of the amount of support that is provided to students, particularly those in first year courses is an important consideration. This supports others' findings on self-directed learning in EfS (Hegarty *et al.* 2011). Case study teachers felt that students needed differing levels of support. So self-directed learning is not just a matter of sending students out to undertake their own research independent of the teacher's input or support, as would be the situation with a wholly learner-centred approach. Students in all case studies really valued teacher support in their learning process, regardless of the L&T approach taken. Student participants in the case studies were quick to comment when they felt they were not given adequate support or guidance through their learning in the course and this had a negative impact of their learning experience. This finding is similar to that found by Hegarty *et al.* (2011) in research undertaken on student learning experiences in a stand-alone first year sustainability course. The authors argue that, despite learner-centred approaches being ideal, when teaching first year students, a mix of teacher-centred and learner-centred approaches is important to assist students who may not be confident in tackling both the complexity of sustainability and self-directed learning simultaneously in PBL. This however does not mean that teacher support is necessarily teacher-centred, as the authors comment, it can be seen as part of learner-centred practice whereby the teacher provides initial support in a course and slowly increases students' responsibility for their own learning (Blumberg 2009). So while the literature advocates self-directed learning in EfS (Barth and Burandt 2010, Cotton and Winter 2010, Fortuin and Bush 2010), care must be taken to understand what this involves in the context of learner-centred practice to ensure enough support is provided for students initially to feel comfortable and confident with undertaking complex tasks associated with the like of PBL, especially when engaging with the complex concepts of sustainability for the first time.

Across all four case studies, having a supportive and positive teacher-learner relationship seemed the most important for student participants' positive learning experiences, regardless of the extent of learner-centred practice. Student data in Case Study One and Two showed a very strong preference for the positive, supportive and friendly relationship that was established with the teacher. These students commented that teachers in these two case studies were like friends and therefore felt comfortable seeking help and expressing their views. While Case Study Three was learner-centred learning according to Blumberg's dimensions of learner-centred practice, student participants expressed a degree of dissatisfaction with what they perceived to be a disengaged teaching approach. This perception of a disengaged teaching approach could be for a number of reasons. For example, student participants in this case study also expressed dissatisfaction with the lack of interactivity in the lectures, so this could have impacted their view of the teacher overall, rather than what the teacher did in one-on-one time with students and groups. The teacher also commented that they did not want to express their personal opinion about sustainability, which was done by teachers in the other three case studies. Students may have perceived this as non-engagement with what the teacher was teaching. Also, students may draw on past experience with teachers to make judgements on what is an 'engaged teacher' which could also affect their perceptions. In the workshops observed in Case Study Three the teacher did interact with students after the lecture, and asked and answered questions so there was a level of teacher engagement with helping students. Focus group participants in Case Study Four expressed positive feedback about the teaching approach commenting that the teacher was passionate despite this course being predominantly teacher-centred. These data indicate that having a positive relationship with the teacher, where the teacher is perceived by students to be 'engaged' with the content and the learning process, is universally important regardless of whether a course is learner- or teacher-centred learning. This links back to the theory of good practice sustainability which also advocated for positive student-teacher relationships (UNECE 2012) which, based on this research stands aside from learner-centred practice, and can occur even when the relationship is hierarchical in terms of a teacher-centred approach. Having a 'passionate' teacher was something that was greatly valued by student participants in all the case studies and is something that will be discussed further in section 5.3 Emerging concepts and practice.

### **Learning and teaching approach: Active learning**

The research showed that active learning occurred in Case Study One in the form of the major assessment, the FBD report, which was based on a PBL model where groups worked as teams

to develop a sustainable inner city development drawing on their research, the design brief and their definitions of sustainability. Workshops were also very active in terms of group work and class discussion with students contributing their ideas throughout workshops. Case Study Two also featured active and collaborative learning through weekly scenario responses, again based on a PBL model and group work to develop responses. Further, these students worked in groups to brainstorm responses to the FBD proposals from Case Study One students. For support, there were weekly lecture and activity class brainstorming sessions where knowledge and understanding were collaboratively constructed with the teacher using mind maps on the white board. Case Study Three had one collaborative learning assessment where students worked in groups on a sustainable design, researching, applying and developing their own design and justifying their choices as part of the group assessment. Active learning was more limited in Case Study Four with students working individually in tests and the final report. There was group work in two presentations however, and based on observation, the majority of groups did not work ‘collaboratively’, rather split tasks and presented sections separately. The main objective in these presentations was to research and present information on a topic given by the teacher, so while there was a group work component, there was little evidence of experiential, participatory or collaborative learning in Case Study Four.

Interestingly, disciplinary expectations of L&T also had an impact on what the student participants found to be ‘interactive’ learning, for example in Case Study Four, which was the least learner-centred approach, students felt that this was the most interactive course in their degree, while Case Study Three which had a number of learner-centred elements, students wanted more interaction. So in terms of engagement, a learner-centred approach is important, but what constitutes interactive learning is relative to what students expect. However, while *relative* interactivity may lead to students feeling satisfied that their course was interactive as seen in Case Study Four, this does not necessarily build practice based skills and knowledge, necessary in learning for sustainability according to theory. While relative interactivity may engage the inherently motivated students, the purpose of active learning is to foster deep engagement across the student cohort and learn by doing. Even though student respondents in Case Study Four felt the course was interactive, the teacher observed that 30% of their student cohort was engaged. Importantly, without active learning, capabilities based outcomes and transformative or deep learning may not have developed. Research on how students react and engage with self-directed, learner-centred learning processes and the use of learning methods like PBL would provide valuable contribution to L&T theory for implementing EfS in degree

programs where student expectations of learning are teacher-centred. Case Study Four would make a good site for further research in applying good practice and undertaking extensive research on student engagement and learning to determine how good practice is perceived by these students who are not accustomed to active learning.

### **Learning and teaching approach: Real issues orientation**

Real issues orientation was something seen in all case studies with theory situated in professional or disciplinary contexts and practice. Dale and Newman (2005:357) argue that ‘sustainable development is not a theoretical pursuit, but by its nature is rooted in praxis.’ While sustainability content was situated wholly in professional contexts and had a ‘real issues orientation’, that is sustainability was always linked to real professional problems and examples in all the data collected from the case studies, the theory was not always applied or put into practice; so *praxis* was not evident in all case studies. Learners applied theory to real issues through practice in Case Study One, Two and Three, while Case Study Four students were asked to research existing technologies in line with a teacher-centred approach as discussed previously. Formative assessment and student reflection on learning is a form of praxis, which featured predominantly in Case Study Two.

Through the case studies, this research indicates that situating content in professional contexts was important for learner engagement and demonstrating relevance of sustainability for learners. The one common pedagogical approach across all case studies was to situate sustainability in context rather than discussing it as an abstract theory. In some cases situating sustainability in personal contexts (for example the Ecological Footprint assessment in Case Study One where learners reflected on personal impacts of consumption) was also undertaken, however this personal link was not common across case studies. The majority of student participants across the case studies felt that sustainability was relevant to their future profession and degree program and important to learn about, regardless of their year level, background or discipline area. Therefore this indicates that situating sustainability in professional practice is important for demonstrating relevance of sustainability and fostering learner engagement.

The research shows that situating sustainability in professional or disciplinary contexts and achieving higher levels of perceived course relevance amongst students can be achieved in the absence of theory-based good practice L&T, yet learner engagement in the courses varied. This indicates that engagement is possibly linked to the L&T approach rather than a ‘real

issues orientation'. For example, learners can undertake a teacher-centred course that embeds sustainability within professional practice and come away with the understanding that sustainability is important to learn about. The implications of this are that while perceived course relevance is an important indicator of a sustainability course's success, engagement (and learning outcomes) also need to be considered to determine capabilities outcomes for students to put sustainability into practice (see discussion regarding learner empowerment in section 5.3).

This research cannot determine the extent to which situating sustainability in professional context helped students develop capabilities for sustainability in practice. The level of praxis-orientated learning advocated in the literature by authors such as Cotton and Winter (2010) differed due to the varying levels of learner-centred approaches taken in the course. This point is explored in this chapter under the section 'capability building'. It can however, be assumed that through situating sustainability in professional practice, learners are better positioned to apply sustainability in future practice than learning about sustainability theory in abstract ways, and see the relevance and importance of doing so.

Interestingly, student participants from Case Study Three, particularly those in the focus group, commented that the course focused too much on practice, rather than exploring the theory of sustainability as it relates to practice. These students felt overwhelmed in their first year learning about the theory and techniques of design practice and sustainability and how it applies to practice simultaneously. The idea behind this pedagogical approach in Case Study Three was to present sustainable design practice as 'good design practice', which is in line with the theory of good practice L&T for sustainability. These focus group students' comments do not challenge this theory, however the views must be noted as they indicate that care must be taken to allow students the time to explore and grapple with the complexity of sustainability theory while it is applied.

Another important point to note about situating sustainability in professional contexts is the availability of examples, resources and case studies that situate sustainability in professional practice. Due to the uniqueness of sustainability education (see Chapter Three), limited resources are available which make connections between sustainability and professional practice. Teachers from Case Study One and Two had professional backgrounds in areas other than the discipline they were teaching into and had experience in teaching sustainability in different discipline areas so you could say were effectively teachers of sustainability.

However, teachers in Case Study Three and Four were qualified or practicing professionals in the case study discipline areas and they used this knowledge to link to sustainability.

Teaching sustainability for these teachers was a relatively new teaching endeavour. The challenge for teachers in Case Study One and Two was to understand the professional contexts in which their students were learning about sustainability so that sustainability could be effectively embedded in these contexts, and the challenge for teachers in Case Study Three and Four was to understand sustainability in order put a sustainability lens on disciplinary contexts that they were already familiar with. Based on observation, research and effort are required from the teacher to select interesting and relevant case studies and examples, and then help students understand these through a 'sustainability lens'. Based on the researcher's own experience working in a teaching team of 8-10 teachers in a large common sustainability course (for more information on this course see Hegarty *et al.* 2011) including a range of disciplines, being creative in sourcing materials and helping students make connections between real issues and sustainability is a key part of L&T for sustainability. Limited resources specifically for L&T such as text books (e.g. that make connections between engineering and sustainability, design and sustainability, building and sustainability) exist therefore it is the teachers' responsibility to develop these as part of situating sustainability in professional contexts and giving courses a real issues orientation. This demands care for L&T in EfS on the part of the teachers: in terms of motivation to seek out engaging content, understanding of sustainability in order to creatively apply it; and reflexive teaching practice so that materials can be reflected on and changed if they are not supporting the intended learning.

On the other hand, using a learner-centred, inquiry based pedagogy means that there is less emphasis on teaching content and demonstrating links between sustainability and professional practice. This allows both teacher and student to explore the connections through shared learning. This approach is more in line with Sterling's (2003) notion of education *as* sustainability or sustainable education and deep learning described in Chapter Three, where the meanings and application of sustainability are continuously shaped through the inquiry process and ongoing learning. The use and development of textbooks on sustainability such as 'sustainability in engineering, may lead to sustainability and its professional applications being viewed in a prescriptive way by both teachers and learners, a move away from the practice described by Sterling (2003). The limited existing resources that link sustainability with professional contexts can be a strength in sustainability education as this encourages both innovative teaching practice and inquiry based learning. Perhaps texts that document

approaches taken to sustainability education in the professions as a resource for teachers (and learners), rather than textbooks, will promote the continuation of reflective and innovative teaching approaches.

### **Learning and teaching approach: Capacity building**

All of the case studies supported skills development, however the emphasis on skills development compared with acquisition of information and what kind of skills differed from case to case.

Case Study One featured predominantly capability based learning outcomes with the acquisition of information as a learning outcome (the ability to define sustainability and understand the five capitals) making up two of the 10 learning objectives. These learning outcomes were aligned with learner-centred activities such as PBL and reflective assessments. Lecture content was applied in workshops through various learner-centred and interactive activities so learning went beyond memorisation of content to higher-order learning, developing evaluation, critical reflection, application and problem solving capabilities.

Case Study Two also included skills based learning objectives in three of the five learning objectives listed for the course. Two of the learning objectives related to awareness and understanding of sustainability theory and concepts and the relevant professional body of knowledge to situate practice. Three skills based objectives included ‘professional skills related to the development, analysis and application of content and professional knowledge in multiple scenario-based learning exercises’ and research and critical analysis skills and ‘Skills in professional engagement, collaboration and multidisciplinary team work’. Similar to Case Study One, these learning objectives were aligned with predominantly learner-centred activities such as PBL and interactive group work activities.

Case Study Three featured learning outcomes which all focused on the application and critical evaluation of knowledge, rather than only comprehension. Learning outcomes included ‘examine, analyse and evaluate theoretical principles’, ‘examine and apply cultural, social and ethical considerations and responsibilities’, ‘Manage your learning as an individual and in collaboration with others’, ‘examine, critique, and evaluate underlying principles and concepts of sustainability’, ‘apply sustainability principles and systems to textile design contexts’, ‘develop and evaluate ethical and sustainable design strategies appropriate for



textile design practices’ and ‘examine and reflect on the role of the textile designer’. These learning objectives were aligned with the two assessment activities that supported application of theory in practice.

Case Study Four featured predominantly knowledge acquisition learning outcomes such as ‘knowledge of Sustainability of air transport systems, climate change and the aviation industry, Policies for climate change and how it affects the aviation industry’ and so on. Technical and professional skills and analytical and communication skills were also listed as a learning outcome and made up two of the eight learning objectives. The course assessments and activities reflected these learning objectives with students required to demonstrate their understanding of technologies, operations and policies through research assignments.

This data shows that learning objectives in the case study courses align with the kinds of L&T methods employed. Case studies featuring skills based learning outcomes included more learner-centred capability building activities and assessments while Case Study Four focused on teacher-centred activities that aimed to demonstrate students understanding of content and develop research and communication skills. Based on the learning objectives stated in the course guides, the first three case studies appear to develop learning of content knowledge through application and evaluation of theory (rather than repetition of theory) so students both develop their own understandings and learn skills in applying, analysing and reflecting, thus building lifelong learning skills.

Interestingly, all four case studies did not explicitly list capabilities outlined in the literature of good practice such as: systemic and holistic thinking; foresighted, anticipatory and futures thinking; and working with complexity and uncertainty. That said, Case Study Two explicitly mentioned collaborative working and multidisciplinary working and Case Study One, Two and Three listed critical thinking and reflection. Case Study Three also included the ability to develop and evaluate ethical design, so therefore the ability to incorporate ethical dimensions into practice. This means that the discourse around learning outcomes described in the theory is not echoed in the stated learning outcomes of the case study courses, yet are being developed implicitly through some L&T practices in the case studies (see results in Chapter Four).

### **Teaching approach: Transformational learning**

Deep learning in EfS means that learners are not being taught what to think, but developing ‘the dispositions necessary to act successfully in different contexts’ (Barth and Michelsen 2013:111). From this research it is difficult to determine if students experienced a transformation or ‘metamorphosis’ (Armstrong and LeHew 2013:4) of their beliefs. Learning *about* sustainability was certainly indicated by student participants although the depth of this learning differed across the case studies. Some student participants referred to only learning about sustainability without explanation of what sustainability is. Others noted learning about concepts and elements related to sustainability including: understanding of impacts of actions; seeing interconnections; thinking about future generations, seeing things from a different perspective; understanding environmental impacts; and seeing with a broadened scope. Generally responses related to learning or changes in thinking did not indicate *how* students understand sustainability, with students mostly talking about ‘sustainability’ rather than delving into the concept’s meaning for them; for example ‘[the course has taught me] to live a more sustainab[le] life and save the planet’.

This brief description of sustainability from many student participants across the case studies may indicate that students achieved surface learning or are only able to articulate surface learning about sustainability. As defined by Ramsden (2003), surface learning is the memorisation of separate facts or pieces of information whereas, in deep learning, students are able to organise concepts into a ‘coherent whole’ and link these with existing knowledge. Therefore, new conceptual frameworks are developed from deep learning that interlink with existing knowledge and integrate new learning into a knowledge system. When analysing students’ comments about their understanding of sustainability in professional practice, there is little indication across the case studies of deeper level knowledge organisation or conceptualisation. For example a comment such as ‘I have learnt we need to be sustainable’ does not indicate that the student understands what sustainability means nor has really grasped the complexities of the concept of sustainability related concepts (such as intergenerational equity, balancing the triple bottom line). Therefore, with the exception of a small number of comments across the case studies, there was little indication of holistic, deep understandings of sustainability in the data collected.

Further research is needed to delve deeper into learning outcomes before conclusions can be drawn on the depth of learning and transformation that occurred in the case study courses. The lack of articulation of deep, transformational learning could be the result of the data

collection methods which relied on student perceptions of their learning. The data broadly indicate that student participants were not able to easily reflect on learning from their course. Given that ‘the explicit focus on reflective learning practice is relatively new to many undergraduate environments’ (Hegarty *et al.* 2011:458) and with some student participants even articulating the challenge of reflecting on their learning (see Case Study Two), it may be that students were not able to fully articulate their learning. However, given that reflection and reflexivity are foundational capabilities of sustainability, it suggests that deep learning and capabilities development related to reflective practice were not achieved.

