The Contribution of Tertiary Sustainability Education to Student Knowledge, Views, Attitudes and Behaviour toward Sustainability

by

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Abstract

Higher education (HE) is increasingly expected to graduate students with the requisite skills and competencies to address contemporary sustainability challenges and many tertiary institutions have begun to introduce sustainability education (SE) into their curriculum. To facilitate student learning, educators require a deep understanding of their students' existing sustainability dispositions and influences that shape their ability and willingness to develop competencies for sustainability. Therefore, this research aims to improve understanding of tertiary students' current attitudes and the influence of SE on their views, knowledge and agency towards sustainability transitions. This research project was guided by a conceptual framework that linked elements across theories in education and learning, environmental psychology and sustainability transitions. This thesis describes the findings of a mixed methods study conducted over three sequential stages and presented as a series of five publications that are drawn together through an exegesis.

The first study provides an initial literature review on different conceptions of sustainability, Education for Sustainability (EfS), learning theories including threshold learning, environmental psychology, social and personal values towards sustainability, and societal and sectoral transitions to sustainability. It explored the role and influence of EfS in facilitating personal, organisational and societal sustainability transitions, and investigated the role and progress of the HE (principally business education) and business sectors around the world and found mixed results, with a low incidence of EfS in Australian business schools. The paper recommended that tertiary business schools audit and embed EfS in all programs, and for educators to identify and locate their students' current knowledge and perspectives before selecting the appropriate pedagogy to scaffold student learning for sustainability. These recommendations were adopted in all subsequent studies.

The second study is a Pilot EfS program conducted at CQUniversity in 2011. The study reports the influence of various types of SE interventions on tertiary students' sustainability and environmental attitudes and knowledge. The sample consisted of international students enrolled in undergraduate or postgraduate programmes or in ESL courses. Sustainability interventions consisted of course-specific introductory sustainability seminars, courses with sustainability elements already embedded in

course curricula, and courses with no elements of sustainability. The influence of such interventions was assessed using a short pre-post survey based on a validated scale, the NEP. Results from student surveys and group discussions indicated significant underlying differences in student views and knowledge about sustainability and varying shifts and resistance in their views following the EfS interventions. Findings revealed heterogeneity in student responses to the same intervention based on their age, gender and culture and shed light on the influence of EfS interventions on particular aspects of students' sustainability knowledge and attitudes, although limited sample sizes precluded statistical inferences to be made.

The third study is a case study that extended the scope of the pilot study to include students' sustainability behaviour and longer-term impacts after 12-18 months. The study reported on the researcher's own EfS praxis in tertiary business education courses over an 8-year period (2005-2013) and the influence on students' sustainability views, conceptions and behaviour over this time. Findings revealed an escalating influence of SE course assessment on student attitudes and behaviour as well as persistence and accumulation of effects over time.

The fourth study expanded the scope and scale of the Pilot EfS and case studies into a multi-university, multi--country study that used a common instrument to systematically investigate the influence of SE on student views, attitudes and behaviour across a range of contexts. Pre-test and post-test snapshots of tertiary student perspectives were taken across various terms of study during 2013-2015. The study reported heterogeneity in initial student sustainability perspectives that were influenced by personal and educational factors such as gender, age, "culture" and discipline of study. Environmental worldviews were largely represented by an "instrumental" view of human-nature relations. The influence of exposure to SE was significant compared to the control group however, the effect was weak and moderated by the students' personal and educational context. Findings indicate the current ad hoc approach to SE leads to learning outcomes that are far from certain and weak. The paper argued for a rethink of current educational approaches towards a more coherent and targeted educational strategy. Further research was recommended into the influence of SE on the incidence and experience of transformative learning (TL) and key learning outcomes, and this was adopted in the final study.

The final study investigated the TL experience of undergraduate students in dedicated SE subjects/units at two Australian HEIs and reported learning outcomes in terms of their knowledge, attitudes, behaviour and agency for sustainability. The study reported the use of an augmented Learning Activities Survey to identify and measure TL outcomes. Findings revealed that shifts in students' mindsets and perspectives towards sustainability were fostered by the concept of holistic sustainability, complex problems and systems thinking, participation in group work, independent research and experiential learning as well as previous learning experiences. However, self-reported behaviour changes were limited to the personal sphere rather than enactment of professional competence.

Key emerging themes from the PhD research project are a convergence in student views and attitudes after tertiary education towards an "integrative eco-humanist" perspective, limited cases of student empowerment and occasional disempowerment from SE, a focus by students on personal behaviour change rather than professional action/agency, and a limited extent of wider agency. Overall, the current "ad hoc" approach to SE in HE is largely ineffective in creating widespread agents for change. Nevertheless, cumulative learning for sustainability was evident with repetition of SE, greater connection to student's lifeworld and motivation for change.

In summary, the thesis provides insights into the current contribution of tertiary education to student learning for sustainability and identifies influences that foster TL for sustainability and the development of their competency to assist in sustainability transitions. Implications for the development of policy and praxis are discussed to support and develop opportunities that enhance student learning in terms of knowledge, skills and competencies for sustainability. With this knowledge, tertiary educators will be better able to assist students to conceptualise and address sustainability challenges, thus providing an array of societal benefits.

Declaration

I, Elizabeth Sidiropoulos, declare that the PhD thesis by Publication entitled The Contribution of Tertiary Sustainability Education to Student Knowledge, Views, Attitudes and Behaviour toward Sustainability is no more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references and footnotes. This thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.
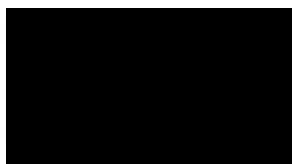
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Details of Included Papers

Chapter No.	Paper Title	Publication Status	Publication Title and Details
4	Navigating the journey to sustainability: the case for embedding sustainability literacy into all tertiary education business programs.	published	International Journal of Environmental, Cultural, Economic and Social Sustainability, 7(3), 247-274. 2011. Scimago ranking Q4, H Index of 5 and SJR of 0.1
5	Supporting the Sustainability Journey of Tertiary International Students in Australia.	published	Australian Journal of Environmental Education, 29(1), 52-79. doi: 10.1017/aee.2013.15. 2013. Scimago ranking Q2, H Index of 14 and SJR of 0.4
6	Education for sustainability in business education programs: a question of value.	published	Journal of Cleaner Production, 85, 472-487. doi: http://dx.doi.org/10.1016/j.jclepr o.2013.10.040. 2014. Scimago ranking Q1, H Index of 132 and SJR of 1.5
7	The personal context of student learning for sustainability: Results of a multi-university research study.	published	Journal of Cleaner Production, 181, 537-554. doi: https://doi.org/10.1016/j.jclepro.2 018.01.083. 2018. Scimago ranking Q1, H Index of 132 and SJR of 1.5
8	Measuring transformative learning for sustainability in higher education: an application of the Learning Activities.	submitted for review	Journal of Further and Higher Education. Scimago ranking Q2, H Index of 14 and SJR of 0.5

Declaration: Elizabeth Sidiropoulos   Signature: Date: 7 March 2019

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Dedication

This thesis and all the works behind it are dedicated to the memory of my late sister Poppy, who was unable to realise her dreams, so I had to complete mine, for both of us.

This is our legacy.

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List of Publications

1. Sidiropoulos, L. (2011). Navigating the journey to sustainability: the case for embedding sustainability literacy into all tertiary education business programs. *International Journal of Environmental, Cultural, Economic and Social Sustainability, 7*(3), 247-274. Scimago ranking Q4

2. Sidiropoulos, L., Wex, I., & Sibley, J. (2013). Supporting the Sustainability Journey of Tertiary International Students in Australia. *Australian Journal of Environmental Education, 29*(1), 52-79. doi: 10.1017/aee.2013.15. Scimago ranking Q2

3. Sidiropoulos, E. (2014). Education for sustainability in business education programs: a question of value. *Journal of Cleaner Production, 85*, 472-487. doi: http://dx.doi.org/10.1016/j.jclepro.2013.10.040. Scimago ranking Q1.

4. Sidiropoulos, E. (2018). The personal context of student learning for sustainability: Results of a multi-university research study. *Journal of Cleaner Production, 181*, 537-554. doi: https://doi.org/10.1016/j.jclepro.2018.01.083. Scimago ranking Q1

5. Sidiropoulos, E. (nd). Measuring transformative learning for sustainability in higher education: an application of the Learning Activities Survey. *Journal of Further and Higher Education* (Manuscript submitted to journal for review). Scimago ranking Q2

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List of Abbreviations

EE	Environmental education
EfS	Education for sustainability
ESD	Education for sustainable development
HE	Higher education
HEI	Higher education institution
HESD	Higher education for sustainable development
LfS	Learning for sustainability
PT	Perspective transformation
SD	Sustainable development
SDG	Sustainable development goal
SE	Sustainability education
TL	Transformative learning
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

Chapter 1: Introduction

Human population growth and behaviour is generating serious global socio-ecological problems and sustainability challenges, such as environmental degradation, rapid biodiversity loss and climate change (UNESCO, 2016). There is an urgent need to transition towards a sustainable societal system (Blackmore et al., 2011). While sustainability is a social construct with many interpretations, there is general agreement that it implies a rebalancing in society along ecological, economic and socio-cultural dimensions (Wals, Weakland, & Corcoran, 2017). There is a view that contemporary socio-ecological systems are dysfunctional and maladaptive (Lotz-Sisitka, Wals, Kronlid, & McGarry, 2015) and require system innovation through a fundamental redesign of underlying structures and processes. However, sustainability challenges are 'wicked' problems, characterised by complexity, ambiguity, controversy and uncertainty regarding the causes and effects as well as appropriate action(s) required. Sustainability problems are also characterised by 'accelerating change' (Wals & Corcoran, 2012) and not amenable to simple solutions, so new approaches are required.

Many different kinds of knowledge, knowing and learning are required to address the wide range of complex sustainability challenges and to transform society (Blackmore, 2007). Confronting and addressing these systemic challenges requires changes in individual and collective worldview from an reductionist/mechanistic approach to a more holistic/integrative perspective (Sterling, 2004b). Deeper knowledge, transformative learning and even transgressive learning is required that crosses disciplinary boundaries and challenges established norms and practices (Lotz-Sisitka et al., 2015; Tilbury, 2011a). It has been suggested we need to learn our way forward (Wals, 2011) with sustainability emerging as a possible outcome of the learning process (Sterling, 2004b) through co-created knowledge and co-evolutionary change at all levels of society (Chabay, 2015). The notion of sustainability is not a universal process but is contextualised to each place and time (Wals et al., 2017). Thus, sustainability is an evolutionary and continuous process of contextualised learning (Wals & Blewitt, 2010). Learning is a key part of the transition of socio-ecological systems with transformation required at multiple scales, from the individual through organisations and communities to society as a whole (Kemper, Hall, & Ballantine, 2019). However, the mechanisms and interactions involved in multi-scale changes are not known and further research is

required to investigate how knowledge, knowing and learning contributes to social change and sustainability transitions (Blackmore et al., 2011; Wals, 2007).

Education is increasingly recognised as an integral and transformative element of lifelong learning and an enabler for sustainability and sustainable development (SD) (UNESCO, 2015b). Following completion of the United Nations Decade of Education for Sustainable Development (UN-DESD, 2005-2014), the United Nations promulgated the Global Action Programme (GAP) on Education for Sustainable Development (ESD) that seeks to scale up ESD action at all levels and in all areas, with a particular emphasis on transformative learning (UNESCO, 2015b). Beyond formal education, ESD is an integral part of lifelong learning (UNESCO, 2016) and regarded as a key instrument to achieving the Sustainable Development Goals (SDGs) outlined in the UN's Agenda 2030 (United Nations, 2015), which is the new global framework for sustainability (UNESCO, 2017). Achieving SD requires transformation at the personal, social and cultural levels (UNESCO, 2015b) and ESD has a pivotal role in creating sustainability change-makers (Rieckmann, 2017).

Learners become change-makers when they are empowered with agency to participate in the process of sustainability transitions and societal change. According to UNESCO (2015b), ESD develops knowledge, attitudes, values, skills and competences to address global citizenship and local challenges of the present and the future. Competences for supporting sustainability include critical and systemic thinking, analytical problem-solving, creativity, working collaboratively and making decisions in the face of uncertainty. Learners can also be empowered to "strike out in new directions; and to participate in socio-political processes, moving their societies towards sustainable development" (Rieckmann, 2017, p. 7). Further, ESD can empower agents of change that include businesses, cities and civil society (Hajer et al., 2015).

The ESD approach has not occurred in a vacuum. The role of education in addressing the relationship between people and planet has a long history with many different emphases on education, communication and participation emerging over time (Wals et al., 2017). Educational approaches have progressed over time from nature conservation, to environmental education (EE), and to ESD (Wals et al., 2017), which remains dominant in the discourse in most international and national policy arenas (Stevenson, Brody, Dillon, & Wals, 2013). While the emphasis has shifted between these approaches over time, there is still a great deal of overlap between them. There is much

debate among scholars in the field about the shift from EE to ESD (Wals, 2010b) and the ambiguities and multiple interpretations of these terms (Stevenson et al., 2013). Debates in the field relate to differences in the philosophy, theory, policy and practice of educational approaches to sustainability and the environment (Scott, 2002; Stevenson et al., 2013). Further, the multiple conceptualisations of sustainability and sustainable development and the differing views of educational intentions have combined to produce a plethora of educational approaches to sustainability education (SE), particularly in higher education (HE).