### **The relationship between transformation and engagement**

According to Warburton (2003), engagement is essential for deep learning and part of this engagement is learner interest in the subject and perceived relevance of the course (as discussed above). Student engagement varied across the case studies based on both the teacher’s comments about student engagement and also student comments about their engagement expressed in focus groups and surveys. Based on student participants’ ability to reflect on deep learning in the course, this research indicates that student engagement in learning is not, in itself, sufficient to support deep learning for sustainability. Case Study One students expressed high levels of engagement with the course, however were limited in their comments about what skills or learning they achieved, indicating that more than engagement and relevance is required to support reflective practice, which is an essential practice of transformational learning according to theory.

Overall, this research indicates that learning which fosters deep transformation is more difficult to measure than is student engagement and overall experience of the course.

### **Learning and teaching approach: Holistic and systemic learning**

Learning about or developing capabilities in holistic and systemic thinking was seen in different ways in the four case studies. The difference between the case studies was predominately related to whether the courses asked students to engage in activities and assessments that prompted systemic thinking, or if they taught about concepts that are based on holistic thinking such as intergenerational equity. For example, in Case Study One systemic thinking and approaches to problem analysis were prompted through the Eco Footprint assessment which demonstrates systemic cause and effects of consumption and in Case Study Two weekly PBL activities required students to apply concepts such as ‘future

proofing' (long-term thinking), carrying capacity (of ecological systems), balancing the ecological and the social in decision making. In Case Study Three, systemic thinking was primarily encouraged through life-cycle analysis, while in Case Study Four, students learnt about the Brundtland definition of sustainability and therefore were exposed to the concept of intergenerational equity. Therefore, students experienced systemic ways to understand issues in the courses. Teachers in Case Study One, Two and Three explicitly stated that systems approaches were included in the courses. The degree to which students thought systemically about issues, as a learning outcome however, is more difficult to determine and is explored further in the following section on learning outcomes.

### **Learning outcomes**

Learning outcomes were measured as a general indication of what pedagogical approaches and L&T methods support learning, specifically capabilities for sustainability. Learning outcomes were intended to be measured based on student perspectives and observational data. The data collected indicate that students' ability to reflect on their own learning was limited, so even general indications of learning outcomes are difficult to determine. As described above, student participants mostly discussed their learning *about* sustainability, rather than indicating deep transformation of values and conceptual frameworks and development of capabilities for sustainability.

This research found that while collecting data on activities that support capabilities development is relatively straightforward, measuring capabilities for sustainability as a learning outcome is a challenging task. While this research did not set out to measure actual learning outcomes, as it was beyond the scope, it did attempt to collect data on perceived learner confidence in applying sustainability, perceived skills developed and perceived confidence in specific capabilities for sustainability. Students were asked about the skills they felt they developed. The notable trend across all student participants was that they seemed more comfortable articulating what they had learned *about*, rather than the skills they felt they had developed. Similarly there seems to be a challenge for learners reflecting on their learning outcomes, beyond understanding and awareness of sustainability, associated measures, and how these relate to professional practice. Participants in all four case studies provided very limited feedback on skills/capabilities they had developed through the courses, with some students from Case Study Two even commenting that reflecting on learning itself is very difficult as described previously in this chapter. The question arises as to how well students understand and reflect on their own learning; remembering that, according to theory,

reflection on learning forms the basis of reflexive practice, transformation and ongoing learning, important for sustainable practice according to theory. Given this, perhaps it is paramount that learners are explicitly encouraged to firstly identify, then reflect on and finally nurture capabilities for sustainability through their learning in EfS. This was attempted in Case Study Two and to a degree in Case Study One, but could be brought to the forefront of learning for sustainability.

Another noteworthy observation about researching students' perceived learning outcomes is the high levels of confidence students expressed in regards to applying a number of capabilities for sustainability. One of the research methods used in the Case study<sup>16</sup> One and Two involved a survey of student's perceived confidence in applying a number of capabilities for sustainability found in the literature (see Appendix 5.6 Example of self-rated perceived confidence level survey for an example of this survey). Students in Case Study One and Two were asked to rate their perceived level of confidence at the beginning and the end of the courses. The data collected showed that students in the first two case studies were very confident in all of the capabilities for sustainability (including skills such as complex problem solving, stakeholder engagement, systems thinking and so on) at the beginning and remained so at the end of the semester. Given that Case Study One and Two featured different L&T practices, were based in different disciplines, and had students with differing levels of previous learning about sustainability, there did not appear to be any correlation between these factors, the students' perceived learning experience in courses, and the self-rated confidence levels. The consistency of the results indicates that further research is required to determine what, if any, correlation exists between student perception of confidence and the effectiveness of L&T practice. Higher perceived confidence levels could indicate a lack of appreciation for the complexity of applying sustainability. For example, students with a deep understanding of professional applications of sustainability may feel less confident applying it in their future professions than those who have a surface or shallow understanding of sustainability. However, this needs to be explored in further research.

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<sup>16</sup> Data from this research method was not included in the results chapter because it was not undertaken in the second two case studies and students' self-rated confidence levels did not provide insight into what L&T practices or other elements were important for developing learners' confidence in applying sustainability. Rather the data from this method indicates that perceived confidence is 'detached' from actual learning experience, a finding which requires further investigation that is beyond the scope of this research.

### **Learning and teaching activities**

Of the L&T activities used in the case studies, the PBL activities stand out as most engaging and rewarding for students, as well as most challenging. In Case Study Three and Four there was a slight preference for teacher-centred or individual based activities, while class discussions were valued across all case studies. What remains to be tested in further research is the learning outcomes from specific L&T activities. These activities would need to be tested separately with base-line data first collected and learners undertaking through the activities to determine the learning outcomes. The following details how the case studies applied the different L&T activities found in the literature and findings from this.

### **Authentic assessment**

It is difficult to determine the extent to which authentic assessment was used in the case studies without analysis of the teachers' feedback and marking sheets for the students' assessments. It can be observed, however, if learning was assessed while students were engaged in active and inquiry-based learning. Due to the PBL nature of the major assessment piece in Case Study One, students did engage in authentic assessment. Part of the assessed component of this activity included requirement for reflection on practice and students' learning submitted as part of students' reports. Case Study Two students were also marked on the degree to which they applied content to their responses, and for the depth of their understanding and application of the interconnections between theory and practice. The PBL style of these assessments allowed students to apply knowledge and learn through doing, including capability of reflection on practice. Reflection, depth of thought and understanding through application were included in assessment criteria across the PBL assessments. Based on observation and teacher comments, authentic assessment such as PBL with reflection forming part of the assessment is very useful for supporting capabilities for sustainability such as reflexive practice for lifelong learning.

### **Inquiry based learning: Problem based learning, case studies, critical incidents and simulations**

This style of activity was seen in Case Study One, Two and Three. PBL was in the form of the major assessment in Case Study One and in weekly scenarios and an end-of-course test in Case Study Two. Case Study Three's first assessment involved working on a design and applying a sustainable design principle to this design so, while not executed in a PBL manner, it required students to problem solve working co-operatively in groups to apply sustainability and justify this application in their designs.

### **Descriptive and visual conceptual tools: Mapping, diagrams and models**

Descriptive and visual tools were used to a certain extent as a L&T aid in the case studies, predominately in the form of mind-mapping was seen in Case Study One and Two. Case Study Two was the only course to include this as strategy for representing problems by mapping them out in student's weekly scenario responses. This however was not a requirement. Therefore, while visual tools were used to assist in unpacking content or representing problems, techniques for mapping problems using systems diagrams or causation mapping in the manner in which they are advocated in the literature (see Chapter Three) were not explicitly taught.

### **Visioning projects: Future-focused visioning projects, scenario analysis and back-casting**

The PBL activities in Case Study One and Two inherently involved a focus on problem responses that are in line with principles and values of sustainability in the long term, while Case Study Three assessments and activities primarily used life-cycle analysis to apply sustainability to design practice, which also includes a focus on use and end-use of a product. In these ways Case Study One, Two and Three students were required to undertake future-focused visioning as part of their problem or design analysis and responses. The requirement to apply concepts such as 'future proofing' in Case Study Two and intergenerational equity in Case Study One, asks students to think about the future. None of the case studies however, used specific activities or approaches such as back-casting or scenario analysis.

### **Situated learning: Place-based education, field work and work-based projects**

Situated learning was not seen in the case studies. Case Study One and Two attempted to emulate workplace environments with in-class PBL assessments, however none of the case study courses situated learning in professional or community settings outside of the classroom. Interestingly, this did not affect the student participants' learning outcomes that sustainability was relevant to their professions. This research indicates that situated learning is not necessary for students to understand the professional relevance of the courses. The research however cannot comment on the benefits for capabilities development that may be developed in situated learning.

A number of Case Study Three and Four focus group respondents expressed doubt about the realistic opportunities of implementing sustainability in their future professional practice

given the profit motives of their current industries. Perhaps these students would have benefited from situated learning where they could grapple with the realities of implementing sustainability in professional practice to better understand opportunities to apply what they had learned in the course in their future professional practice.

### **Interactive, perspective sharing activities: Group discussions, debates, role plays and stimulus activities**

Group discussions and sharing was found in all case studies to varying degrees. Sharing and discussion was built into every activity and assessment in Case Study One and Two either in small groups or as a class, while Case Study Three included group sharing and discussion in the first assessment. Case Study Four allowed for some class discussion and questions during lectures and also at the end of presentations. Formal role plays and debates were not seen in any of the case studies. In all cases, stimulus activities were used to varying degrees with the use of examples or videos to prompt questions and discussions. Based on observational and student participant data, the extent of discussion was based on the level of learner-centred L&T approach. For Case Study Two and Three student respondents, class discussions were seen as an important activity for their learning. Case Study Four student participants commented that they found group work least helpful for their learning. The students' negative group work experience could be due to a number of reasons, such as: expectations of a teacher-centred approach (see results chapter); limited class time allocated to group work; and only two groups seemed focused on the task. This indicates that in order for students to engage with group work, it needs to be supported through the development of skills in group work and perhaps the need to build assessment into the group work activities.

### **Reflexive accounts**

Reflexive accounts include activities in which students were asked to reflect on their learning about sustainability and how their learning changed as a result of new knowledge. This practice was particularly emphasised in Case Study Two where students were asked to reflect on their processes of engagement with the activities on almost a weekly basis. Reflection was an assessment criteria for the major assessment in Case Study One where students were asked to provide an individual reflection on their learning through undertaking the course and the challenges they experienced applying sustainability. Case Study Three students were asked to reflect on the group learning process in their first group assessment and also reflect on their own sustainable design philosophies.



## **Critical reading and writing**

Critical reading and writing and critical analysis was an assessment criteria and learning outcome in all case studies. Sustainability is inherently challenging so that understanding how it can apply is inherently critical in nature. However, critical analysis of texts and the ability to understand values, assumptions and worldviews underpinning different arguments was not featured in all case studies. Case Study One specifically undertook critical article analysis of course readings as part of the assessments. Room was provided for students to undertake their own critical analysis of sustainability itself in Case Study One, Two and Three. In all three case studies students were asked to develop their own definitions of sustainability, justify these and apply these to their projects. Case Study One encouraged critical analysis of course readings, predominantly through class discussions unpacking the ideas underpinning the texts.

## **5.3 Emerging concepts and practice**

### **Videos**

The use of videos to base activities on is something that is not largely mentioned in the literature. However, inclusion of videos was important for students in three ways: students found videos engaging: videos that connected theory and practice in real life examples legitimated what the students were learning in the course; relevant videos helped to validate their learning efforts by demonstrating that sustainability is relevant to professional practice. According to Cullen *et al.* (2012:49) for conceptual change to occur in learners, ‘the previous belief must no longer be satisfactory, and the new belief must be intelligent, plausible and fruitful’. Based on the data, videos appeared to provide a picture of sustainability as plausible, intelligent and fruitful for the students to an extent that teachers were not able to provide through their own knowledge and arguments. Videos also serve the purpose of presenting alternative views that teachers cannot express from their own speaking positions (as described by the teacher in Case Study One). The research indicates that videos, which included ‘expert opinion’, through examples of sustainability in practice, fostered empowerment and optimism in students to show that sustainability is ‘real’, that it currently exists in their professions, and is possible. The use of videos however, must be used as part of learner-centred activities rather than passive transfer of information so the students have the opportunity to analyse the perspectives and practices seen the videos and share and apply these in the context of their own views and understandings. Based on this research, making videos part of active class activities is an important L&T aid. Further, students who watched videos recommended as

supplementary materials, also found the experience engaging and effective for their learning (as seen in Case Study Four).

### **Learner empowerment**

Problem based learning that mimics real life or realistic scenarios appears important for helping students feel empowered and TO see that opportunities for change towards sustainability are possible in their industry. For example, students from Case Study Three felt their designs were not realistic, bringing into question their ability to realistically implement sustainable design practice. Similarly students in Case Study Four had mixed opinions about whether change in their industry was possible. Students from both case studies questioned the economic feasibility of sustainable design in their industries. Case Study One and Two however featured PBL, and situated this learning within real case studies, which appears to have helped students practise tools such as the triple bottom line in 'real life'. This seemed to encourage students to have more confidence in applying sustainability in their future professional practice. This supports the theory of good practice described by Sibbel (2009) who argues that self-efficacy is very important for changing behaviour and implementing sustainability in practice; arguing that this can be supported through problem solving activities, peer and professional support of learning. It is important to note that learner empowerment may also be influenced by where their respective industries or professions 'are at' in terms of implementing sustainable practice. This, however, does not detract from the need to encourage problem solving with real life scenarios; either simulated in the class room, as seen in Case Study One and Two, or involving professional input as advocated by Sibbel (2009). The positive feedback from student participants across the case studies regarding guest speakers supports Sibbel's claims about professional input.

### **Creativity**

Supporting creative capability in learning in EfS in HE is something that is not generally mentioned in the theory of good practice. However, I have proposed elsewhere that fostering creativity should be a priority in course design and delivery for learning for sustainability (Sandri 2013). Case Study Three was unusual in that the teachers emphasised the importance of creativity in their students' learning, and broadly in the application of sustainable design for their industry. The course coordinator commented that creativity is something that is taken for granted in their discipline and that 'creativity is an incredible tool that our students have to be able to problem solve'. This observation is significant for learning for sustainability given that addressing sustainability challenges is fundamentally about problem solving. Case Study Three students recognised that they were engaged in creative practice however, students from

other case studies did not feel that they were being creative in what they were doing, despite using sustainability frameworks to understand and create problem solutions related to their disciplinary areas (in their PBL assessments).

### **Addressing student resistance and disengagement with learning**

A key challenge expressed by most teachers was how to engage disengaged students. The teacher in Case Study Four observed the most disengaged students, while the teacher in Case Study Three observed none, and in the other courses some disengaged students were noted. Based on comments by the teacher in Case Study Four, it seems a distinction needs to be made between students who were disengaged generally with learning in the course (particularly with learning for sustainability or learning in general) and students that express their resistance to learning for sustainability based on their beliefs and values about sustainability and its relevance. Past research has found that providing clear rationales for courses (Hegarty *et al.* 2011) and making the course relevant (Warburton 2003) are important for student engagement and addressing resistance to learning specifically for sustainability. Blumberg (2009) also distinguishes between intrinsically motivated students that have an interest in learning and those students that require extrinsic motivation. Blumberg argues that for students to take responsibility for their own learning, retain knowledge and be able to apply it, using extrinsic motivators (such as attendance requirements and participation marks) to encourage non-intrinsically motivated students to learn is not effective. These insights plus the data from this research indicate that a L&T aim should be to encourage students to be intrinsically motivated through learner-centred practice. The example provided by Blumberg (2009) involves a teacher choosing to use weekly games instead of class presentations that are developed by groups of students so that students become intrinsically motivated through both preparing the games and playing the games. Further, the game activity requires focus in undertaking games and creativity in game design, and so contributes to these other aspects of EfS.

### **Passionate teachers**

Based on this research, students' perceived level of teacher engagement and passion contributed considerably to their learning experiences. The student participants valued teachers who conveyed passion for the content and for teaching. By comparison, teacher neutrality may have an impact on the learners' engagement in exploring sustainability. According to Dillon and Grace (2004:415) 'there is widespread disagreement about whether teachers should remain neutral' when teaching controversial issues. By 'controversial issues'

the authors mean 'significant numbers of people argue about them without reaching a conclusion' (Dillon and Grace 2004:411). Sustainability therefore could be considered a subject area that contains many controversial issues. In order for students to develop their own perspectives on sustainability and not feel like they were being 'preached to', the Case Study Three teacher made a conscious effort to not disclose personal views on the issues and sustainability. What the case studies show however, is that where teachers openly expressed their passion for sustainability or their views on sustainability, students found teachers to be more passionate and engaged; and this helped their own engagement with the learning. Some students in Case Study One and Two even commented that the teacher's passion made them want to do their very best in the subject, indicating that teacher passion may also encourage intrinsic motivation for learning.