Higher Education Institutions (HEIs) have a key role in fostering learning and the transition to SD. Their activities in research, teaching and community outreach facilitate the creation and translation of knowledge, which contribute both directly and indirectly to learning by individuals, groups and institutions towards sustainability. Their role is specifically recognised in several supranational and national policies (Lozano et al., 2015; Lozano, Lukman, Lozano, Huisingh, & Lambrechts, 2013) and many institutions have expressed commitment to sustainability by participating in various declarations, charters and initiatives (Calder & Clugston, 2003). Yet, despite such declarations, sustainability is largely implemented in a piece-meal fashion in HEIs (Lambrechts, Mulà, Ceulemans, Molderez, & Gaeremynck, 2013), with SE remaining on the fringes of mainstream curricula (Thomas, 2018; Wals, 2014). Sustainability education appears to be implemented in an 'ad hoc' fashion in HE (Leihy & Salazar, 2011; UNESCO, 2014b). The main reasons are the tradition of liberalism in academia with the 'free-choice' integration of sustainability in courses, which varies considerably due to the contested nature of sustainability and different views of the role of education, as well as different disciplinary traditions.

While much has been written regarding the challenges of implementing SE in HEIs around the world, less has been documented regarding actual learning outcomes from current ad hoc approaches, and the pathways for achieving more effective sustainability teaching praxis in such a highly contested, ad hoc environment. Few studies have investigated the overall influence of SE across courses within particular HE settings and the results show learning outcomes to be highly variable and generally weak (Jowett et al., 2013; Shephard et al., 2014; Sidiropoulos, 2018; Teisl et al., 2011). In the main, learning outcomes of SE in HE conducted across multiple contexts remains under researched. Sustainability education is often oriented to individual change and

transformation, yet not much is known about how such change emerges from the learning process or how it contributes to transformative agency in students (Lotz-Sisitka, Mukute, Chikunda, Baloi, & Pesanayi, 2017). Without stronger direction, tertiary educators may adopt practices based on their own sustainability dispositions that do not accommodate student needs or the interests of industries/professions they serve. Therefore, research is needed to investigate the influences of current SE practices in such a contested environment, which privileges 'free choice' actions by educators and students over the imminent challenge of sustainability issues, and to identify sustainability competent praxis to ensure students are provided with learning opportunities that build their competencies and agency to participate in sustainability transitions.

Purpose

The purpose of this thesis is to investigate how current approaches to SE in HE contribute to the development of students' sustainability dispositions (knowledge, attitudes, and behaviour), competencies and agency to enable them to participate in different sustainability transition contexts around the world.

Structure of this thesis

This thesis is a PhD by Publication structured in a framework of nine chapters. Following the introduction, chapter two is an updated review of the literature and outlines key aims of this research. Chapter 3 is an exegesis that provides the conceptual, methodological and publications schema that links and connects the five separate studies that were conducted and are reported in Chapters 4 to 8. Chapter 4 provides an initial literature review on learning for sustainability and the role of HE, particularly business education programs in contributing to societal sustainability transitions. Chapter 5 reports on a pilot EfS study of the influence of various SE initiatives at a particular HEI setting, whereas Chapter 6 is a case study of the researcher's own teaching initiatives over an 8-year period in the same setting. Chapter 7 is an international multi-university study on the influence of SE initiatives in a variety of settings. Chapter 8 is the final study on transformative learning experiences and outcomes from dedicated SE units at two HEIs. Chapter 9 provides a summary and synthesis of the results, a discussion of the significance of the research, and a conclusion.

Chapter 2 Literature Review

This section provides an overview of the key and contemporary literature of the field that positions the overall thesis of five connected studies. The studies are supported by their own reviews of pertinent literature and this section provides contextualisation and support for the integration, interpretation and synthesis of key findings across the studies. The review covers the following topics: (1) The role of education and learning in achieving more sustainable outcomes; (2) the situation of SE in HE (3) outcomes from SE approaches in HE; (4) the shift in the field from behaviour modification towards developing competence and agency; (5) the shift in the field from instrumental learning towards transformative learning; (6) the connection between individual learning and changes in personal behaviour; and, (7) the connection between individual learning and changes in organisations and wider social-ecological systems.

2.1 The role of education and learning for sustainability

The world is facing increasingly urgent sustainability challenges that manifest as combined undesirable outcomes in economic, environmental and social considerations, such as poverty, obesity, homelessness, climate change, deforestation, and ecosystem destruction. These interconnected problems can be described as 'wicked problems' (Rittel & Webber, 1973) that are complex and have no easy solution. Wicked problems are characterised as being difficult to define with multiple views of the problem; potential outcomes are uncertain with no clear end point; many interdependencies and causes are located within dynamic social processes; and, solutions are neither right nor wrong but reflect the particular way a problem is articulated (Australian Public Service Commission, 2012; Rittel & Webber, 1973).

Addressing such complex, uncertain and contested problems requires an improvement in the capacity of individuals, communities, organisations, and societies to adapt and develop in a more sustainable direction (Chabay, Siebenhüner, van Eijndhoven, & Schreurs, 2009). Education has been identified as a key strategy to support this development (Rieckmann, 2017; Wals, 2011) with an interplay of knowledge, learning and societal change necessary to promote societal learning and a transition towards greater sustainability (Chabay et al., 2009).

Definitions of sustainability and SD abound. The most popular definition of SD originated from the Brundtland Commission, as "development that meets the needs of

the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). More broadly, SD is an emerging vision of the relationship between social/cultural development and economic opportunity on the one hand, and environmental requirements on the other (UNESCO, 1997). Sustainability entails a dynamic balance among factors related to fulfilling human needs and protecting the natural environment. Different interpretations of human needs and means of achieving them are reflected in contrasting approaches to education and learning in relation to sustainability, which are evident over time in the literature.

There is a long history of educational efforts that focus on environmental and social concerns (Wals & Benavot, 2017). The role of education and learning in enabling societal transitions towards sustainability began several decades ago with initiatives in EE that were promulgated by supranational and national policies. According to UNESCO (1997, p. 15), 'education is the most effective means that society possesses for confronting the challenges of the future…(and) will shape the world of tomorrow'. The concept of EE grew from the conservation movement and began in the early 1970s, following the United Nations Conference on the Human Environment in Stockholm in 1972. Environmental education has focused on goals and outcomes that align with the concept of sustainability (UNESCO, 2002) and has since been responsible for many educational innovations, including ESD (see for example, reviews of the history of EE/ESD by Sterling, 2004a; Wals, 2010b).