Another notable point made by Dillon and Grace (2004:415) is that the challenge 'when teaching about controversial issues is to recognize that they are often controversial because the protagonists from their own worldview are applying reason and thereby arriving at their different perspectives. Students need to explore how it is that individuals can apparently arrive at different perspectives on an issue. Introducing them to multiple perspectives is therefore an essential part of the methods of teaching about controversial issues'. Teachers therefore have an opportunity to model this by explicitly stating their values and assumptions and demonstrating how this forms their worldview. An example of this comes from Case Study One where the teacher was explicit about their views and values on the weekly topics and talked about what assumptions informed these. They then asked students to undertake the same reflective practice making it clear that there are many values and worldviews and these shape what people think and do and therefore professional practice. In addition, this research shows that where students felt they shared a friendly and trusting relationship with teachers, the students were more comfortable and felt 'safe' to express their own views and explore values; the students did not feel there was a 'right answer' and their views were valued because the teacher was engaged in the topic and modelled engagement in the learning process.

## 6.0 Chapter Six: Conclusion

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### 6.1 Introduction

This research set out to investigate what makes good learning and teaching (L&T) practice for learning for sustainability. It did this by undertaking research on four university level education for sustainability (EfS) case study courses to explore the experience of teachers and learners, and to compare this with the theory of good practice advocated in the literature. This study was undertaken to help fill a critical research gap in empirical data on L&T practice in sustainability. The research aimed to provide insight into the lived experience of L&T in EfS in higher education (HE), as a resource for educators (and learners) by adding empirical evidence to support and/or challenge existing EfS theory of good practice. It is expected that this research will assist university educators in Australia and abroad to develop effective L&T practice for EfS. The insights can also facilitate the uptake of EfS by showing what is possible in the sustainability learning endeavour in HE. In addition, this study shows the strengths and challenges of the research approaches taken and makes recommendations for future research on L&T in EfS.

This concluding chapter will firstly reflect on the key insights from the research and explore the implications of these insights and the unique contribution that the findings make to research and practice of EfS in HE. It will then highlight the research limitations before

providing some key directions for further research based on the outcomes and insights of this study.

## ***6.2 What is good practice L&T for sustainability in HE?***

This research set out to investigate what good practice L&T for sustainability looks like in HE. Recognising the limited existing empirical research available, the research has followed an inductive grounded research approach to ‘cast a wide net’ in order to explore many elements of L&T practice. Its purpose has been to develop key insights into effective L&T practice, rather than develop a set of rules on ‘good practice’. Therefore the research indicates, rather than tests, variables to provide a foundation for further research into assessing L&T approaches in EfS.

Combinations of different practices were seen in the case studies, and these practices affected student learning in different ways. Building on this, the investigation indicates that, based on the perceptions of case study teachers and students, good practice L&T for sustainability involves learner-centred practice, which, for a variety of reasons, is important for addressing the unique L&T needs and elements of EfS. Learner-centred L&T underpins all of the approaches advocated in the literature such as transformative learning, values reflection, and real issues orientations. This research also shows that these learner-centred approaches are well received by students, or in situations where this type of learning experience was limited, was desired by some student participants.

The research has shown there are several important components associated with L&T for EfS. Firstly, reflective or reflexive practice is argued to be a critical learning outcome of EfS, so it is paramount that learners are encouraged to reflect on their own learning, values and assumptions as part of activities and assessments. This research indicates that one-off, or sporadic reflective activities, are not enough to develop this capability. It is also not enough for teachers to discuss their values, and model reflective practice to students, in the absence of reflective requirements that are built into activities and assessments. Yet the research indicates that even when reflection is built into weekly activities, students’ ability to reflect on their learning is only marginally improved. This is no surprise, given that reflexive practice is not traditionally seen as a learning priority; arguably it needs to be, in order to support the level of reflexive practice required to meet sustainability challenges. Importantly, the research does indicate that there is scope to integrate reflection, and responding to feedback, through

the assessments and class activities, and that students can be asked explicitly to articulate the capabilities and knowledge they are developing through their learning in EfS.

Following from this, supporting learners' capabilities development through learner-centred approaches and learners' awareness of this learning, is also an important part of good practice. The research showed that students generally gained an understanding of sustainability through the case study courses and could see the professional relevance of sustainability in all four courses. It is commonly theorised that in order to address sustainability, learners need more than knowledge about sustainability (see Chapter Three). While sustainability content in these case studies was situated wholly in professional contexts and had a 'real issues orientation', the theory was not always applied or put into practice. According to theory, learning for sustainability must support the development of systems and holistic thinking, reflexive practice and lifelong learning to meet the evolving nature and needs of complex and ever-changing sustainability challenges. These learning outcomes are difficult to measure however, and were beyond the scope of this research. Nonetheless, students' *perceived* learning outcomes were identified, and presented insights into the challenges for learners to reflect on their own learning; this was the situation across the case studies, regardless of the discipline area.

Problem-based learning (PBL) is something that, based on this research, appears to address many of the unique L&T needs in EfS. Student participants found this approach not only challenging and engaging, but also rewarding. This style of assessment provides real issues orientation and demonstrates to students, through their own inquiry, that sustainability is relevant and applicable to their practice. It also develops capabilities and can allow for reflexive practice, depending upon the way in which it is structured. A significant challenge for developing good practice for problem-based independent learning is finding the right balance between self-directed learning and teacher support.

Based on students' and teachers' perceptions, good practice also involves a balancing act on the part of the teacher to support learning while providing students with the opportunity for independent learning and to engage with learning challenges that build capabilities. Care must be taken to allow students the time to explore and grapple with the complexity of sustainability theory while it is applied to ensure students do not feel overwhelmed. This can be seen in the PBL activities in Case Study One and Two.

It is also important to note that the success of such constructivist approaches may not be well received due to student expectations of learning in HE. This research indicates that disciplinary expectations of L&T had an impact on what the student participants found to be ‘interactive’ learning and therefore, what constitutes interactive learning, is relative to what students expect. However, while *relative* interactivity may lead to students feeling satisfied that their course was interactive as seen in Case Study Four, this does not necessarily build practice based skills necessary in learning for sustainability according to theory.

This research has shown that reflexive teaching practice is also important for good practice L&T in EfS. Sustainability is a new educational endeavour in HE, which means there is much room to shape the pedagogical approaches taken through reflexive teaching practice and testing new ideas in the classroom and assessments. Reflexive teaching practice that enables pedagogical innovation, adaptation to the changing nature of sustainability in professional practice, and changes in learning needs is an important element of good practice. Based on the research undertaken, there are no textbooks on sustainability or set curricula that would be found in traditional disciplines. However, this is not necessarily a weakness of EfS but rather an opportunity for teachers to innovate in their L&T practice and learn from others’ practices. Reflexive practice involves balancing the needs of students, teachers and external stakeholder needs (professional bodies, for example) to ensure that learning for sustainability is engaging, enjoyable, relevant and transformative, while also supporting the capabilities required in professional practice. In undertaking reflexive teaching practice in EfS, this research has found that student data on a number of factors are important for understanding the effectiveness for both student engagement and learning outcomes in EfS, including:

- Student interest in the course and motivation to learn (which activities or aspects of the course motivates students to learn, indicating intrinsic motivators for learning)
- Perceived professional relevance and self-efficacy, the self-belief that students can make changes or apply sustainability in professional practice
- Learning outcomes (this is best assessed through authentic assessment that builds and assesses capabilities and deep learning), learner engagement and whether students felt their learning was rewarding.

Activities and assessments which encourage learners’ intrinsic motivation and engagement are important for addressing the key L&T challenge of engaging disengaged students found in three of the four case studies. This research has shown that student engagement was



particularly a problem with the teacher-centred approach to L&T and that students seemed to engage most with activities that focused on real issues, prompted active learning and also with teachers who conveyed passion for sustainability and who were themselves fully engaged in the learning process which helped students to develop trusting relationships with their teacher.

The teacher-learner relationship seemed the most important influence for student participants' learning experiences, regardless of the extent of learner-centred practice. These points indicate that having a positive relationship with the teacher, where the teacher is perceived by students to be 'engaged' with the content and the learning process, is universally important, regardless of whether a course is learner- or teacher-centred. Students' perception of the teacher as passionate about the subject area also appears to have the potential to encourage intrinsic motivation for learning. Personal values exploration and critical analysis of assumptions also need supportive teachers who model self-reflection practices for students, rather than remain values neutral.

Despite student engagement being an important factor in supporting a positive learning experience in EfS, this research indicates that student engagement in learning is not, in itself, sufficient to support deep learning for sustainability based on student participants' limited ability to reflect on learning from the courses. The challenge then becomes how to support L&T that fosters deep learning, supports the development of capabilities for sustainability, and learners' awareness and reflection on this learning process. Varying degrees of deep learning were seen in the case studies. The results show that those practices more in line with good practice according to theory do in fact support or have the potential to foster deep learning for sustainability more so than teacher-centred approaches, despite student perspectives on what approach they would prefer.

### ***6.3 Implications of findings for EfS in HE***

This research makes a unique contribution to EfS in HE because it validates much of what is advocated as good practice L&T for sustainability by investigating the lived experiences of EfS in practice. Student and teacher experiences in EfS have also brought to light some key challenges in L&T in EfS.

The implications of the research findings are:

- Good practice as found in this research does in fact require a high level of commitment and passion on the part of the teacher to develop course content that effectively situates sustainability in professional practice and engages students through learner-centred teaching methods and development of trusting and open student-teacher relationships. There may be resource limitations such as time and other work commitments for teachers wanting to engage in the perceived good practice as is seen in the case studies.
- Teachers have to feel comfortable with expressing their values and being open to students doing the same as part of supporting engagement in the learning process in EfS.
- Continued support for teachers to undertake reflexive teaching practice for pedagogical innovation is important. Research has shown that teachers who engage in reflexive practice developed a positive relationship with students and achieved high levels of student engagement. Experiences of EfS need to be shared to support a ‘community of learning’ amongst EfS practitioners. This should extend to include sharing of student experiences in EfS. Rather than narrow the scope of good practice L&T for EfS down to a set of tested practices, teachers (and learners) need to learn from communities of practice and share the trials and errors of implementing sustainability education in order to continually reflect on what good practice L&T means in the context of EfS.
- The theory of experiential, real issues orientated learning as underpinning good practice EfS is validated by the student experiences presented in this research. This research has shown that L&T in EfS requires constructivist pedagogies where teachers and learners co-create knowledge and that this practice engages students in the learning experience. Active, experiential learning is found to engage students in the learning process in EfS. Likewise, connection to real life issues that develop both student capability, and demonstrate legitimacy of sustainability practice in learner’s future professional practice is a key part of good practice.
- Comprehensive research into L&T experience and outcomes is not a straight-forward task, as this dissertation has shown. Also, this research has also illuminated just how many elements of L&T in practice need further empirical investigation to understand the learning processes and outcomes taking place in EfS. These elements can also be useful for EfS practitioners to become aware of to develop their own teaching practice.

#### **6.4 Research limitations**

This research has drawn on Grounded Theory philosophy that was most suitable to achieve the research aim to fill a gap in empirical research in L&T in EfS and add lived experience to theory. The multicase design and mixed methods approaches used in this research provided valuable data from which a number of important findings for research on L&T in EfS have been drawn. All methods however have limitations. The data collected are robust, based on the use of multi-methods, however the sample of example case study courses is small, despite drawing examples from different disciplines. Furthermore, student participant in the research varied across the case studies: Student surveys in Case Study One and Two had more respondents and completed surveys than in Case Study Three and Four. Therefore the data presented in this dissertation is not 'perfect' and requires a number of qualifications in order to aid the translation of the results to other situations and to assist other researchers.

Student and teacher participants self-selected or volunteered to be part of the research, an aspect of qualitative case study research that could not be avoided without coercion. This was mitigated to some extent with observation of L&T in practice in the case studies so I could triangulate students' and teachers' perspectives with this observational data. In future research, student and teacher motivation for participating in the research could be included as part of focus group, interview and survey questions (for example, what is your motivation for participating in the research), therefore making participation motivations more transparent. If available, the use of course experience data collected through university course experience surveys could also be used to triangulate data and likewise, analysis of student assessments, if these have suitable content to answer research questions. These additional sources of data however are still dependant on self-selection.

Teachers in Case Study One and Two were colleagues, and the teacher in Case Study Two was the second supervisor in this dissertation. This meant that there was an existing personal relationship with these case study teachers and awareness of, and interest in, helping with this research process. No personal relationship existed with the teachers in Case Study Three and Four before the research took place. The personal relationships shared with the first two case study teachers meant that interaction with these case study course teachers, access to observe lectures and workshops and personal introduction to students differed somewhat to Case Study Three and Four. This may have affected student survey response rates, with more

students participating in the survey. Despite the differences in access to the case study courses, the methods used to collect and analyse data were the same for all four case studies.

It also needs to be noted that I taught the Case Study Two course the year following the data collection period, and prior to the analysis of the data from the four case studies. However, this research draws predominantly on the qualitative data from teachers and students in the case studies to support the findings, therefore my involvement in the Case Study Two course following data collection had little impact on the results from the case study, aside from having a more in-depth experiential knowledge of the course design and delivery. The research methods ensured that I was able to present the same level of detail on each of the courses through teacher interview, classroom observation and use of course teaching materials.

There are also four different disciplinary contexts for the case studies in this thesis. It is important to recognise these contexts since they generate factors that are likely to affect the ways that EfS is acknowledged, understood, and implemented. These factors include:

- Where the related industries are at in terms of understanding, attitudes towards and approaches to sustainability;
- The driving forces for the program and if there a strong push by industry to include sustainability in the program area;
- The professional identities of students and how that shapes their ideas of sustainability and its relevance;
- The common L&T approaches applied by teachers and expected by students in different discipline program areas. As argued by Christie *et al.* (2012:7) ‘...different disciplines rely more heavily on certain pedagogies than others – for example the traditional positivist view of sciences (that knowledge is concrete and measurable) lends itself to a pedagogy where students are recipients of the teachers’ knowledge’ and this therefore can create the student expectation of teacher-centred approaches.

So while some case study courses may be more ‘advanced’ in terms of good practice L&T in EfS, how sustainability is understood and implemented and the success factors will be dependent on the disciplinary contexts for the above reasons.

Formal teacher training and knowledge of L&T theory also varied across the case studies, which could have influenced the ability of the teachers to articulate their approaches. The semi-structured nature of the interviews overcame this somewhat by allowing for additional questions to be asked in order to clarify and explore answers to develop a clear understanding of the interviewees perspectives on their approach.

### **6.5 Further research**

This research began a process of investigating what good practice L&T for sustainability looks like, according to the lived experience of learners and teachers in EfS courses. In line with the Grounded Theory approach taken, the research presented in this dissertation forms the foundation for further exploration of the concepts and practices that have been found to be useful for teachers and learners in EfS. Due to resource limitations, a full Grounded Theory exploration of concepts and development of theory based on a reiterative research process could not be undertaken. But by identifying key elements of good practice according to student and teacher experiences, this research has begun a journey. The next step on this path, when following a grounded approach, is to return to the classroom to investigate these concepts in greater depth with students and teachers. This step is needed in order to reach data saturation from which solid theory can be developed.

The research reported here has raised a range of possible topics for further research, including:

- Research with a specific focus on learning outcomes of the activities and approaches that were indicated to be good practice in this study. The use of student perceptions generated valuable data to achieve the aims of this research, however further research can be undertaken using mixed methods to explore learning outcomes of specific activities. Further research is required on what L&T activities support deep learning, with a specific focus on ways to measure this deep learning as the use of student perception in this research was limited by the fact that students found reflection on learning challenging.
- Research specifically on learner reflection and ways that this can be effectively supported in HE would make a valuable contribution to EfS to help support this important, yet under-developed capability. Empirical research which tests students' ability to reflect on their learning after undertaking reflection using different methods, would provide valuable

data to inform good practice L&T to specifically support the development of reflective practice.

- Research with a specific focus on intrinsic motivators for student engagement with EfS is also important. This research found that one motivator for engagement in learning was teacher passion and engagement, and generally the use of learner-centred approaches and methods. Further research is required to investigate elements that can foster student engagement in learning for sustainability and overcome resistance to learning about sustainability.
- Longitudinal action research focused on transforming an EfS course, from being delivered in a teacher-centred manner to having a clear learner-centred approach, would provide valuable data on student perceptions of the changing L&T practice over time. This research has identified a need for further investigations of this kind, especially where students are from a discipline in which teacher-centred approaches are expected, such as Case Study Four.