The term ESD emerged from EE and was first used at the World Conference on Environment and Development in Rio de Janeiro in 1992 (Lukman & Glavič, 2007). Education was to be re-oriented to foster values and attitudes regarding respect for the environment (UNESCO, 2006). Early efforts in ESD entailed a refocus at all levels in education to build the concepts, skills, motivation and commitment needed for SD (UNESCO, 2002) and included Higher Education for sustainable development (HESD) (Barth & Rieckmann, 2015a, 2015b). The core themes of ESD were lifelong learning, interdisciplinary education, partnerships, education across diverse cultures and empowerment (UNESCO, 1997). Great emphasis was placed on learning in the context of lifelong learning that includes not just formal education, but non-formal and informal modes of learning across the broad spheres of education, work and leisure (UNESCO, 1997).

The two major global frameworks for ESD led by UNESCO, include the UN Decade of ESD (2005-2014) and the subsequent GAP. The GAP focusses on the five priority areas of advancing policy, transforming learning and education, capacity building of educators and trainers, empowering and mobilizing youth and accelerating local action. Education for sustainable development is highlighted in all 17 SDGs in the UN's Agenda 2030 and specifically in SDG-4 on education, capacity building and lifelong learning for all (UNESCO, 2014a).

According to UNESCO (2015b), ESD is increasingly recognised as a key enabler for sustainable development and aims to:

> empower learners to transform themselves and the society they live in by developing knowledge, skills, attitudes, competences and values required for addressing global citizenship and local contextual challenges of the present and the future, such as critical and systemic thinking, analytical problem-solving, creativity, working collaboratively and making decisions in the face of uncertainty, and understanding of the interconnectedness of global challenges and responsibilities emanating from such awareness. (p.5)

This view of ESD is not simply concerned with linking society, environment and economic systems in a superficial way, but is considered an agenda for proactive and systemic social change (Tilbury, 2007; Tilbury & Cooke, 2005). However, this view of ESD is not unanimously supported, and there is disagreement among policy makers, scholars and practitioners regarding the scope, purpose and methods of ESD (see for example, the review of EE/ESD positioning by Wals & Jickling, 2002), as well as ESD outcomes (see the review by Granados-Sánchez et al., 2011). The contestation is predominantly based on differing conceptions of sustainability, and/or contrasting views on the role of education in addressing sustainability challenges, which are discussed below.

Sustainability is understood to be a normative and widely contested concept (Baker, 2006), based on vastly different conceptualisations of the human-nature relationship, which in turn, influence education and learning. In one typology, conceptualisations of sustainability range from "weak" to "strong" (Neumayer, 2013; SANZ, 2009). Proponents of the "weak" view of sustainability regard natural capital as substitutable by other forms of capital, and adopt a managerial approach to the natural environment.

This view is situated within the dominant social (capitalist) paradigm and relies on convergent values and views to develop and implement technical solutions for green businesses and consumers. In this instrumental view, students are viewed as practitioners (Kearins & Springett, 2003; Neumayer, 2013; Springett, 2005; von der Heidt & Lamberton, 2011). By comparison, those who favour a "strong" view of sustainability regard the natural environment as non-substitutable, and seek to preserve the natural environment. This view adopts a critical and emancipatory perspective that challenges the dominant paradigm and relies on divergent views to problematise existing institutional structures and co-create new possibilities. In this emancipatory view, students are viewed as change agents (Kearins & Springett, 2003; Neumayer, 2013; Springett, 2005; von der Heidt & Lamberton, 2011).

Educators disagree on the manner in which sustainability is included in the curriculum and the educative purpose of such an intervention. Essentially all education expresses either a 'transmissive' or 'transformative' methodology that reflects the teaching praxis, philosophy and purpose of education (Sterling, 2001). Wals, Geerling-Eijff, Hubeek, van der Kroon, and Vader (2008) clearly distinguish between instrumental learning that is transmissive, based on instructive methodology and focused on knowledge and behaviour change, and emancipatory learning that is transformative, based on constructive methodology (i.e., student-centred) and focused on human development. They argue that policymakers and practitioners should select the educative approach according to the change challenge at stake and the degree of (un)certainty about desired solutions. Thus, the learning approach depends on the context.

However, Wals (2010a) highlights the tension between the instrumental and emancipatory approaches to ESD from an education perspective, focusing on the intent of ESD. Teaching for a particular viewpoint and specific behavioural outcome is considered by some to be undemocratic and counter to the liberal ideals of education (Jickling, 1992; Wals, 2010a). Other commentators question whether EE/ESD can be functionally democratic, based on democratic values and in pursuit of democratic values when there are asymmetrical relations between educators and learners in a system that specifies any normative outcomes (Shephard & Brown, 2016). Furthermore, Sterling (2010a) suggests the instrumental view has prescriptive tendencies informed by a realist view of the world, while the intrinsic view has developmental tendencies based on an idealist view of the world. Sterling (2010a) argues that from a sustainability point of

view, "given the urgency of the issues that face us, the intrinsic stance may be necessary but not sufficient" (pp. 514-5).

While the polar positions of instrumental ESD (for knowledge and behaviour change) and emancipatory ESD (for capacity building) are generally critical of each other (Barth, 2016), in practice, elements of both are often combined in addressing sustainability challenges (Wals et al., 2008). The traditional instrumental and reductionist approaches to knowledge in HE are complemented with more integrative and holistic approaches (Holmberg & Samuelsson, 2006). Vare and Scott (2007) articulate the benefits of combining the instrumental ESD (ESD 1) and emancipatory ESD (ESD2) pedagogies, thus:

> ESD 1 as the promotion of informed, skilled behaviours and ways of thinking, useful in the short-term where the need is clearly identified and agreed, and ESD 2 as building capacity to think critically about what experts say and to test ideas, exploring the dilemmas and contradictions inherent in sustainable living. (p.19).

It has been argued that ESD is essential at all levels of education and in all disciplines (Leihy & Salazar, 2011). However, there is disagreement about how sustainability should be integrated into the curriculum. Views range from the consideration of sustainability topics within individual disciplines and epistemologies (Stables & Scott, 2002), to a radical transformation of education systems per se that foster an emergent ecological, participatory worldview based on 'whole systems thinking' (Sterling, 2001). Disciplinary approaches to sustainability are also advanced by Chambers (2013) and Stough, Ceulemans, Lambrechts, and Cappuyns (2018), with clear linkages required between modules across a programme of study (Boyle, Wilson, & Dimmock, 2015). Deep integration of sustainability issues within traditional disciplines is preferable to an "add-on" approach (Hiller Connell, Remington, & Armstrong, 2012). Further, disciplinary approaches to sustainability may facilitate "epistemological stretching", which is a process of "expanding the ways of knowing that someone respects, understands, and/or engages with" (Harmin, Barrett, & Hoessler, 2017, p. 1490) and enables them to articulate and critically engage with epistemologies of other academic fields.

A wide range of terms have evolved regarding different aims and aspects of education and sustainability such as EE, ESD, EfS, learning for sustainability (LfS) and SE. The two major orientations are EE and ESD and while the two are "closely related

phenomena" (Reid & Scott, 2006, p. 575), important differences are recognised in terms of their content and underlying pedagogic and didactic dimensions (Wals & Kieft, 2010). Long standing tensions relate to their conceptual congruence, dimensions and complementarity; hierarchy; orientation, outcomes, etc., (see explications by Sterling, 2004a, 2010b; Stevenson, 2006; Wals & Benavot, 2017). Even within ESD, the "education" component is conceptualised differently, based on varying approaches to participation, self-determination and autonomous thinking (Wals & Kieft, 2010). However, Wals and Kieft (2010) suggest it is more helpful to focus on their similarities than on differences.

In this research study, sustainability is assumed to be both an explorative process and a broad direction (Sterling, 2010a). The generic term of SE is used to encompass the spectrum of interpretations (Jabareen, 2012) and aligns with Pace (2010), that all forms of holistic SE can coexist. Perhaps eclipsing all the above is the assertion by Holmberg and Samuelsson (2006): "Education for sustainable development (ESD) is about dealing with complex systems, systems thinking and learning about core concepts. ESD is a learning process not a product!" (p.8). The next section focusses on the role of learning and provides a brief outline of key learning theories and learning requirements for sustainability.

2.1.1 Learning theory connections

Learning to know, to do, to be, and to live together with others is not only the foundation for lifelong learning but also for SD (UNESCO, 1997). This section briefly reviews the types of learning required for SD and the main learning theories associated with this type of learning.

Many attempts have been made to categorise and organise learning theories to aid an understanding of their ideas (for a review see Blackmore, 2007) and to demonstrate how understanding and conceptualisation of learning has evolved over time (De Corte, 2010). Three mainstream perspectives on learning in SE are the behaviourist, cognitive, and situational/social approaches (Reid & Nikel, 2008), that differ in their epistemology, ontology and field of interest (Lundholm & Plummer, 2010). Behaviourist theories were the earliest approaches, where learning was based on imitation and the focus was on observable changes in dispositions and behaviour. These were followed by cognitive theories, which regard learning as an active, constructive, and cumulative process to the acquisition of knowledge, with greater attention to

cognitive aspects of internal mental processes and knowledge structures. The situative perspective emerged from further development of the constructivist view, with an emphasis on how an individual learns in the context of a communal or relational situation (Blackmore et al., 2011; Reid & Nikel, 2008). This socio-constructivist view regards learning as "participation" and, according to De Corte (2010, p. 41), "constitutes the current dominant view of learning". The above categorisation was originally developed by Greeno, Collins, and Resnick (1996) who note that "the perspectives frame theoretical and practical issues in distinctive and complementary ways" (p.16).

Effective learning is viewed as a "constructive, cumulative, self-regulated ...process of knowledge and meaning building" that is individually different (De Corte, 2010, p. 56), with meaningful engagement of students affected by differences in their knowledge, motivation and abilities (Dumont, Istance, & Benavides, 2010; Hansmann, 2010). It is important therefore to consider the 'learning system' (Biggs, 1996, 2003; Biggs, 1993; Blake, Sterling, & Goodson, 2013) that consists of the teaching context, the learner context and learning outcomes influenced by wider systems. Accordingly, sustainability learning extends beyond individual units of study and reflects the "horizontal connectedness" of learning across the study programme (Lozano & Peattie, 2011; Rose, Ryan, & Desha, 2015). It also encompasses the campus environment (Chiong, Mohamad, & Abdul Aziz, 2016; Kember, Hong, Yau, & Ho, 2017) and connects to learning opportunities in their lifeworld (Fung, 2017; Hiser, 2012; Istance & Dumont, 2010; Winter & Cotton, 2012).

The importance of enhancing student sustainability learning by linking across the 'learning system' has been acknowledged by researchers. Scott (2002) contends that most LfS is situated in non-formal and informal settings, at various levels (as individuals and in groups) and both within and between institutions, organisations and communities. This view is echoed by Wals (2011) who posits that sustainability-focused social learning occurs at the intersection of informal, non-formal and formal education. Informal learning has been shown to enhance opportunities for sustainability learning (Hopkinson, Hughes, & Layer, 2008; Winter, Cotton, Hopkinson, & Grant, 2015) and to bypass various barriers to integration of SE in the HE curriculum (Ryan & Cotton, 2013). Indeed, the informal curriculum of campus related extra-curricular activities and experiences, "may be more important than the formal curriculum in sustainability learning, [yet] its impact in HE is only just starting to be explored (Ryan

& Cotton, 2013, p. 159). The 'hidden' curriculum implicit in campus management of buildings and resources, also affects LfS (Müller-Christ et al., 2014). Thus, HEIs can enhance sustainability learning by linking opportunities for situational learning across formal, informal and non-formal settings.

The type of learning required in contemporary SE varies according to the multiple perspectives about sustainability per se and whether the required changes can be accommodated within contemporary society or whether reform, reconfiguration, or transformation of social-ecological systems is required to achieve the desired human-nature relationship (Geels, McMeekin, Mylan, & Southerton, 2015; Scott, 2002). The current emphasis of ESD by UNESCO (2014a) is on societal transformation by empowering learners to transform themselves and the society in which they live. Loeber, van Mierlo, Grin, and Leeuwis (2007) assert this view of learning for SD is essentially revolutionary as it calls for system innovation and requires participants to adopt a reflexive perspective for: "opening up of existing routines, rules, values and assumptions embedded in the institutions that have co-evolved with earlier "unsustainable" modes of socio-technological development" (p84). An emancipatory ESD approach is required to build an individual's capacity for critical, systemic and reflective thinking. Graduates need to develop such qualities to contribute to sustainability transitions in their capacity as individuals and in groups. Importantly, the capacity for individuals and groups to participate in societal transitions is learnt, constructed and dynamic (Reid & Nikel, 2008) and HE can contribute to the process of sustainability transitions by developing students' individual and collective capacity.