## **6.6 A final word**

This research has found that despite the fact that teacher-centred approaches can provide students with professional relevance when learning about sustainability, good practice involves learner-centred practice. This is because learner-centred practice supports the development of capabilities such as lifelong learning, through activities seen in the case studies such as problem-based learning. Overall the case studies show that students are learning about sustainability, to varying degrees, and can have an engaging and rewarding learning experience in sustainability education. Hence, the findings from this research give reason to be very optimistic about innovations in pedagogical approaches and L&T methods in sustainability in HE as well as student willingness to engage in learning for sustainability. Of the 125 students who took part in the research, nearly all expressed an appreciation of the value of learning about sustainability in their degree program, even when the L&T approach was not in line with 'good practice' according to theory. This indicates that students are willing to engage with sustainability and understand the importance of learning for sustainability. All five educators who took part in the research expressed strong commitment for L&T about sustainability. Perhaps as a consequence, approaches taken in the case studies

appear to have brought about a general understanding of sustainability in learners. Also, because all case studies situated sustainability in the professional context, student participants could clearly see the links between sustainability and their profession.





## Appendix

### 1.1 Teacher interview questions

#### Course/subject description

1. So tell me a little about your course/subject.
2. What are your course/subject objectives and why have you decided on these?
3. Can you briefly describe the course/subject focus and what content areas are included i.e. what are the topics? What learning outcomes do these focus areas aim to achieve?
4. Does your course/subject include skills or capabilities development? If so, what are these and how are they developed in your course?
5. Can you describe the student learning outcomes that are achieved through your course/subject?
6. How are these achieved and demonstrated?
7. How do students demonstrate their learning, describe the assessments used for your course/subject? Why have you chosen these assessments?
8. Describe the main activities that take place in your classes e.g. what are the students doing?
9. Think of a typical class you've taught recently. Describe, from beginning to end, what took place in that class.
10. What other learning/teaching activities do you typically include in your classes?
11. Are there any other activities that students participate in as part of your course/subject that have not been mentioned?

#### Pedagogy

12. Please outline the process(es) that you have undertaken to develop your course/subject?
13. How would you describe your approach to teaching?
14. In the context of sustainability education, how do you think your students learn best?
15. Please outline the process that you have undertaken to develop your L&T approach for sustainability?
16. Have you drawn on any literature or examples to develop your L&T approaches? If so, can you recall what these are?

## **Understanding of sustainability education**

17. What is your definition of sustainability education?
18. What should students be learning in sustainability education? What do you see as important and why?
19. What learning outcomes do you see as being most important for sustainability education?
20. How did you first become involved in sustainability education?

## **Challenges and opportunities**

21. Thinking about your own course/subject, what have been or continue to be the key challenges that you experience in your L&T practice? Think about these at a classroom level (assessments, activities, student assumptions etc.), from a university level, professional and discipline level, and even the broader societal level.
22. Thinking about your own course/subject, what have been or continue to be the key opportunities for sustainability L&T? Think about these at a classroom level (assessments, activities, student assumptions etc.), from a university level, professional and discipline level, and even the broader societal level.
23. Thinking about your own course/subject, what have been or continue to be the most rewarding outcomes that you experience in your L&T practice?

## **1.2 Student survey questions**

1. What program are you currently enrolled in?
2. Approximately how many [course name] lectures/workshops did you attend over the semester?
3. On average, how many hours did you spend studying for this subject each week outside of class time? This question was asked to see how much additional effort/time was put into the course outside of what I observed during class time. If students had a negative experience of any part of the course it may be because of less time spent studying in combination with their skills and other factors
4. What is your gender?
5. What is your year level?

6. What is your age group?
7. Are you an international student?
8. Have you studied or had previous experience with sustainability/sustainable design ideas prior to this subject?
9. Overall, how interested were you in this subject, [course name]? Interest in the course based on previous knowledge and experience may impact on students experience and learning in the course)
10. In the beginning of the subject, how interested were you to learn about sustainability/sustainable design in [course name]?
11. Overall, how motivated were you to learn in this subject, [course name]? One may be interested or attend class but not active in their learning or desire to learn through the course. This question gives a sense of whether students were willing and active learners in the course.
12. Which of the following describe your experiences during the [course name] subject? Please tick the most appropriate boxes. This question gives an indication of the students' memory of their experiences in the course overall.
13. Overall, what parts of the [course name] subject did you find most engaging and why?
14. Overall, what parts of the [course name] subject did you find least engaging and why?
15. Did you have the opportunity to draw on your own knowledge and experience as part of the learning for this subject?
16. Overall, the effort required in [course name] (in both completing assessments and participating in class activities) is ultimately rewarding. This question is an important indicator of the overall value the course had for the students. Learning is not always 'fun' and 'easy'. Learning, specifically in regards to such a morally challenging field as sustainability, is better viewed in terms of the reward for achievements rather than enjoyment.
17. Overall I found the [course name] subject... (Please tick the most appropriate boxes)  
This question is another attempt to gauge the students overall feelings during the course. Given the complex and morally charged content in sustainability education, students can easily become depressed or apathetic about addressing the issues.
18. Has your thinking changed as a result of the [course name] subject? If yes, please describe the ways that the course has changed your thinking. This question is very important as a gauge of course impact and learning. Any learning changes conceptual frameworks so 'changed thinking' is an indication of learning.

19. Please rate the level of importance of the following activities were for your learning about sustainability during the [course name] subject. Please select N/A if the activity was not offered as part of the subject.
20. What workshop activities best helped you learn about sustainability and its related principles and ideas? Describe all the ones that stand out for you and why.
21. To what extent did the following assessments and course topics help you learn about sustainability and how it applies to your future professional practice?
22. Were there any parts of the assessment that you found particularly challenging? Please explain what these parts were, why you found them challenging and what, if anything, helped you overcome these challenges.
23. Were there any sustainability concepts or theory that you found challenging to understand in the [course name] subject? Please explain what these concepts were, why you found them challenging and what, if anything, helped you understand them.
24. Was there a 'light bulb moment' that helped your learning about sustainability during the course? If yes, describe this moment and how it came about.
25. How satisfied were you with the [course name] subject in terms of understanding Sustainable Development?
26. Describe the relationship between your teacher in this course and you and your fellow students over the semester. Describe your teacher's approach.
27. Did this relationship with your teacher help or hinder your learning about sustainability, and why?
28. What skills do you feel you developed through the [course name] subject? List as many as you like.
29. What parts of the course (including lecture, workshops and assessment) best helped you develop the skills you feel you have gained in this course? Please describe and make links between the skills and the parts of the course you thought developed these (for example, 'communication skills were developed through group work in workshops').
30. Please rate the level of confidence the [course name] course has given you in applying the following skills in your future professional role/s:
31. Did any of the workshop activities and assessments require you to be creative or develop what you think are creative responses? For example, were you surprised by your ideas? This question relates to research I have been doing on creativity as an important attribute and skill for sustainability.

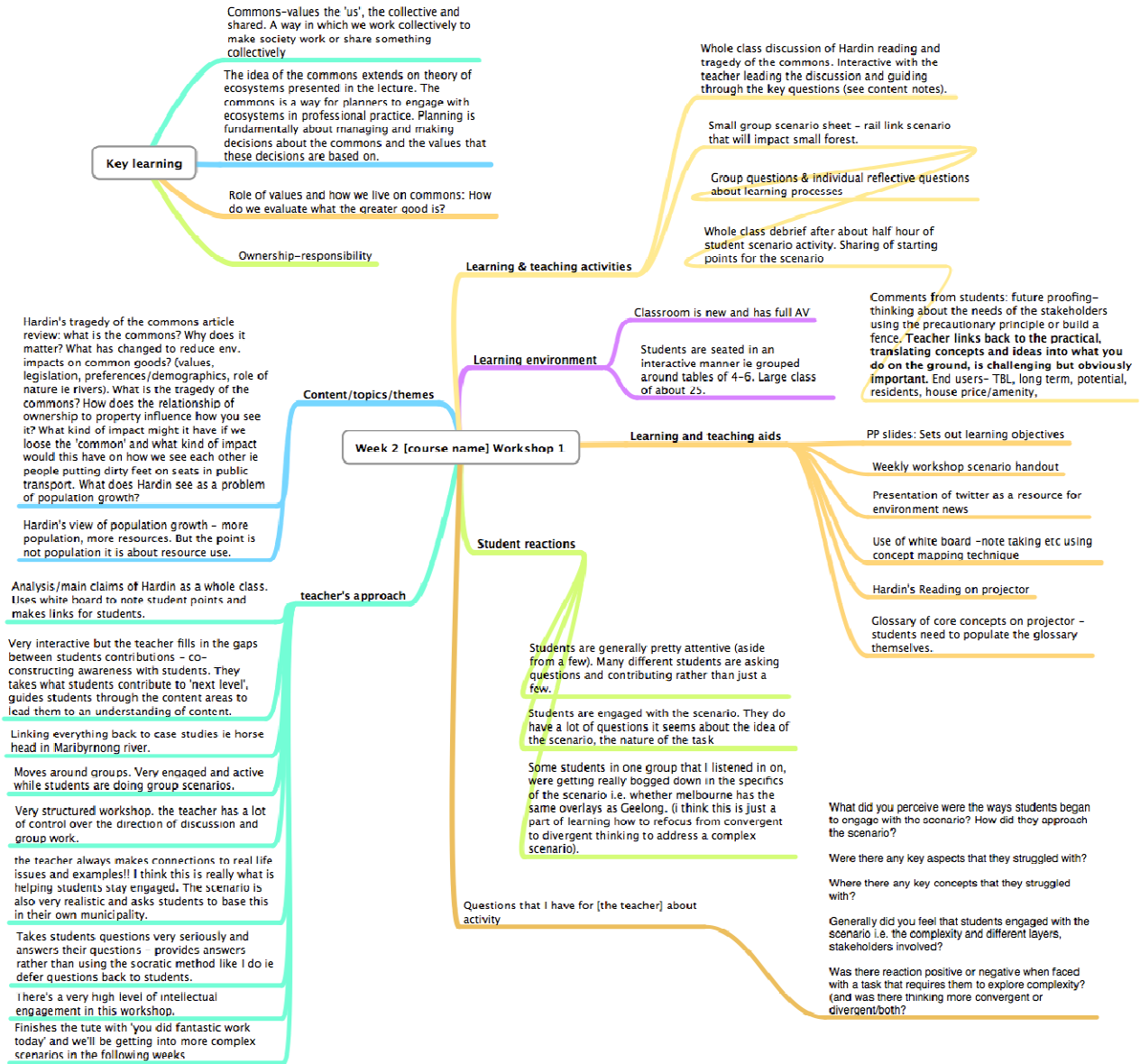
32. Do you think that your learning from this course, [course name], is relevant to your future professional area? Did you feel that clear links were made between the course and your future professional role?
33. Do you feel confident in applying sustainability principles/ideas/theory in your professional career?
34. Can you describe what sustainability in your future professional practice should look like to you?
35. With respect to issues of sustainability, did this course influence you in changing your approach to your studies and future career path?
36. Before attending the [course name] course I believed sustainability was an issue that was relevant to me personally.
37. Having undertaken the [course name] course I now believe sustainability is an issue relevant to relevant to me personally.
38. Before attending the [course name] course I believed sustainability was an issue relevant to my future professional practice.
39. Having undertaken the [course name] course I now believe sustainability is an issue relevant to my future professional practice
40. In general, how important do you think it is to learn about sustainability?
41. Do you think the [course name] course should continue to be part of your degree program?
42. Would you suggest any alterations to the [course name] course to improve the learning experience for future students? If yes, what are they?

### ***1.3 Student focus group questions***

1. How valuable do you think the course/subject is?
2. Do you think that your learning from the course/subject is important to your future professional area? Why/why not and how?
3. Do you feel confident in applying sustainability principles/ideas/theory in your professional career? Why/why not?
4. What did you find most engaging and why? Lectures, workshops, group work, assignments, reading pack etc.
5. What did you think about [assignments]? Did you find [them] useful and interesting? What did you learn from these?
6. Can you describe your relationship with your teacher and their approach to teaching? How did you find this?

7. What activities or course/subject material best helped you learn about sustainability?
8. Were there parts of the course (theory or concepts) that you found really challenging to understand? Did anything help with this? Likewise with activities?
9. What skills and capabilities do you feel you developed through the course/subject and what parts of the course/subject helped to develop these?
10. Has this course required you to draw on creativity? Has it built confidence in thinking about alternative ways of doing things?
  - a. Were you surprised by the solutions you came up with? In other words, were your scenario responses different to what you thought was possible at the beginning of the course?
11. How do the large classes affect your learning? Do you like large classes or would you prefer smaller classes?
12. What have you learned from the course overall?
13. How important do you think sustainability is?
14. Do you think the course should continue to be part of your degree program? How relevant do you think the course/subject is to your discipline area?
15. Would you suggest any changes?

## 1.4 Observation note mapping example



## 2.1 Case Study One course overview

### Introduction and brief history

Case Study One is a core subject in the first year of three different bachelor programs in the build environment. The subject is course work based and runs for one full semester (12 weeks) with a one hour lecture and following two and a half hour workshop/tutorial each week for the duration of the semester. A total of 205 students undertook the course when this case study research took place. These students were divided up over four weekly workshops

that were made up of a mix of students from the three bachelor programs. The subject is a recent addition to the bachelor programs. One academic delivers co-ordination, lectures and workshops. Students come into this course with little knowledge of sustainability beyond their existing awareness (through the media for example).

The course guide provides the following description and context of the course:

The main aim of this course is to create a greater understanding of our environment, society and economy, and to recognize the impact we as individuals and professional building, property, valuation and project management practitioners have within and across these three areas. [This course] is designed to enable students to critically reflect on how their own personal, disciplinary professional practice as it relates to issues of sustainability.

[This course] requires students to explore the diverse ways of defining sustainability using the dimensions of natural environment, society and culture and the economy, often referred to as the triple bottom line. In defining sustainability the course requires students to reflect on their practice of sustainability and subsequent professional practice. This includes recognition of the different philosophical/disciplinary orientations and the emerging consequences in practice. By using sustainability as a concept to explore assumptions, biases and the limitations of existing approaches to practice, it is hoped that you will be able to develop a critically reflexive approach to your practice, perhaps with some sustainability content as well.

### **Course learning objectives**

The course guide outlines the following learning objectives for the course overall:

- Define sustainability and to identify the differences between your definition and those of others.
- Understand and apply key sustainability principles in relation to your disciplinary practice.
- Define and understand the five types of capital (natural, human, social, economic and manufactured).
- Recognise, describe and reflect upon your personal and professional practice in relation to sustainability;
- The development of skills in evaluating current sustainability concepts, theories, methodologies and practices;
- Reflect critically upon different sustainability concepts, theories and methodologies as they relate;



- To your ability to make decisions on the basis of a personal and professional interpretation of sustainability;
  - To your ability to identify good sustainability practice/management;
  - To your understanding of what constitutes exemplary sustainability leadership and management
- Communicate effectively by clearly constructing arguments including presenting and defending positions, and to be able to constructively comment on the work of others.
  - To apply knowledge in problem-based learning exercises.
  - Research and critical analysis skills, including the ability to perform database searches, critically read and revise writing, develop lines of argument supported by appropriate evidence, reference correctly.
  - Skills in participating in discussion groups, and ability to contribute to academic discussions.

### **Course structure and delivery**

The course is delivered through weekly lectures and workshops. The course guide outlines the general course activities and style as follows:

Workshops will introduce you to the concept and practice of sustainability from a variety of perspectives. Each workshop will include the following elements;

- Theory and Personal Practice.  
This section will provide students with the history of the specific sustainability topics; provide discussions of the issues currently being faced, and their relationship with the issue (in terms of personal practice).
- Disciplinary Practice.  
This section explores how the theoretical components introduced at the start of the workshop relate to disciplinary practice.
- Tools/Techniques  
The techniques instruct the students with procedures and approaches for evaluating the impacts of the industry components of sustainability. The 'tools' introduce students to some toolboxes, templates, rating systems, indicators and strategic change/management techniques that facilitate their understanding of background information.

Inherent to the workshop approach is to engage students in active learning. The purpose of active learning is to deepen students understanding as well as help them develop positive attitudes towards sustainability. Workshop activities will be conducted in both an open group format and in smaller discussion teams and workgroups. Workshops will ensure that the theoretically

components presented in the course will be set within the four disciplinary contexts of [the School] – so you will be applying the content area to a field of future work...

The course also uses the online ‘blackboard’ web program to post workshop and lecture materials, written group work materials and also assignments through a journal function.

The workshops are grouped into three areas with the first three weeks focusing on foundational theory and concepts relating to sustainability, weeks four to 10 focus on application, implications and relevance of different capitals to professional practice (including environmental, manufactured, human, social, and economic), and the final two weeks of the course are about professional decision making and organisational change.

### **Assessment overview**

There are a number of assessments in the course including article reviews to build critical analysis skills, an ecological footprint report which requires students to undertake and reflect on their own ecological footprint, and a PBL style group Fisherman’s Bend development report/tender document and map accompanied by an individual reflection on the project and course.