Sustainability education calls for a paradigm shift in HEIs to adopt a whole-institutional approach to sustainability (Rieckmann, 2017). This entails embedding principles of sustainability within all functional areas (Sterling, 2010b) and reorienting their teaching, research, campus operations and community outreach activities to become sustainable universities (Lukman & Glavič, 2007). Such a whole-institutional approach to learning is aligned with situational and lifelong learning approaches, as outlined above. The next section discusses the extent to which such a reorientation of learning for SD has been achieved by universities globally and in Australia.

2.2 The situation of Sustainability Education in Higher Education

Higher education is regarded as particularly important in the context of ESD given their high societal impact and role as major multipliers of SD (Cortese, 2003; Hansen &

Lehmann, 2006; Sharp, 2002). Higher education institutions help shape the future of society by generating and transferring new knowledge, raising awareness of sustainability challenges and preparing future professionals, decision makers, educators and change agents with the knowledge, skills, competencies and agency to deal with the complexity of SD (Wals, 2015).

The critical role of HE is reflected in the promulgation of supranational policy frameworks (see Lozano et al., 2015; Lozano et al., 2013), national education policies, and an array of declarations, charters and initiatives for HEIs to demonstrate their commitment to embedding sustainability into their system (Calder & Clugston, 2003). Collectively, these initiatives afforded HEIs a clear mandate to implement SE in their academic programmes. Yet, despite such multi-level support, HE has been one of the slowest sectors to respond to ESD (Sterling, 2001). Implementation of ESD in HE has faced several challenges, including the inter-disciplinary and multi-disciplinary nature of SD, the required focus on learner-centred approaches, and the need for organizational learning (Sterling, 2001). Progress towards integrating ESD in HE in recent years has occurred against a backdrop of widespread changes in government policy, management arrangements and funding of the HE sector (von der Heidt & Lamberton, 2011). Reforms in HE have focused on greater efficiency and accountability, and changes in management and control have not always been conducive to the systematic reorientation of university structures and activities towards sustainability (Wals, 2014).

A series of roundtable discussions during a UNESCO conference on HESD in 2011, led to the conclusion that although some progress had been made, "for meaningful changes towards sustainability, whole-university approaches are needed in which development in the three dimensions [campus, curriculum and community] are linked to each other" (Müller-Christ et al., 2014, p. 136). By the end of the DESD in 2014, some commentators claimed considerable progress was made by HEIs to incorporate SD into their curriculum (Leal Filho, 2014; UNESCO, 2014b; Wals, 2014). However, other commentators' interpretation of 'progress' was mixed. Several studies confirm the lack of significant progress in SE at HEIs (e.g., Aleixo, Azeiteiro, & Leal, 2018; Ávila et al., 2017; GUNI, 2012; Lozano et al., 2015; Tilbury, 2011b). Shephard (2010) found 'the concept of 'higher education for sustainability' is fraught with problems' (p.21), with educational efforts largely pursued by committed educators in individual disciplines. Shephard (2010) concluded that "on balance, higher education is failing to adequately

address the sustainability needs of society" (p.21), and suggested a different approach might be necessary.

Similar resolutions about progress of SE in HE were noted by other scholars. Lambrechts et al. (2013) argued HEIs appeared to integrate sustainability in a piecemeal fashion and were far from reorienting themselves towards sustainability. Kapitulčinová, AtKisson, Perdue, and Will (2018) concluded that progress towards implementing SE in most HEIs was limited, and the HE sector overall remained in the "initiation/awakening stage" of the sustainability maturation curve. Finally, Huckle (2014) suggested that ESD had been absorbed by the neo-liberal paradigm and was effectively oriented towards ecological modernisation or light green versions of the status-quo. The reformist aims of the DESD for positive societal transformation (UNESCO, 2006) failed to challenge the dominant paradigm of neoliberalism as a hegemonic force blocking transitions towards greater sustainability. In the end, the result was "business-as-usual" (Huckle & Wals, 2015; Wilson & von der Heidt, 2013).

In practice, SE represents a challenge to HE (Sterling & Witham, 2008) and their role in societal change is still being debated (Shephard, 2010). While the holistic concept of SD is inherently multi- and transdisciplinary in nature, this view is not widely held by students and many teachers (Pappas, 2012; Sinakou, Boeve-de Pauw, & Van Petegem, 2017) who are accustomed to particular disciplines (Winter, Cotton, et al., 2015). Disciplinary traditions are based on epistemologies with different conceptions of sustainability and different teaching and learning approaches. Studies show many academics adopt a narrow view of sustainability that privileges only two of the three dimensions (environment, society, and economy) of holistic sustainability (Gale, Davison, Wood, Williams, & Towle, 2015; Sinakou, Boeve-de Pauw, Goossens, & Van Petegem, 2018; Stough et al., 2018). Therefore, the traditional discipline-based structuring of knowledge and research constitutes a major barrier to interdisciplinary learning that is required in ESD (van Dam-Mieras, 2006). Sinakou et al. (2017) refer to this as an ESD policy-practice gap. According to reviews conducted by Wals (2012), UNESCO (2014b) and Mulà et al. (2017), university educators require capacity building in education and training for ESD. Mulà et al.'s (2017) review reported a lack of capacity to integrate ESD effectively into mainstream teaching practices with limited training for academic staff in universities in 33 European countries.

For many HEIs, ESD has been implemented as a 'bolt-on' option of adding sustainability related content in some courses, and in the delivery of specialist modules or courses in sustainability (Granados-Sánchez et al., 2011; Mulà et al., 2017). The tendency has been to rely on a stand-alone, typically multi/trans-disciplinary sustainability unit to cover issues of sustainability for an entire study programme (vertical integration), which is not as effective as the integration of issues across an entire programme (horizontal integration) as shown by Barrella and Watson (2016) and Miller (2016). An integration approach to SE that combines both horizontal and vertical integration and is driven by bottom-up and top-down efforts seems to be most beneficial (Ceulemans, De Prins, Cappuyns, & De Coninck, 2011).

Several studies also indicate SE in HE is largely implemented in an 'ad hoc' fashion, notably in the Asia Pacific region (Leihy & Salazar, 2011; UNESCO, 2014b). The term 'ad hoc' denotes an incremental (and arguably expedient) approach to sustainability in the curriculum, with sustainability issues included in a few units only (Boyle et al., 2015). The ad hoc approach adopted by many Australian HEIs is associated with "weak" sustainability (Baker, 2006), that reinforces the dominant capitalist paradigm of production and consumption (von der Heidt & Lamberton, 2011, p. 677).

The main reason for the ad hoc approach appears to be a lack of political leadership to advance ESD across the sector (UNESCO, 2014b), and the absence of academic leadership within individual institutions (Dredge & Schott, 2013; Dyer & Dyer, 2017; Lozano et al., 2015; Scott, Tilbury, Sharp, & Deane, 2012; Sidiropoulos, 2010). In contemporary HEIs, academics are often key gatekeepers (Müller-Christ et al., 2014) on curriculum content and choose whether and how to introduce SE into their courses (Evans, Stevenson, Lasen, Ferreira, & Davis, 2017; Holdsworth & Hegarty, 2016; Shephard, 2010; Sinakou et al., 2018). The inclusion of SE often reflects academics' personal sustainability orientations and values (Cross, 1998; Hursh, Henderson, & Greenwood, 2015; Kelly, 2010), the influence of intrinsic and extrinsic motivations, and their own capabilities (Biasutti, Makrakis, Concina, & Frate, 2018; Evans et al., 2017; Perera & Hewege, 2016; von der Heidt & Lamberton, 2014). Beyond their personal dispositions, academic teaching practices may also be constrained by external limitations that are implied/applied by the faculty (Beddewela, Warin, Hesselden, & Coslet, 2017), the institution, disciplinary traditions (Bradley, 2019; Christie, Miller, Cooke, & White, 2014; Landrum & Ohsowski, 2017), professional bodies (Brown,

Bornasal, Brooks, & Martin, 2015; Thürer, Tomašević, Stevenson, Qu, & Huisingh, 2018), government agencies and/or sector level organisations (Ryan & Cotton, 2013).

Barriers to sustainability learning in HE also stem from students who often resist the inclusion of sustainability in their courses and fail to see its relevance to their discipline (Burns, 2016; Hegarty, Thomas, Kriewaldt, Holdsworth, & Bekessy, 2011; Karol & Mackintosh, 2011; Swaim, Maloni, Napshin, & Henley, 2014). Sustainability education calls for participatory and exploratory learning, yet indications of student resistance were found for pedagogies such as active learning (Recabarren, Alvarez, & Diaz, 2015; Watson, Pelkey, Noyes, & Rodgers, 2016) and for engaging in critical reflection and self-reflection that challenge their personal epistemologies and worldviews (Glisczinski, 2007; Karol & Mackintosh, 2011).

Holistic sustainability is a complex epistemology that may require more deliberate scaffolding of LfS (Perera & Hewege, 2016; Sidiropoulos, 2011; Sidiropoulos, Wex, & Sibley, 2013). A "guided discovery" learning approach that balances guided learning (based on external regulation) and discovery learning (based on self-regulation) may produce stronger learning outcomes in SE. Guided discovery learning aligns with the structure of human cognitive architecture and avoids cognitive overload in dealing with complex epistemologies such as holistic sustainability (De Corte, 2010). However, many teachers and adult students prefer the transmission model in HE, which is inconsistent with evidence on potent learning outcomes (De Corte, 2010). Given these barriers, it is possible that more effective learning outcomes from SE, particularly the development of adaptive capacity to translate learning to other contexts, may pose major challenges to HE professionals, leaders and policymakers (De Corte, 2010).

Finally, educators who design and pursue SE in HE are often not EE/ESD experts, but committed individuals with varied approaches, political viewpoints and disciplinary expertise (Ryan & Cotton, 2013). These educators may be interested in assessing learning outcomes of their SE endeavours in a given disciplinary context. However, no standard tool is available for educators to assess learning outcomes from SE, and this represents a gap in the literature.

This section considered the situation of SE in the HE "learning system" (Blake et al., 2013) and discussed two of three elements in the learning system, namely the teaching context and learner context. The next section reviews the third element, namely the learning outcomes from SE endeavours in HE.

2.3 Outcomes from approaches to SE in HE

This section provides a brief overview of SE learning outcomes related to HE and incorporates early reviews of the literature in EE and related fields by Rickinson (2001, 2006), Reid and Scott (2006), and Stevenson and Evans (2011), with updates from recent studies on learning outcomes from curricular EE/ESD in HE.

Rickinson (2001) conducted an early review of empirical studies on school-based EE research during 1993-1999. At that time, the explicit goal of EE was to influence student knowledge, attitudes and behaviour in a linear, cause-effect manner. Most studies were quantitative and positivist with qualitative approaches grounded predominantly in interpretivist/constructivist epistemologies. Key findings were a low level of initial environmental knowledge in students, the positive effect of EE on students' environmental knowledge, attitudes, and (in a few cases) behaviour, and the importance of the learner's personal context in the learning process. Rickinson (2001) initially suggested more research was required on the learning process, and subsequently (Rickinson, 2006) called for more research on environmental learning through a person's life course, both 'life-wide' and 'lifelong' (p449). There was also a recognition of 'free-choice learning and the environment' reflecting the importance of informal and lifelong learning (Falk, 2005; Rickinson, 2006). Despite the increasing recognition of learning across a range of contexts (Lave, Wenger, & Wenger, 1991), few studies in EE/ESD had evaluated how sustainability learning accumulates over time (Otsuka, Nakamura, Hama, & Saito, 2018; Reid & Scott, 2006), except for research by Yavetz, Goldman, and Pe'er (2009). This area of accumulated LfS represented a gap in the literature at that time.

The review by Reid and Scott (2006) focused on articles published in the Environmental Education Research journal during 1995-2004, and they note the predominance of mostly qualitative, small studies, very few of which were conducted in HE. The authors describe research outputs as "ad hoc, highly contextualized and piecemeal" (p.578), and called for more consideration and/or use of quantitative approaches. Stevenson and Evans (2011) reviewed articles published in the Australian Journal of Environmental Education during 1990-2000 and noted most articles were focused on critiquing and theorising the conceptual and curriculum framing of EE. Very few articles were on evaluations of learning outcomes, and on assessments of environmental knowledge, beliefs, values, attitudes or behaviour.

The complexity of the learning experience was identified by Rickinson and Lundholm (2008) who called for more research on students' environmental learning processes in HE. A few years later, Tilbury (2011a) conducted an expert review of processes and learning for ESD, on behalf of UNESCO. The review was informed mainly by programme or context-specific research studies as there was a lack of meta-analysis studies or longitudinal research. Tilbury (2011a) concluded that ESD was "poorly researched and weakly evidenced'(p. 9) and the ESD literature was just beginning "to feature evaluative studies that map the outcomes, outputs and impacts of ESD projects and programmes" (p42).