- The *article reviews* (worth 20%) are completed in class and assessed at the end of semester. The students undertake a number of article reviews from the course readings however only two of these are assessed. The short reviews ask students to articulate each article’s main argument, sub-claims, evidence and assumptions as well as full Harvard referencing.
- The *Ecological Footprint Report* (worth 20% and due in week seven) is a 1000 word report that asks students to undertake their own calculation of their footprint using an online calculator and reflect on this.
- The *Fisherman’s Bend Development group report* (FBD report) (worth 40% and due week eight for the first phase and week 13 for second phase) is developed in groups of three to six students predominantly during class time over the semester. Students are given the site specifications as well as real life approximations of different dwelling sizes and types and associated costs. They are required to work to the State Government vision for the site which requires the development to be mixed use, affordable and sustainable and contain 7,000 dwellings which house 15,000 people. Over the semester students work on

their development proposal in groups, drawing their plan (roughly to scale) on A3 size graph paper and also incrementally writing their reports. The groups are asked to apply the theory of the five capitals (environmental, social, human, manufactured and economic) to the development as they work through these over the semester. The students are required to justify all their initiatives and decisions in the development, based on their collective definition of sustainability. The first phase of the report is presented as a draft tender document. This document is then given to planning students of Case Study Two who assess the document based on their own assessment criteria. The feedback from the planning students is then given to the construction students in this case study to use for the second phase of their major assessment.

The second phase final report requires students to propose the development while considering stakeholders and concepts of sustainability in their designs. They also have to address and incorporate the feedback from the planning students into their proposal and justify design decisions and trade-offs. Each student then has to provide a personal reflection on the assessment process and learning which is only seen by the teacher.

## *2.2 Case Study One specific research methods*

### **Observation:**

One lecture (week three) and eight workshops were observed during the semester including week three, four, five, seven, eight, nine, eleven and twelve. My presence was made known to the students in the third week of semester. I remained a silent observer in each observation sitting. The observation results are used primarily to show what L&T methods are used in the courses from the viewpoint of the researcher.

### **Teacher interview:**

A one hour semi-structured interview was undertaken mid-semester with the interviewee who is the course designer, coordinator, lecturer and workshop teacher mid-semester.

### **Student survey:**

An online survey was emailed to all students enrolled in the course in the final week of the course. The survey was open for three weeks and two emails were sent to students

in the course to invite and remind them about the survey. 25, \$15 gift cards were offered to students who completed the survey to provide an incentive for them to participate and also thank them for their contribution. Out of the 205 students enrolled and emailed about the survey, 44 students began the survey and 29 of these completed their survey. Therefore the response rate was 21.4% and the completion rate was 14.1%.

### **Student focus group:**

One focus group was held before the Thursday morning workshop in week 11. Students were invited to participate in the week prior and a sign-up sheet was passed around during each workshop. Students were then reminded about the focus group via the emails provided on the sign-up sheet. 10 students attended the focus group of the 240 enrolled in the course. These students were predominantly mature age and from all three of the program areas. The focus group went for approximately half an hour and five \$20 iTunes vouchers were given to randomly selected participants.

## **2.3 Case Study One observation results**

### **Lectures**

The lecture was held in a large cinema space across from the University. The teacher delivered the lecture using PowerPoint, beginning with the lecture learning objectives and working through the content material for each week's topics. The lecturer stated at the start of week three's lecture that all content that would be presented in the form of questions, claims, evidence and assumptions in order to 'model what they are asking students to do' in their readings and assessments. This means that content is presented in the lectures in the form of a critical analysis for the students to make their own judgements on. In addition to the theory presented, the lecturer also incorporated case studies and examples of the theory in practice.

In terms of delivery style, the teacher moved around the room in order to interact and maintain attention from students rather than standing in one place. Questions were regularly asked of students so the lectures were semi-interactive.

### **Teaching environment**

All four workshops were held in the University's new interactive learning classrooms. Tables were circular to facilitate discussion and there were multiple projector screens so students

could easily view the PowerPoint on the projector screens. The classrooms were designed to accommodate large classes of about 60 students.

### **What learning and teaching methods are used in the course?**

The teacher used a PowerPoint to structure the workshops that include the learning objectives, L&T activities, explanations of assessments and videos. Each week the workshops were structured to include similar activities. Part of the workshops involved questions and activities on the readings and lecture material, followed by videos and questions or case studies and then work on the assessment pieces.

Many different teaching aids and activities were used over the semester. The classes observed were very interactive and the teacher devoted a lot of time to supporting students through listening to their views, stepping them through the assessment process and helping to answer questions. Students appeared comfortable expressing themselves and the teacher took a non-judgmental, even playful approach to responding to students' criticisms of sustainability. Most of the class time was spent on working on the assessment pieces or skills and awareness building activities that students could use for their assessment. The FBD report assessment by far took up most of the workshop time over the semester and, in the workshops observed, students appeared to be very engaged in the task. All activities were either directly related or linked to by the teacher to the built environment so students had constant reinforcement that sustainability is relevant to their learning and how. The teacher constantly made the links between the skills and knowledge gained.

There were a range of L&T activities throughout the semester's workshops. The more common were related to questions which students worked on in groups and also videos with questions. The following table provides examples from the observed workshops of the L&T activities used in the course.

Week	Activity
Week 3	<u>Definition of sustainability exploring different worldviews</u> Students were asked to define sustainability from the worldviews of neoliberalism, technocentrism & ecocentrism for 5-10 minutes in groups
	<u>Values quiz</u> An online values quiz, predominantly about how resources should be valued, was completed on an overhead slide. Students were asked to individually answer the questions as they went through the quiz then they discussed these as a class.

	<p><u><i>Introduction of the FBD report assessment</i></u></p> <p>The teacher introduced and explained the Fishermen’s Bend development assessment.</p>
	<p><u><i>Natural capital</i></u></p> <p>Students were asked to answer questions about natural capital including, What is it? Why is it important? Why is it problematic? Students were encouraged to enter answers straight into their assessment wikis set up for their Fisherman’s Bend development proposal. The students’ answers were discussed as a class and the teacher also presented their definition of natural capital to be transparent about their own worldview.</p>
Week 5	<p><u><i>Ecological sustainable design</i></u></p> <p>Week five began with a video on ecological sustainable design principles. The video included a description of the ‘teletubies house’. A key quote from the video was that there is ‘no recipe for ESD, every project is a creative project’ (paraphrased). This video covered real case studies of all the benefits of ESD and seven ESD objectives which the students can draw inspiration from for the Fisherman’s Bend Development. After the video there was a class discussion and a brainstorm of design principles mentioned</p>
	<p><u><i>Stakeholder identification</i></u></p> <p>The teacher linked the idea of systemic and holistic design to an activity where students identified all the stakeholders in their profession and discussed how to address their needs through integrated design.</p>
	<p><u><i>Applying environmentally sustainable design</i></u></p> <p>Students were then asked to apply and include ESD principles in their development proposal in class (on their physical plan and their wiki page).</p>
	<p><u><i>‘Story of a coke can’</i></u></p> <p>The ‘story of a coke can’ was introduced at the beginning of the workshop with students asked to participate by answering questions. In groups students were asked to define overconsumption and think of the impacts of overconsumption on individuals, family, community, economy, civil society, culture (each group given a different stakeholder). Groups were asked to write their responses on the white board.</p>
	<p><u><i>Article analysis</i></u></p> <p>Students then analysed an article about suburban development on the peri-urban fringe. The questions about the article included: What are the challenges facing the community? What are the impacts of development in the area across the different capitals? What are the overlaps between capitals? What are the potential solutions? These questions started a discussion about whose responsibility adequate provision of infrastructure is and for who should this infrastructure be provided.</p>
Week 8	<p><u><i>Questions about human capital</i></u></p> <p>This workshop started with group questions about human capital: how does your industry impact on the development of human capital? Students were asked to explain the relevance of sustainability to health, learning and work and asked to write their responses for each three categories on the whiteboard. To finish the activity the teacher summarises all the students' work for the class.</p>

	<p><u>'Slumming it up' video</u></p> <p>This activity was followed by a video of Kevin McLeod in Darabi ('Slumming it') to explore what is required to have human capital. The teacher then links the video to what we need to be happy, and how we can develop land that meets existing needs while not impacting on the human and social capital within the areas that are being developed.</p>
	<p><u>Redevelopment case study</u></p> <p>To further explore the impacts of development on social and human capital the teacher uses a case study of redevelopment of public housing.</p>
Week 9	<p><u>'What's up with the GDP?' activity</u></p> <p>The teacher asks students to copy down a definition of financial capital from the overhead and asks students to then respond to a scenario, 'what's up with the GDP', in regards to the Salmon Bay community after an oil spill.</p>
	<p><u>Enron video</u></p> <p>A video clip of an Enron documentary presents issues with deregulation, free market and corporate greed. The teacher then links the video to the student's professional area by asking what happens when we place short-term profits over long-term sustainability</p>
	<p><u>Guest speaker</u></p> <p>A guest speaker from the school presents the economic considerations of real estate development.</p>
Week 11	<p><u>Mind-map of barriers to sustainability</u></p> <p>Students created mind-maps of barriers to achieve sustainability in the building profession.</p>

## 2.4 Case Study One survey respondents' perspectives on the teaching approach

The following table shows the qualitative responses to the question about teaching approach:

Qualitative responses to question 27	
Did this relationship with your teacher help or hinder your learning about sustainability, and why?	
1.	This relationship was extremely helpful as I did not feel strange about approaching [the teacher] with issues both within their course and others.
2.	It definitely helped, as I said, because when we were uncertain about things, because the teacher is so approachable made it easy to solve our uncertainties.
3.	Teacher helped me because the teacher was always available for my time
4.	harbored a further interest within the subject.
5.	No, if anything it helped it flourish. The teacher was the best.
6.	It helped greatly as I was able to have all my queries answered.

7.	helped, because anything that I didn't understand the teacher explained to me more clearly one on one and would help me with any queries
8.	this helped because the students knew they would be able to engage with the teacher to learn more and ask questions
9.	motivates me to create a more sustainability life and helps me to understand what is sustainability
10.	As mentioned above the more informal, relaxed and friendly approach to learning I found to be quite helpful and allowed for myself to discuss my perceived assumptions to gain validation or corrective information.
11.	Yes, if the teacher had just stood up the front and talked, I would have been extremely bored. The teacher was very personable which made it a comfortable environment to ask question and interact
12.	It helped a lot as I find my tutor very approachable and my doubts can be cleared.
13.	Help because you could confidently ask and answer questions so you could take some responsibility for your learning
14.	help because it was clear what we were doing wrong
15.	Yes because it created discussion on the issue
16.	Helped, provided amazing level of assistance
17.	it helped, it make discussions productive

Teacher availability, approachability, helpfulness and friendliness according to the responses appears to have created a 'comfortable environment', that was also described in the responses above as productive for learning, relaxed, motivating, confidence building in taking responsibility for independent learning, and harbouring further interest.

The following table presents adjectives used by respondents to describe the teacher and the student-teacher relationship in the qualitative responses to Question 26 asking students to describe the teaching approach. Frequency counts of adjectives used in responses are provided in brackets.

<p>Adjectives used in qualitative responses to question 26</p> <p>Describe the relationship between your teacher in this course and you and your fellow students over the semester. Describe your teacher's approach.</p>
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Helpful (10)	Enthusiastic (1)	Relevant advice (1)
Friendly/a friend (4)	Interested (1)	Knowledgeable (1)
Enjoyable (3)	Great teacher (1)	Explains well (1)
Interactive (3)	Nice (1)	Mentor (1)
Great relationship (3)	Easy to get along with (1)	Open (1)
Caring (2)	Easy going (1)	Engaging (1)
Approachable (2)	Informal (1)	Outstanding (1)
Understanding (2)	Relaxed (1)	Fun (1)
Passionate (1)	Welcoming (1)	Perfect (1)
Willing (1)	Informative (1)	

From this, we can see that for the student survey respondents, the approach that the teacher has taken has led to a positive teacher-student relationship and has helped or supported learning in the course for these students.

### 2.5 Case Study One survey respondents' 'light bulb' moments

The students that talked of a 'light bulb' moment described the following:

Selected qualitative responses to question 24	
Was there a 'light bulb moment' that helped your learning about sustainability during the course? If yes, describe this moment and how it came about.	
1.	When i realised how simple it is to reflect a capital to one another.
2.	Yes, at the start i found it hard to distinguish between the capitals but once explain i got the difference between them all.
3.	When discussing each of the 5 capitals and their impacts would cause a 'light bulb' moment, as previously mentioned it allowed myself to link up existing knowledge.
4.	The difference between social and human capital. At first, i used to think that both capitals are almost similar.
5.	Some of the videos explanation methods of making a building sustainable provided visual confirmation of how they are implemented and how they effectively work.
6.	LIght-bulb moment came when we were told all those startling facts about the inbalance of spending in the world. E.g. more on makeup in the US than third world food ect.
7.	watching videos helps apply knowledge and closely understand how important some issues are
8.	I realised whilst watching the green school building video that a green building can be achieved using some very simple inexpensive methods
9.	Ecological Footprint: doing this exercise taught me how everyday routines can negatively impact society. Once doing that, everything in managing sustainability kind of "clicked".
10.	Ecological footprint

11.	watching the video about calculation of your ecological footprint.
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### 3.1 Case Study Two course overview

#### Introduction and brief history

Case Study Two is a core subject in both the second year of an undergraduate planning degree and an undergraduate planning and landscape architecture double degree. The course is offered in the social sciences school. The subject is course work based and runs for one full semester (12 weeks) with a one hour lecture and following two hour workshop/tutorial each week for the duration of the semester. A total of 68 students undertook the course when this case study research took place. These students were divided up over two workshops with predominantly single degree students in the first workshop and double degree students in second workshop. Co-ordination, lectures and workshops are undertaken and delivered by one academic. The course underwent major restructuring with the appointment of the current coordinator who has been co-ordinating, lecturing and teaching into the subject in the two years previous to this research taking place.

The course guide provides the following description of the course:

Consistent with a worldwide trend, the size of Australian cities has increased dramatically over the last 100 years, placing significant pressures on the natural resource base and regional infrastructures. Evidence of rapidly changing climates, diminishing resources, and a catastrophic loss of global biodiversity illustrates the critical need for designers and planners to articulate an ecologically sound blueprint for urban development. Given this substantial challenge, this course seeks to develop a theoretical and methodological framework for incorporating ecological knowledge, values and criteria into the urban and rural planning process. In addition to this professional knowledge, the course will explore some underpinning factors in these scenarios. Consideration will be given to the ideological and political contexts which inform present trends and various interventions offered to mitigate those trends. In addition, the course will take a strong focus on the professional skills required for planners and urban designers.

#### Course learning objectives

The course guide outlines the following learning objectives for the course overall:

1. An awareness of the ecological and natural capital foundation of planning and design decisions that shape the natural environment in Australia;

2. Basic knowledge of the principles of ecology, environmental problems arising from the working of modern urban-industrial societies and the decoupling of natural capital from other/secondary kinds of capital, environmental research methods, environmental risk assessment and the broad social, economic and regulatory frameworks in which environmental problems are resolved;
3. A range of professional skills related to the development, analysis and application of content and professional knowledge in multiple scenario-based learning exercises;
4. Research and critical analysis skills, including independent academic and professional research, critical reading and revision, multi-setting writing, academic debate, development of lines of argument supported by appropriate references, and
5. Skills in professional engagement, collaboration and multidisciplinary team work within the built environment context.

These learning outcomes are supported through the activities in the following table:

Planned Student Learning Experiences	Learning Objective
<b>Lectures</b> - Students in lectures and through access to web-based material acquire a framework of relevant knowledge and an understanding of underlying theoretical/conceptual material.	1,2,3
<b>Tutorial exercises</b> - Students completing tutorial exercises engage in a critical analysis of relevant knowledge and underlying theoretical/conceptual material. Students develop responsibility for a synthesis of knowledge and the ability to apply this knowledge flexibly and creatively to real-world issues in their field of interest. Students acquire abilities to develop group and individual problem solving skills.	1,2,3,4,5,6
<b>Multidisciplinary professional engagement</b> – Students will engage with and respond to a hypothetical development proposal by students in degree programs in property and construction management. This activity helps students to develop effective professional assessment and written communication skills and expose themselves to the experience of formal planning and consultancy advice provision. Students will engage with examples and templates for the provision of professional advice.	6
<b>Academic and professional writing</b> - Students completing assignments will apply conceptual material to research, will develop critical thinking skills in research methods, will develop skills to evaluate studies, and will develop skills in effective communication (both verbal and written) of research findings to relevant academic/community representatives.	1,3,5
<b>Tutorial participation and problem responses</b> - Students discuss and critically analyse papers from prescribed reading. Through tutorial participation, students develop effective communication skills and develop an ability to work as a member of a team. In so doing, students acquire abilities to develop group and individual problem solving skills.	3,4,5,6

### Course structure and delivery

The course is delivered through weekly lectures and workshops. The course guide outlines the general delivery structure as follows:

Lectures and tutorials will introduce you to core concepts and practices relating to ecological and sustainability considerations, and their integration with the social and economic, in urban design and planning. Students will attend three hours of classes a week: a 1.5-hour lecture,

and a 1.5- hour tutorial. For the tutorial, students are engaged in revision and application of concepts covered in lectures, and learning activities linked to the learning objectives listed under C. Tutorial activities are conducted in both an open group format and in smaller discussion teams and workgroups.

The course also uses the online ‘blackboard’ web program to post workshop and lecture materials and also assignments.

The semester workshops and lectures are focused on the following content areas:

- Week 1: Orientation, overview and foundational concepts
- Week 2: Foundations of ecology in planning and design
- Week 3: Ways of seeing and valuing ecology; world views, history and indigeneity
- Week 4: Environmentally sustainable planning & design – principles and debates
- Week 5: Integrated planning and design - waste and water
- Week 6: Integrated planning and design – energy and biodiversity
- Week 7: Principles -case study lecture – the fishermen’s bend site and ESD
- Week 8: Constraints planning and negative scenarios – the practice of future proofing
- Week 9: No lecture – preparation of task 2
- Week 10: Environmental risk assessment and research methods
- Week 11: Visioning sustainable futures – ecological challenges and Solutions
- Week 12: Test

### **Assessment overview**

There are three assessments in the course including a workbook that that is completed by students over the semester, a written development application response, and a scenario-based learning test.

1. The *workbook* (worth 30%) includes five scenario responses that are workshopped in groups during class time which students then write up individually out of class. The workbook also includes a glossary of concepts related to the course content which students are asked to develop individually based on their learning from the weekly readings, workshops and lecture materials. This glossary is then used in the end of semester test. The course guide outlines the following criteria for this assessment:
  - Depth of thought in response to FIVE (5) scenarios chosen and the linkage of ecological and environmental concepts to planning and community well being (10 marks).

- Detail and development in theoretical notions and relevant legislation within the test glossary (10 marks).
- Comprehensive and thorough use of literature (at least 12 academic sources), (including Hardin's Tragedy of the Commons)\* from the course to develop theoretical context, referenced using the Harvard system (5 marks).
- Extensive identification of cross linkages and interrelationships within the glossary in relation to both theory and legislation/overlays etc (5 marks).

2. The *Fishermen's Bend Development Application Response* (FBD Response) (worth 30% and due in week nine) is a multi-disciplinary assignment shared between first year students from this case study and Case Study One of this research. This task required construction students from Case Study One to create a development proposal (which includes both a written description of their tender and a physical site map) for the soon to be developed Fisherman's Bend site in inner city Melbourne. Case Study One students are asked to apply the concepts that they are learning from their sustainability course in the development proposals. The role of this Case Study's students is to then provide feedback on the development proposals. Case Study Two planning students are asked to provide feedback based on their own knowledge from this Case Study Two course and their studies so far. Case Study Two students completed this work in small groups and submitted written feedback as a group that was assessed and passed back to the Case Study One students as part of the their course assessment. The assessment criteria for this assignment outlined in the course guide are:

- Group Assessed: Identification of key issues (positive and negative) in the development proposal in relation to integrated ecological and social concerns (you should seek to identify strengths, weaknesses, opportunities, risks and costs/benefits) (7 marks).
- Group Assessed: Identification and direct usage of key course readings, materials, concepts and notions in relation to ecological planning/design and its integration with the social (7 marks).
- Group Assessed: The innovation, quality and specific detail in your response to the development proposal regarding amendments/initiatives which you have identified as doable or highly desirable for the Fishermen's Bend site and context (8 marks).
- Individually Assessed: Your (individual) report and mind map which identifies, interrelates and discusses YOUR specific experience of the process of preparing the submission, key learnings you have gained, frustration or difficulties you encountered, and benefits you can identify as emerging from this task (8 marks).

3. The *scenario based learning* test requires students to write a written response to a scenario, similar to what they do during the semester in each workshop. The scenario must incorporate the concepts from the students' glossaries which they have been developing over the semester. The response can be in the form of a concept map or report, so long as connections are made and a clear articulation of ideas is present. Week 12's lecture time is used for the 1.5 hour open book test.

### **3.2 Case Study Two specific research methods**

#### **Observation:**

Five lectures and five workshops were observed during the semester including week two, four, six, seven, eight and eleven. My presence was made known to the students in the second week of semester. I remained a silent observer in each observation sitting.

#### **Teacher interview:**

A one hour semi-structured interview was undertaken mid-semester with the interviewee who is the course designer, coordinator, lecturer and workshop teacher.

#### **Student survey:**

An online survey was emailed to all students enrolled in the course in the final week of the course. The survey was open for three weeks and three emails were sent to students in the course to invite and remind them about the survey. Fifteen, \$15 gift cards were offered to students who completed the survey to provide an incentive for them to participate and also thank them for their contribution. Out of 68 students enrolled in the course, 18 participants began the survey and 12 of these participants completed their survey. Therefore the response rate was 26.47% and the completion rate was 66.7%.

#### **Student focus group:**

Two focus groups were carried out immediately after each workshop in week 10. Students were invited to stay for the focus group after the workshop. Eight single degree students volunteered to take part in the first focus group and nine double degree students in the second. The first focus group included only second year students and the second focus group were predominately second year with three first year students. The focus groups went for approximately half an hour each and discussed questions about

students' experiences through the course.

### **3.4 Case Study Two observation results**

#### **Lectures**

The lectures were held in a medium size lecture space with the teacher talking to students using a PowerPoint presentation to structure the lecture and present information. At the start of each lecture learning objectives for the week were outlined. Generally, the teacher presents students with theory and links to real world examples of the theory (or lack of) in planning practice using references, descriptions and case studies. A number of times in each lecture the teacher asked students questions and allowed space for students to ask questions during the lecture. Generally the questions from students were quite critical of the content which was openly encouraged by the lecturer.<sup>17</sup> Despite the lecture being delivered in a traditional format with the presentation of theory and examples, the students were invited by the lecturer to raise questions or criticisms during the lecture time.

During each lecture observed, the lecturer continuously made strong links between ecology and ecological thinking and planning practice. Ecological Principles in Land-Use Planning were presented as 'two sides of the same coin', with ecological principles embedded in practice rather than two separate fields of planning and ecology. Each lecture featured key concepts such as biodiversity, ecology, future proofing, decoupling/re-coupling triple bottom line, which students have to define in their own words and place in their glossary as part of their workbook assessment (see below). Key pieces of relevant legislation were also included where necessary in lecture content.

The way the content was delivered did not simplify the way planning intersects with environment and sustainability. The lectures were loaded with information and different elements of each topic. It could be seen as an overload of information, however this method could also be useful to show just how complex and fundamental environment and sustainability is to planning practice. The content was rooted in context and practice (this is part of what makes the lectures so full of information and examples). Theory and practice are

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<sup>17</sup> Student question example 'what is the point of stopping species loss, how do you know what the value is of certain species or decide which ones can be lost?' The teachers' response to this question was 'I want you to be involved in that decision in an extremely informed way that is aware of the impacts now and into the future'.

combined in delivery of the content in the lectures. No concept was described without a practical example of this theory emerging in practice or the need for it to emerge in practice.

There was a strong emphasis through all the lectures on the role that values and worldviews play on understanding and responding to issues in their professional contexts. Students were also continuously prompted to consider issues or developments on a micro- and macro-level and also consider the stakeholders' needs in all of the examples.

There were also number of guest lecturers during the semester talking about their experience of ecological thinking in their practices.

### **Teaching environment**

The two workshops were held in one of university's renovated classrooms that sits about 40 students. The classroom was fully equipped with AV and the tables were arranged for each tutorial so that students sit around tables in groups.

### **What learning and teaching methods are used in the course?**

There were a number L&T activities throughout the semesters' workshops. The more common were related to PBL activities and class discussions unpacking and applying theory. Every workshop was structured around PowerPoint slides and began with the learning objectives for the workshop. Each week the workshops were structured to include similar activities. Much of the workshops were spent unpacking the key concepts and discussing the readings then applying theory to a scenario worksheet that forms part of the students' workbook assessment.

### ***Example workshop***

The first workshop that was observed was in week two. The teacher took the same approach in following workshops that were observed, so the first workshop will be described here to provide an example.

The first activity in week two was a class discussion where the students, prompted by many questions from the teacher, analysed and unpacked the weekly reading about the 'Tragedy of the Commons'. The teacher used the white-board to concept map students' thoughts and show links between different ideas. The workshop was very interactive with students making many comments and adding to eachothers' ideas and the teacher filling in the gaps between student contributions co-constructing understanding with students. The teachers' role in this activity



was very much about taking what the students were contributing to really tease out all the theory their ideas could be linked with and guide them through the content areas to lead them to an understanding of content. As a result there was a very high level of student engagement in this workshop as demonstrated by student questions and criticisms. As in the lectures, the teacher continually drew on students' own knowledge and experience to provide real life examples of the theory or ideas in practice. The teacher constantly maintained control over the discussion through prompting, feedback to students and guiding questions.

The next part of the workshop involved group work on scenario responses. The teacher played a very active and supportive role moving around the groups to answer their questions and ask questions to encourage students to consider aspects of the scenario they had not touched on. The teacher took all student questions very seriously, however rather putting the responsibility back on the students to answer the questions, the teacher provided an answer for them, slightly stepping out of the learner-centred approach.

Overall the workshops were very structured with the teacher always maintaining control over the direction of discussion and group work. The teacher wrapped up the workshop with 'you did fantastic work today', noting that they would be undertaking more complex scenarios in the following weeks. The teacher gave the students constant positive reinforcement about all their contributions. The teacher really made a point of making all the students contributions valued and important.

### **3.5 Course influence on the way survey respondents think**

Has your thinking changed as a result of the course? If yes, please describe the ways that the course has changed your thinking.	
1.	Absolutely, through acquiring new concepts
2.	I can see more ways to integrate sustainability into existing structures.
3.	because i thought that governments had out best interest in mind, ours and the planets, which is not so the case
4.	I have a better appreciation for how our decisions today affect the future
5.	Its taught myself to think in a more innovative manner and then work backwards from there, rather than constrain yourself from the outset by current notions or limits.
6.	-I am now mindful of the generational impacts I'm going to have as a planner -In effect, it has shaped my values and outlook on everything, not just things related to my profession
7.	It has made me deeply think and understand thoughts that were constantly in the back of my mind and has allowed me to further develop these into understandings that can be used throughout the rest of my

	career.
8.	Because I have been introduced to a lot more ecological concepts, I will utilise these concepts for future reference when dealing with the rest of my course and professional life.

### 3.6 Focus group responses regarding course influence on thinking

Focus group responses regarding course influence on thinking	
1.	<i>It hasn't changed the way I think. But make me explore the way or how I think and my ideas. Being more critical about how I'm thinking</i>
2.	<i>The emerging theories are relevant to know and will be in the future – Makes you think about how you think in relation to those.</i>
3.	<i>I've had these values in myself and now they have a proper name and a theory to go with them. More visible.</i>

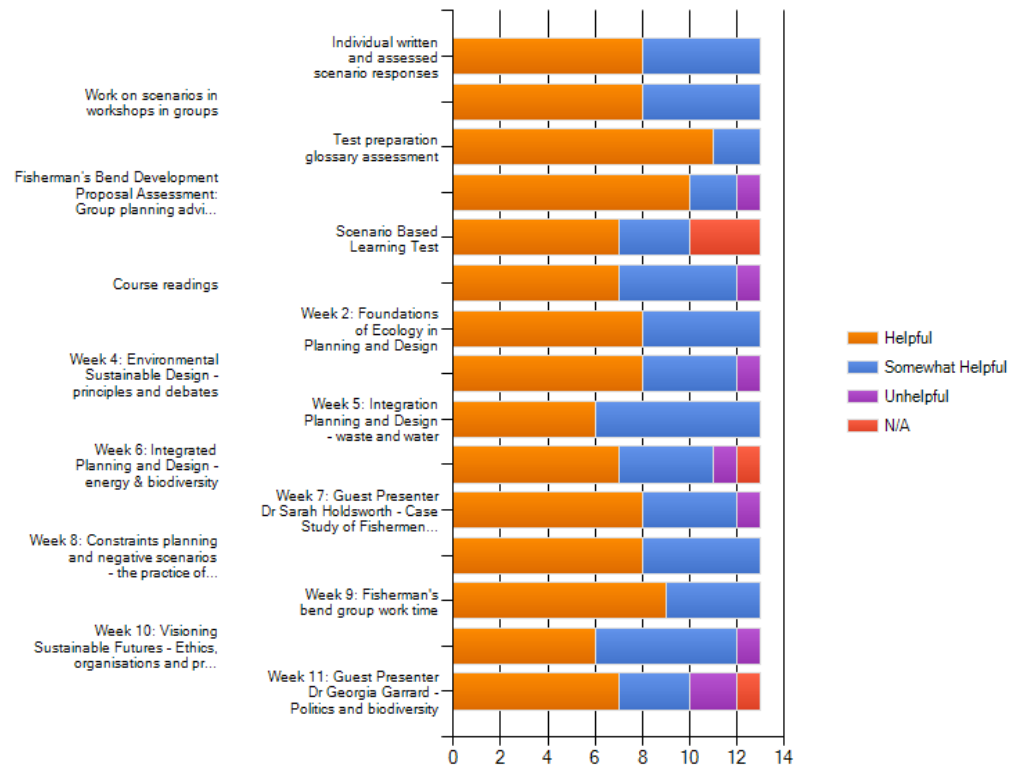
### 3.7 Level of importance of L&T activities for respondents learning about sustainability

Level of importance of L&T activities for respondents learning about sustainability during the course, ordered from L&T activities rated most important to least important.

Answer Options	Rating Average
Brainstorming with the whole class	1.47
Speaking in small groups with the teacher	1.53
Applying theory to case studies in small to medium group	1.57
Applying theory to case studies as a whole class	1.67
Working on assessments alone out of class time (individual homework)	1.67
Working on assessments in groups out of class time (group homework)	1.67
Listening to the teacher explain/demonstrate in the workshops	1.73
Question and answer with teacher as a whole class	1.73
Sharing work in small to medium group in the workshops	1.73
Small to medium group activity/exercises in the workshops	1.80
Speaking one on one with the teacher	1.80
Working on assessments in small to medium group in the workshops	1.87
Discussion with the whole class	2.13
Sharing work with the whole class	2.13
Working on assessments as a whole class	2.13
Attending the lectures	2.20
Watching a video in the workshops or lecture	2.20

Working on assessments on your own in the workshops	2.27
Listening to a guest speaker	2.33
Taking notes on your own in the workshops/lecture	2.53
Interactive activities/games with the whole class	2.62
Reading on your own in the workshops	2.87

### 3.8 Level of importance of L&T activities for respondents learning about relevance of sustainability to their future profession



#### 4.1 Case Study Three course overview

##### Introduction and brief history

Case Study Three is a second semester course in the first year of an undergraduate design program. The course had won a State Government award for EfS excellence. The subject is course work based, with combined lecture/workshops running for five weeks and workshop time for assessment development and discussions with the teacher for the remainder of the semester. A total of 37 students undertook the course when the case study research took place. These students all attended the one lecture/workshop each week that ran for approximately four hours each week. The lecture/workshop was delivered by one teacher. The program

coordinator originally designed the course along with other teaching staff in the school. The teacher currently taking the course was not involved in the course design.

When interviewed, the program coordinator stated that students apply sustainability in all of their subjects so they do have some prior knowledge of sustainability before the course, although this has just been mentioned rather than explored explicitly in a dedicated subject. Therefore students have some familiarity of the language of sustainability before beginning the subject.

It is important to note that the skills development in the course relates to both foundational practical textiles skills and knowledge as well as sustainable design approaches and concepts like life-cycle analysis and triple bottom line. Therefore sustainability is very much embedded in practice, however this also means that the focus of the course is not solely on skills for sustainability. The final assessment piece crosses over two subjects with the development of a design intent in this course which is produced in a different subject.

The course was established to make links between theory of sustainable design and studio design which has a practical outcome. The course is placed in the second semester of the degree program because students have enough basic background knowledge of textiles to then make sustainability the focus of their design. This means that they have the disciplinary language to talk about sustainability and grapple with the complexity of sustainable design because they have the foundational textiles knowledge. It is important to note that this case study is not intended to be a stand-alone course with sustainability integrated across all courses in the program.

The online course guide provides the following brief description of the course:

In this course you will examine the issues associated with and the underlying principles of sustainability and how these relate to the fashion and textile industry. You will learn about ethical and sustainable design strategies and examine the role of the textile designer within these contexts.

### **Course learning objectives**

According to the online course guide, the course has the following 'Objectives/Learning Outcomes/Capability Development':

- Research - examine, analyse and evaluate theoretical principles, emerging trends and issues pertinent to textile design and related design and textile industries.
- Industry - examine and apply cultural, social and ethical considerations and responsibilities for fashion and textiles contexts; Manage your learning as an individual and in collaboration with others.
- Sustainable practice - examine, critique, and evaluate underlying principles and concepts of sustainability appropriate to textile design and the textile industry. Apply sustainability principles and systems to textile design contexts.

According to the online course guide ‘upon successful completion of this course, [students] will be able to’:

- Identify and analyse principles of sustainability for textile design.
- Develop and evaluate ethical and sustainable design strategies appropriate for textile design practices.
- Examine and reflect on the role of the textile designer.

The online course guide also states that students ‘will learn and develop’:

- Research and analytical capabilities relevant for Textile Design.
- A working knowledge of the principles of production, manufacturing and technical language associated with the classification of textile fibres, yarns and fabrics.
- An understanding of the complexities of the global textile industry and the role of the designer.
- An understanding of sustainable and environmental considerations to all aspects of the textile industry and begin to develop a working practice of sustainable design.
- An awareness of current research and innovation within the technical and research sectors of the textile industry.
- Additionally you will be required to work independently in non-contact time to consolidate and further develop concepts and information presented in class in order to complete the assessment tasks.

### **Course structure and delivery**

The five lecture topics in the course are:

1. Sustainability - What is global warming? Why are we talking about sustainability?
2. Sustainable Textile design approaches
3. Sustainable design and development
4. Life cycle analysis in Detail
5. Cultural and Social Sustainability - ethical practice

The workshops typically included a two to three hour lecture followed by activity or group work time.

### **Assessment overview**

There are two assessments in the course, the first called *Re-Search: Group Project* and the second titled *Re-Design: Research Project*

#### ***Re-Search: Group Project***

The first assessment is a group project and is worth 30% of the total mark for the course. The assessment runs for the first seven weeks of semester and is due in week seven along with a class group presentation of the project. The aim of the assessment is described in the project brief:

‘Working in groups, create a series of digital research documents based on a concept relating to sustainability and apply the knowledge gained to the design of a textile item.’ Medium sized groups are given one of the following six topics to inform the development of a sustainable design product:

1. *Use matters*: ‘How can a textile product’s useful life be extended and its environmental impact minimised?’
2. *Fast fashion*: ‘Could the concept of fast fashion be made sustainable or is it simply not the way forward? Investigate the attitudes of consumers towards clothing (& fashion). Who’s buying into fast fashion and why? What is the typical life of a garment, are there alternatives? What strategies could be developed?’
3. *Slow design*: ‘Could the ‘slow design’ paradigm change the way textile products are designed and made?’
4. *Zero waste*: ‘How can textile products be designed to ensure zero waste?’
5. *Up-cycle*: ‘How can textile products be designed to be Up-cycled? Can other products be up-cycled into textile products at the end of their use?’
6. *Trash it!*: ‘How can we design textiles that wont end up in landfill? Discuss with the use of examples.’

Groups are provided with a short description of each topic and between three and five resources to read to begin their research.

It is intended that the groups are self-directed. They need to decide on roles to allocate each member and how to approach the project. The groups are advised by the brief to ‘consider

each group member strengths' and to share the tasks equally between members. The group member roles that are suggested in the project brief include:

- Researcher
- Writer / recorder
- Photographer / illustrator
- Stylist
- Fabricator / designer
- Presenter
- Management and leadership
- Teamwork

There are four components of the research project: a digital resource folder, the designed item, a PowerPoint presentation and an individual evaluation report. The components of the research project include:

- *A digital resource folder* including a 'referenced report of 1500 - 2000 words (inc. images) based on the allocated topic... includ[ing] examples of textile products, labels or companies that represent useful approaches.' A 'list of 10 key words... related to [the] research' and definitions of keywords, and an annotated reference list of '10 references the group found most useful that relate to the research topic.' The groups must also include a design intent of '4-6 pages of text and images' and a 15 slide powerpoint presentation of their product design.
- *A textile design item*, 'to represent the group's research topic': '...each group must demonstrate how they have applied the research ideas and concepts to the design process and/or design outcome (think systems, design cycles and artefact). Each group must determine what '*materials*' to work with to generate the product. In selecting your materials consider fibre choice, the source of materials (local, global), waste minimisation/prevention and retirement options (i.e. design to be disassembled, biodegradable or last forever?). Note the group must consider and document responsible disposal options for any unused materials (scrap from manufacturing). In creating your textile item, the group must also develop a document (design intent) to explain and justify the design thinking behind the textile item. I.e. show how the design outcome represents your research topic. This document should be 4-6 pages

(A4) and include text and images. Specifically, you need to include the following as part of the design intent document:

1. Material audit - Document all materials used (i.e. fabric, sewing threads, etc).  
Include what the materials are made of (fibre content) and point of origin.
2. Design philosophy - Summarise key design thinking – how the design represents the research topic (support with references).
3. Design process – Document what the group did, and how (i.e. photograph).’

The criteria for the assessment is outlined in the brief as follows:

<p><b>40% Digital Research folder</b></p>	<ul style="list-style-type: none"> <li>▪ Research: well written content demonstrating a good understanding and critical analysis of research material; well selected relevant examples relating to research topic; relevant visual material with strong links to text; information is well presented.</li> <li>▪ List of key words: well selected key words with clear, concise explanations.</li> <li>▪ Annotated reference list: correct referencing from a variety of academically credible sources using the Harvard System; annotated notes provide well written summary and critical analysis of research material.</li> </ul>
<p><b>25% Designed item</b></p>	<ul style="list-style-type: none"> <li>▪ Well considered design outcome concept; strong link between designed item, design intent and research topic;</li> <li>▪ Well written design intent document demonstrating a high level of critical analysis and reflection of design philosophy and design process undertaken.</li> </ul>
<p><b>15% PowerPoint Presentation</b></p>	<ul style="list-style-type: none"> <li>▪ Content is informative, well organised and presented; styling and Pp presentation is clear, professional with well selected text and images; Presentation is engaging with audience consideration with both the content and delivery of material</li> </ul>
<p><b>20% Individual Evaluation Report</b></p>	<ul style="list-style-type: none"> <li>▪ Well written content; evidence of critical and reflective analysis of the group’s performance</li> </ul>

***Re-Design: Research Project***

The second assessment is an individual project and builds on an assessment from a simultaneously running studio course. This assessment requires students to incorporate and apply sustainable design to a design project called ‘Craftlife’ from the studio course. Students need to design a t-shirt that they want to wear that incorporates sustainable design elements.



The project builds on the students' research on the first assessment. Students have access to each group's project to help inform their t-shirt design for this second assessment. This assessment includes three components:

- Design intent
- Life-cycle analysis
- PowerPoint presentation

The project brief provides the following description of the first component:

Articulate an approach associated with sustainability to apply to your craft life project. Consider themes investigated within the Re.Search project for inspiration. You may combine and/or contrast different approaches and methods to develop your personal direction for your T-shirt concept.

For example you may wish to consider working with design approaches/elements within the areas of: slow design, zero waste, up-cycling, design for disassembly, post-life opportunities, local design, sustainable material selection, cradle to cradle, cultural and social awareness, ethical manufacturing processes. This decision must be made very early on and will influence how you approach your design practice.

The Design Intent 'must draw on examples of other designers or companies taking useful approaches that relate to your own, however these examples do not have to directly relate to fashion or be based on T-shirts.'

The second component is described as follows:

Conduct a Life-cycle assessment of your T-shirt concept for Craftlife. Consider both the development cycle and physical cycle, ensuring you cover at least 4 of the key stages of the life cycle.

You must cover: Materials, Manufacturing, Use, Retirement. Optional: Distribution, Packaging

For each stage, identify and discuss the most significant impacts and sustainability issues associated with your T-shirt design and design process (5-7 points per stage and imagery). Document what you did or could do to overcome these impacts. Remain holistic in your sustainable approach and consider the developmental, social and physical cycles of your Craftlife T-shirt concept. This document should be succinct, and may be in point form. The document needs to show how your design intent has influenced your decision making process for Craftlife and thus the life cycle of your T-shirt.

The final component is the PowerPoint presentation due in week 13 and is described as follows:

Create a PowerPoint presentation of 10 slides to summarise your research and how it was applied to your Craftlife project. The PowerPoint is to support your 5-minute class presentation for Craftlife on the hand in date.

In summarising your research you should include slides (text & imagery) on:

1. Research relating to selected sustainability concept.
2. Design practice – to show links between research and design practice – such as photography to show key phases of your design process and selected resource book pages.
3. Outcomes from Craftlife – Your concept board, croquis and final T-shirt.

The criteria for the assessment are outlined in the brief as follows:

<p><b>Design Intent</b>  <b>Mini deadline Week 9 (for feedback)</b>  <b>Complete Design Intent</b>  <b>Due week 12</b></p>	<ul style="list-style-type: none"> <li>▪ Design Statement: Well summarized statement of intent outlining key areas of intended research and developing a clear direction for the project</li> <li>▪ Research: well written content demonstrating a good understanding and critical analysis of research material and topic; well selected relevant examples relating to research topic.</li> <li>▪ Relevant visual material with strong links to written content.</li> <li>▪ Information is well presented.</li> <li>▪ Reference list: correct referencing from a variety of academically credible sources using an appropriate referencing system.</li> </ul>
<p><b>Life-cycle assessment</b>  <b>Due week 13</b></p>	<ul style="list-style-type: none"> <li>▪ Evidence of critical analysis of design process and product's life-cycle; and a strong link between design intent and design practice.</li> <li>▪ Quality of written content &amp; analysis.</li> <li>▪ Relevant visual material with strong links to written content.</li> <li>▪ Information is well presented.</li> </ul>
<p><b>PowerPoint Presentation</b>  <b>Due week 13</b></p>	<ul style="list-style-type: none"> <li>▪ Content is informative, well organised and presented;</li> <li>▪ Styling and presentation is clear, professional with well selected text and images</li> </ul>

## 4.2 Case Study Three specific research methods

### Observation:

Two lecture/workshops were observed during the semester including week four and week seven. My presence was made known to the students in the fourth week of semester. I remained a silent observer in each observation sitting.

**Teacher interview:**

A 50 minute semi-structured interview was undertaken with the course coordinator/lecturer at the end of semester face-to-face. A 30 minute interview was also undertaken with the program coordinator mid-semester face-to-face. The program coordinator designed the course so their perspectives were important for this research for understanding the intent of the course design, which is why this additional interview was undertaken.

**Student survey:**

An online survey was emailed to all students enrolled in the course one week after the final week of the course in Week 15. The survey was open for three weeks and three emails were sent to students in the course to invite and remind them about the survey. Six, \$15 gift cards were offered to students who completed the survey to provide an incentive for them to participate and also thank them for their contribution. These were offered to the first four and last two students to complete the survey to encourage students to complete the survey even after the final reminder. Eight participants out of the 37 students enrolled in the course began the survey and five of these participants completed their survey. Therefore the response rate was 21.6% and the completion rate was 62.5%.

**Student focus group:**

One focus group was held after the Wednesday workshop in week 10. Students were invited to participate in the week prior and reminded by the lecturer before the focus group. Six students attended the focus group. These students were all in their first year of the program. The focus group went for approximately 40 minutes and five \$20 iTunes vouchers were given to participants. It should be noted that the researcher was not present during the selection of participants from the class. The teacher invited participants and asked those willing to sit with the researcher for the focus group in the adjoining room. This may have affected the students that participated in the focus group.

### 4.3 Case Study Three observation results

#### Lectures and teaching environment

The two workshops/lectures observed were held in one of university's design lab rooms with large tables set out so that students sat in groups of about 6-8. The classroom was equipped with AV. Lectures were undertaken in the workshop space and were delivered by the teacher who stood at one end of the classroom and used a PowerPoint presentation to present the content. In the two lectures observed the teacher presented the content and students took notes and asked questions which happened regularly throughout the lecture presentation. The teacher talked slowly to ensure that students had time to take notes. Learning and teaching aids included a PowerPoint slide with minimal text and many colourful picture examples, a handout with a guide to the assessment that included questions to discuss in the group work to help with the assessment process.

#### What learning and teaching methods are used in the course?

##### *Structure, L&T activities and student responses*

Week four's lecture/workshop involved a 1.5 hour lecture and then group work on the assessment after a break for about 50 minutes. Students were given 1.5 hours to work on their assessment in the workshop time.

The lecture observed included an overview of the concepts:

- Futures thinking
- Manufacturing technology
- Design for disassembly
- Energy use
- Life-cycle analysis

Each of these concepts was defined and examples of the concept in design practice shown using the PowerPoint or described.

##### *Assessment group work*

Students were each given a concept related to sustainable design which they needed to apply in producing a textile product. Life-cycle analysis was a key part of the design process for this assessment. Groups each decided on a leader and the teacher asked students to think about something they would like to design as a group, then apply life cycle analysis or think about the processes they would like to use and work backwards. Students were asked to: research

topic (the concept that they have been given to include in their design), consider what item to design, brainstorm, explore materials, scenarios, and inspiration, sketch, prototype, and then reflect and evaluate.

#### **4.4 Level of importance of L&T activities for respondents learning about sustainability**

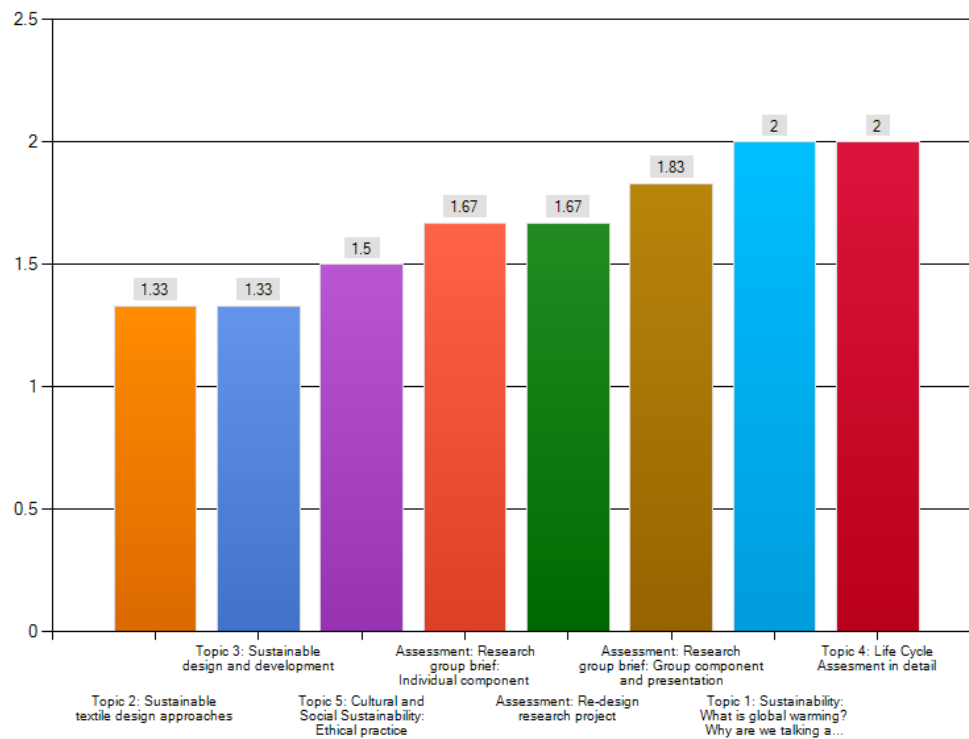
While students commented that they would prefer the L&T approach to be ‘more interactive’, working on assessments alone out of class time was rated the most important activity for learning about sustainability. There appears to be a contradiction in the activities which students would like to see in class and the activities that respondents felt helped their learning about sustainability. This may indicate that non-interactive activities and assessments can support learning, however do not foster a positive learning experience. Activities with the whole of class such as games, working on assessments and sharing work were rated least important. However, interestingly, discussion as a whole class was rated second most important for learning so students got something out of talking as a class but not other activities with the class. This may be due to less sharing of work with the class than discussions which were observed to occur during lectures, so therefore the frequency of these activities in the course could affect students’ responses to this question. The responses also indicated that various group based activities were also useful for learning as well as reading in workshops. Therefore responses are mixed as to whether respondents prefer individual learning activities or group activities for learning about sustainability.

<b>Answer Options</b>	<b>Rating Average</b>
Working on assessments alone out of class time (individual homework)	1.67
Discussion with the whole class	2.00
Applying theory to case studies in small to medium group	2.00
Speaking one on one with the teacher	2.00
Working on assessments in small to medium group in the workshops	2.17
Working on assessments in groups out of class time (group homework)	2.17
Reading on your own in the workshops	2.20
Working on assessments on your own in the workshops	2.33
Taking notes on your own in the workshops/lecture	2.33
Small to medium group activity/exercises in the workshops	2.33
Applying theory to case studies as a whole class	2.40

Speaking in small groups with the teacher	2.50
Attending the lectures	2.67
Listening to the teacher explain/demonstrate in the workshops	2.67
Sharing work in small to medium group in the workshops	2.67
Watching a video in the workshops	2.67
Question and answer with teacher as a whole class	2.83
Listening to a guest speaker	2.83
Brainstorming with the whole class	3.00
Sharing work with the whole class	3.00
Interactive activities/games with the whole class	3.00
Working on assessments as a whole class	3.50

#### ***4.5 Level of importance of L&T activities for respondents learning about relevance of the sustainability to their future profession***

In terms of learning about how sustainability applies to students' future professional practice, responses varied. For example, two out of six students felt that life cycle analysis and the individual second assessment were unhelpful. However the other four respondents felt these were helpful or somewhat helpful. The topics that most helped students learn about professional relevance related directly to design including Topic 2: Sustainable textiles design approaches and Topic 3: Sustainable design and development.



In terms of activities that supported skills development one student commented that the ‘Research project helped to develop [their] research and writing skills. Lectures helped [them] to gain knowledge of sustainability’, while another student commented that ‘the design intent paper made me aware of the context of my work’. One student commented that the group work helped maintain their interest in the course and drive to complete the project.

### 5.1 Case Study Four course overview

#### Introduction and brief history

Case Study Four is a core subject in the second year of an applied science degree in the discipline of engineering. The subject is course work based and runs for one full semester (12 weeks) with a two to three hour combined lecture/workshop each week for the duration of the semester. A total of 68 students undertook the course when this case study research took place. Co-ordination, lectures and workshops are undertaken and delivered by two engineering academics.

Sustainability is introduced in a first year common course across the engineering disciplines which introduces sustainability (social, environmental and economic) and requires students to work in teams on a sustainability project applying their knowledge and skills. This project is

not discipline specific however, so students understanding of sustainability is limited to what they know informally before undertaking this course.

This is the first time this course has been run in the degree program. For third year students completing the course it was undertaken as an elective, and for second year students undertaking the course it was a compulsory subject.

The course guide provides the following description and context of the course:

The aviation industry is growing rapidly in the global economy with the emergence of new Low Cost Carriers and the increasing strength of major airlines growing their fleets to meet the current demands of travel. This has implications on the environment and climate change. The future of the aviation industry depends on policy makers being able to make this growth sustainable and address the issues of climate change and other environmental impacts of the aviation industry. The aviation and the aerospace industry have taken positive steps towards minimizing the effects of environmental impact. This course discusses the current steps being taken to address environmental issues in the aviation and the aerospace industry, the technological advancements being made towards a sustainable future and the effect of policies like the carbon tax on the industry.

This course also aims to teach you important skills that will enable you to operate effectively as a professional within your work environment. All professionals are technically competent in a particular specialist area; however, technical skills are only part of the range of skills that aviation professionals use every day. They are also required to work in teams to solve complex problems and communicate their solutions effectively.

### **Course learning objectives**

The hard copy course guide outlines the following learning objectives for the course overall:

- Sustainability of air transport systems
- Climate change and the aviation industry
- Policies for climate change and how it affects the aviation industry
- Reduction of climate change within the industry
- Fuel technologies
- Noise reduction technologies
- Technical and professional skills
- Analytical and Communication skills

The online course guide provided on the school's website outlines the following learning objectives that provide more detail than the hardcopy provided to the researcher by the teaching staff.

Students will develop technical abilities in relation to the evaluation of the various factors influencing the sustainability of aviation from both a financial and environmental perspective. Students will develop integrative abilities in relation (ability to discuss and analyse at a basic level) to sustainable aviation operations on a global basis. Students passing this course will:



- a) Demonstrate broad appreciation of sustainability in aviation operations by being able to:
- Discuss sustainable development in aviation and airport contexts.
  - Distinguish between eco-efficiency and sustainability in the global air transport industry.
  - Describe the social and economic benefits of commercial aviation at both the national and global levels.
  - Understand and explain the global atmospheric impacts of commercial aviation and the influence of commercial airline aircraft's current and future atmospheric impacts.
  - Describe aircraft noise and its effects on the community and the approaches being taken to control aircraft noise.
  - Demonstrate an appropriate understanding of environmental management systems and the potential for reducing the climate impact of aviation.
  - Discuss the various industry actors that are influencing emissions from aviation operations.
  - Identify and explain the various strategies and policy instruments available for commercial aviation climate policy.
  - Explain the roles of emission trading schemes in the global air transport industry.
- b) Demonstrate their analytical skills relevant to sustainable aviation by being able to:
- Analyse and predict the potential for modal substitution and, in particular, high-speed ground based transport systems.
  - Critically analyse and discuss the potential offered by aircraft and engine technologies that may significantly reduce the environmental burden of the global air transport industry.
  - Analyse the role of alternative fuels in the global air transport industry.
  - Evaluate airline's environmental performance in terms of fuel consumption, emissions and aircraft noise.
  - Evaluate sustainable strategic management in the context of the global air transport industry
  - Evaluate the financial sustainability of airlines.

### **Course structure and delivery**

The course guide states that the learning objectives will be addressed through the lectures and tutorials with 'the aim of the assessment' being to 'check' student learning about the objectives above.

The course is delivered through weekly combined lecture and workshops. The course guide outlines the weekly course content as follows:

1. Introduction to course: Introduction to sustainability of air transport systems (aircraft, airports etc)
2. Science of climate change (global warming): Impact of aviation on climate change
3. Climate change policies for aviation: Carbon tax and carbon offsetting for aviation
4. Class Quiz 1: Climate reduction technologies: Improved flight operations
5. Climate reduction technologies: Light-weight design of aircraft
6. Group Presentations 1
7. Climate reduction technologies: Fuel efficient power plants (e.g. high by-pass engines, open rotor etc)
8. Climate reduction technologies: Biofuels
9. Aircraft noise and noise reduction technologies
10. Group Presentations 2
11. Group presentation 2 (cont.) Final remarks & review
12. Class Quiz 2

The recommended textbook for the course is *Towards Sustainable Aviation* (2003) by Upham, P, Maughan, J, Raper, D, and Thomas, C.

Students are also given resources to follow up in their own time via the course blackboard. According to the focus group participants, these resources included videos which are drawn on to answer questions in the class quizzes. The extra readings are useful for this.

### **Assessment overview**

There are five assessments in the course including class quizzes, presentations and a research report. The grading for each assessment is listed in the course guide as follows:

1. Class Quiz 1 –1 hr, 20% of Course Grade, undertaken in week 4
2. Individual Assignment 1, 15% of Course grade, due in week 5
3. Group presentation –10 minutes per group, 10% of Course grade, due in week 6
4. Group presentation, 15 minutes per group + report, 15% of Course grade, due in week 10 or 11
5. Class Quiz 2 –1.5 hr, 25% of Course grade, undertaken in week 12.

From the interview undertaken with one of the course lecturers, the following provides an example of the questions and topics given in the assessment tasks. These were described by the one of the teachers in the interview undertaken for this research project.

Quiz question examples:

- How does nitrous oxide, which is part of emissions fuel burn, effect global warming?
- How does carbon dioxide which is also an emission of fuel burn, effect the environment?
- How do you quantify the kilograms of CO<sub>2</sub> that is being emitted as a result of a flight from Sydney to Melbourne?
- What steps are being taken by the aerospace industry in terms of aircraft design to reduce fuel burn and thus the effects on environment?
- Discuss the advantages of carbon tax.
- The carbon tax and the European Union emissions trading scheme is successful in reducing emissions from the aviation sector, discuss the disadvantages of both schemes.

- Discuss how the carbon pricing scheme works in Australia and how it effects the Australia aviation industry.
- Describe through what mechanisms carbon dioxide and trails effect the radiative forcing balance in the atmosphere.

Individual research paper research questions:

- What is the scientific evidence against human induced global warming?
- Why is public opinion divided over human induced global warming when the scientific evidence appears strong?
- What promising strategies exists for net carbon emissions reductions in aircraft and in airports in 2015 to 2025?
- Present a model for calculating CO<sub>2</sub> emissions for a domestic airline.
- Discuss the use of advance chevron nozzles in noise reduction.
- Discuss steps taken by leading high traffic volume airports to reduce their noise footprint.
- Hydrogen as a potentially sustainable fuel for aircraft.

## ***5.2 Case Study Four specific research methods***

### **Observation:**

Three lecture/workshops were observed during the semester including week five, six and ten. Only the second half of the lectures were able to be observed due to my other commitments. My presence was made known to the students in the fifth week of semester. I remained a silent observer in each observation sitting. It should be noted that the content presented in the course is very discipline specific and technical so it was difficult to understand and even appreciate how much impact the technical improvements would have in terms of changes for sustainability in the aviation industry. This observational research does not intend to comment on the technical content knowledge presented in lectures and workshops. The observation focuses on the theory of good practice L&T for sustainability and sustainability as content knowledge to analyse the observational data for this dissertation.

### **Teacher interview:**

A 40 minute semi-structured interview was undertaken with the course coordinator/lecturer at the end of semester over the phone.

**Student survey:**

An online survey was emailed to all students enrolled in the course in the final week of the course. The survey was open for three weeks and three emails were sent to students in the course to invite and remind them about the survey. Six \$15 gift cards were offered to students who completed the survey to provide an incentive for them to participate and also thank them for their contribution. These were offered to the first four and last two students to complete the survey to encourage students to complete the survey even after the final reminder. Survey response: 11 participants of the 68 enrolled began the survey and 7 of these participants completed their survey.

Therefore the response rate was 16.17% and the completion rate was 63.6%.

**Student focus group:**

One focus group was held after the Monday workshop in week 10. Students were invited to participate in the week prior and reminded by the lecturer before the focus group. Six students attended the focus group, this included four international students. Four students were third year students who were doing the course as an elective and two were second year students who were doing the course as a compulsory subject. All were aviation major students. The focus group went for approximately half an hour and \$20 iTunes vouchers were given to randomly selected participants. A second focus group was scheduled for after class in week 11 however no students volunteered to participate so the focus group could not run.

### ***5.3 Case Study Four observation results***

**Lectures and Teaching environment**

The lecture/workshops were held in a classroom that seats about 70 students and was equipped with full audio-visual equipment. The first week observed, the lecture and workshop were combined taking up most of the two hour class time. The lecture presented information on the different weekly topics using PowerPoint and included videos and time for students' questions and comments so the lecture was semi-informal. The workshop made up a small portion of the time and allowed time for students to work on their assessments in groups if they needed this time and for the teacher to help organise students into groups if needed. The second two lecture/workshops observed were dedicated to student presentations which took up the entire class time.

## What learning and teaching methods are used in the course?

### Structure, L&T activities and student responses

The following table provides examples from the observed workshops of the L&T activities used in the course.

Week	Activity and key observation notes
Five	<p><b>1.5 hour lecture:</b> <i>Climate reduction technologies: Light-weight design of aircraft.</i></p> <p>The lecture content was technical, for example, discussing efficiency in the context of reducing CO<sub>2</sub> and an overview of specific existing and developmental technologies that can reduce CO<sub>2</sub> i.e. 'the geared turbofan'. The lecture also covered many challenges/problems with efficiency technologies and future technologies such as optimising smaller components, weight reductions, and hybrid and electric engines.</p>
Six	<p><b>Student presentations about efficiency technologies</b></p> <p>Discussion of sustainability or related concepts was limited in the students' presentations, for example the teacher commented that the first presentation observed in week six should have explicitly mentioned the sustainable design features in their presentation. The second group observed talked about noise reduction, however did not touch on how it links with sustainability at all. This group did however demonstrate good problem solving/critical thinking by exploring the different kinds of strategies and levels of strategy for achieving noise reductions, for example through policy/regulations, technology, and operations which links with development of capabilities for sustainability. The third group looked at what factors contribute to airport noise including economic growth and tourism situating their study of noise in broader contexts which also links to capabilities for sustainability, however there was no explicit mention of key concepts associated with sustainability in the presentation.</p> <p>Teachers of the course provided feedback to students about their presentations in front of the class. Teacher feedback about the presentations observed was mostly regarding presentation skills.</p>
Ten	<p><b>Student presentations:</b></p> <p>Similar to week six's presentations, groups presented on different efficiency technologies, for example, blended wing body and reduction of noise footprints.</p> <p>One group linked to sustainability/environment in the following statement; 'we'll all be doing our bit for the environment' however did not critically evaluate how their technology did this. Another group did discuss environmental sustainability and the positive and negative aspects of their technology (hydrogen fuel) in relation to sustainability and practicality of implementation.</p>

	<p>This indicates that the focus of the presentations observed were about the technologies, rather than critically assessing how sustainable they were or using assessment tools like life-cycle analysis or triple bottom line to frame or understand the technologies.</p> <p>Students' questions at the end of each presentation allowed the groups to discuss the technologies presented in a more critical manner i.e. how fast is the plane? Can it fit in existing airports? How many people does it carry? Does existing airport infrastructure, tools and services fit the new plane?</p>
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#### *5.4 Level of importance of L&T activities for respondents learning about sustainability*

<b>Answer Options</b>	<b>Rating Average</b>
Discussion with the whole class	1.63
Listening to the teacher explain/demonstrate in the workshops	1.75
Speaking one on one with the teacher	1.75
Working on assessments alone out of class time (individual homework)	1.75
Applying theory to case studies as a whole class	1.83
Question and answer with teacher as a whole class	1.88
Attending the lectures	2.00
Watching a video in the workshops	2.00
Listening to a guest speaker	2.00
Speaking in small groups with the teacher	2.25
Working on assessments in groups out of class time (group homework)	2.25
Working on assessments on your own in the workshops	2.29
Applying theory to case studies in small to medium group	2.29
Taking notes on your own in the workshops/lecture	2.38
Sharing work in small to medium group in the workshops	2.38
Brainstorming with the whole class	2.43
Sharing work with the whole class	2.50
Small to medium group activity/exercises in the workshops	2.50
Working on assessments as a whole class	2.57
Reading on your own in the workshops	2.67
Interactive activities/games with the whole class	2.67
Working on assessments in small to medium group in the workshops	2.75

## 5.5 Level of importance of L&T activities for respondents learning about relevance of sustainability to their future profession

Answer Options	Rating Average
Presentation 1 and report	1.25
Presentation 2 and report	1.50
Individual Assignment 1 (due end of week 5)	1.50
Lecture Week 2: Science of climate change (global warming), Impact of aviation on climate change	1.50
Lecture Week 3: Climate change policies for aviation, Carbon tax and carbon offsetting for aviation	1.50
Lecture Week 5: Climate reduction technologies: Light-weight design of aircraft	1.50
Lecture Week 7: Climate reduction technologies: Fuel efficient power plants (e.g. high by-pass engines, open rotor etc)	1.50
Lecture Week 8: Climate reduction technologies: Biofuels	1.50
Class quiz 1	1.63
Class quiz 2	1.63

## 5.6 Example of self-rated perceived confidence level survey

Please rate your level of confidence in applying the following skills in your future professional role. Tick the most appropriate box for each skill listed. (It may help to think about these skills in the context of responding to or working on a particular issue or project in a professional role).	Very confident	Confident	Somewhat confident	Not confident
1. <b>Working with different stakeholders</b>				
2. <b>Interdisciplinary skills</b> ( <i>working with people from different disciplines or fields</i> )				
3. <b>Systemic and holistic thinking</b> ( <i>thinking about the 'big picture' and the many flow on effects of actions on different social and environmental areas, and stakeholders</i> )				
4. <b>Foresighted thinking</b> ( <i>thinking about future consequences of actions</i> )				
5. <b>Tackling/responding to complex and uncertain issues</b> ( <i>issues with no simple, clearly identifiable answer and where there is a high degree of uncertainty about the exact outcomes</i> )				
6. <b>Acting fairly and ecologically</b> ( <i>thinking about the outcomes of decisions in terms of social justice and ecological impacts</i> )				
7. <b>Dealing with ambiguity and frustration</b> ( <i>keeping presence of mind when there is no clear or simple way to respond to an issue</i> )				
8. <b>Critical thinking</b> ( <i>reflecting, questioning and analysing issues or</i>				

<i>processes)</i>				
9. <b>Problem solving</b> ( <i>identify issues, evaluate, think of alternatives, and plan responses</i> )				
10. <b>Planning</b> ( <i>planning how to organise and implement responses to issues</i> )				
11. <b>Creative thinking</b> and realising innovative responses ( <i>thinking of new ways to define and address issues</i> )				
12. <b>Viewing issues differently</b> ( <i>seeing problems from a different perspective or in a new way</i> )				
<b>13. Finding of alternative ways to approach and address issues</b>				
14. <b>Participation and group work skills</b> ( <i>being able to work effectively as part of a group</i> )				
15. <b>Empathy</b> ( <i>being able to appreciate and consider others' positions, needs and values</i> )				
16. <b>Communication</b> and use of media ( <i>communicating with others verbally and through the use of written media such as email, social media, reports</i> ).				
17. <b>Research</b> ( <i>collecting information and data</i> )				
18. <b>Evaluation</b> ( <i>looking at and weighing up all the options and information available</i> )				
19. <b>Making decisions and judgements</b> ( <i>being able to make decisions and exercise judgment on the information available and why it is the most suitable decision</i> )				
20. <b>Reflect on your own learning</b> and how this has occurred ( <i>this requires critical self reflection on you own strengths and weaknesses – what you have learnt and what you can do better</i> )				
21. <b>Being aware and mindful of your own values</b> and the influence they have on your decisions				
<b>How confident are you in your self-assessment of the above skills?</b>				



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