Over the last decades, HESD has become a diverse, significant and stable field of research. Barth and Rieckmann (2015b) conducted a systematic literature review of research in HESD during 1992-2012 and concluded that it was characterised by a Western dominance, was dominated by descriptive studies, focused particularly on curriculum development and teaching and learning approaches, and provided very limited evidence-based research on learning outcomes and the development of competencies (Barth & Rieckmann, 2015b). Barth and Michelsen (2012) noted an increased emphasis on assessment of progress in ESD in 2009, during the mid-term review of DESD. However, there was a strong contention in the literature that most research on sustainability at the post-secondary level was focused on case studies rather than comparison of multiple institutions (Vaughter, Wright, McKenzie, & Lidstone, 2013). In 2012, no published studies were found on the environmental and sustainability dispositions of international tertiary students in Australia, which represented a gap in the literature at that time.

Literature reviews on learning outcomes of ESD/SE interventions in HE are provided in Studies 1-5 (Chapters 4-8) of this thesis. The following discussion provides a brief summary of evaluation studies of SE and an update. Evaluation studies indicate learning outcomes to be mixed in the type of effect on student attitudes (e.g., Harraway, Broughton-Ansin, Deaker, Jowett, & Shephard, 2012; Jowett et al., 2013; Shephard et al., 2014; Sidiropoulos, 2014; Teisl et al., 2011) and weak in overall effect, with the exception of interdisciplinary units that produced stronger and more consistent results (Burns, 2013; Hegarty et al., 2011; Howlett, Ferreira, & Blomfield, 2016; Noy, Patrick, Capetola, & McBurnie, 2017). Various studies show learning outcomes are influenced by students' gender (Rideout, 2014; Sammalisto, Sundström, von Haartman, Holm, &

Yao, 2016; Zelezny, Chua, & Aldrich, 2000), culture (Deng, Walker, & Swinnerton, 2006; Ogunbode, 2013; Price, Walker, & Boschetti, 2014; Sidiropoulos, 2018), and academic major (Harring, Lundholm, & Torbjörnsson, 2017; Kuo & Jackson, 2014; Lang, 2011; Sherburn & Devlin, 2004).

O'Flaherty and Liddy (2017) recently conducted a systematic review and synthesis of the literature on the impact of ESD/EE interventions on learners that echo the above findings reported in Studies 1-5 (Chapters 4-8). Their review indicated that learning outcomes ranged from individual learning to emancipatory learning, depending on the socio-political and cultural context, the pedagogy adopted and potentially the epistemological context. The type of learning outcomes ranged across the cognitive, affective, conative and reflective domains. Further, the authors noted a wide range of methodological approaches used to assess learning outcomes for SE in HE, such as surveys, interviews, focus groups, reflective writing, diaries, and concept maps.

A key feature of SE evaluation studies in HE has been the diversity of methods used. Research methods included case studies and other qualitative approaches, and the increasing use of the New Ecological Paradigm (NEP; Dunlap, Van Liere, Mertig, & Jones, 2000) as an instrument to measure students' affective dispositions. The NEP was also increasingly utilised in pre-post studies to measure changes in the sustainability dispositions of student cohorts over time (Anderson et al., 2007; Shephard et al., 2014; Teisl et al., 2011). The main emphasis of quantitative studies was to measure attitudes, or knowledge, or behaviour and was usually limited to one HE setting. A consistent approach to assessing aspects of sustainability learning outcomes across a variety of HE settings was not evident, and this represented a gap in the literature.

In summary, a review of the literature has revealed increased attention to evaluation studies of EE/ESD initiatives in HE. Results from review studies and individual studies indicate learning outcomes to be mixed in type and weak in effect, and influenced by a wide variety of factors. Gaps were identified in the literature in terms of sustainability dispositions of international tertiary students in Australia, in systematic explorations of learning outcomes from SE across HE settings, in students' learning progressions across their study programmes, and, in a consistent approach to assessing learning outcomes across the cognitive, conative and affective domains. The next section focusses on recent shifts in the literature on teaching and learning approaches to SE in HE.

2.4 The shift from behaviour modification towards competence and agency

The approach to sustainability learning has shifted over time and in parallel with an evolving understanding of sustainability. Sustainability was initially envisaged as a problem to be solved by better management (WCED, 1987) but is increasingly recognized as a dynamic process that requires adaptive capacity in socio-ecological systems to deal with change (Lundholm & Plummer, 2010). The perception of sustainability as an adaptive and continuous learning process (Reid & Scott, 2006; Sterling, 2004b; Wals & Blewitt, 2010; Wals, 2011) is also reflected in ESD. The current focus of ESD is on creating conditions for transformative learning that enable people to transcend the current systems and paradigms, and envisage alternative pathways (Rieckmann, 2017; UNESCO, 2014a). The change in emphasis has been influenced by empirical findings in both SE and environmental psychology and by the rising importance of competency development in HE. Two notable shifts have been observed and reported in the SE literature: from an emphasis on attitude/behaviour change to developing competence and agency (Sterling, Glasser, Rieckmann, & Warwick, 2017) (discussed in this section); and, from instrumental learning towards transformative learning (Winter, Cotton, et al., 2015) (discussed in the next section).

Early EE approaches to behaviour change were based on the Information-Deficit Model (IDM) of education (Kollmuss & Agyeman, 2002) and informed by socio-psychology that posited a linear relationship between environmental awareness and environmental behaviour (Fishbein & Ajzen, 1980; Wals, 2010b; Winter, Cotton, et al., 2015). The approach was premised on the assumption that education could improve knowledge that would foster concern and awareness, and eventually lead to environmentally responsible behaviour change (Frisk & Larson, 2011). However, this strategy yielded disappointing outcomes (Finger, 1994; Nolet, 2009) that mirrored findings of a similar gap between knowledge and behaviour in environmental psychology (Kollmuss & Agyeman, 2002). Deterministic models of a linear relationship between environmental values, awareness, locus of control and pro-environmental behaviour were found to be wanting. Environmental educators learnt over the years that providing information about environmental and sustainability issues was not enough to elicit long-term behaviour change (Feriver, Teksöz, Olgan, & Reid, 2016; Sterling, 2007). It became evident that possession of knowledge and information might be necessary but was not sufficient to

stimulate behaviour change (Cotton, Miller, Winter, Bailey, & Sterling, 2016; Moore, 2003).

Consequently, the language of 'behaviour change' became contentious and the effectiveness of strategies for changing behaviour was questioned in the ESD literature (Tilbury, 2011a). Instead of attempts to force compliance and behaviour modification, Tilbury (2011a) identifies that ESD could contribute to an understanding of SD as a process of democratic citizenship. Many environmental educators have since abandoned their instrumental approach (ESD1) to behaviour change (Finger, 1994; Stern, 2000), although some tertiary educators have persisted in such endeavours (Sammalisto et al., 2016; Sterling, 2001; Zsóka, Szerényi, Széchy, & Kocsis, 2013). In the main, there has been a shift in the literature towards ESD as a life-long learning process that assists learners to make a difference in their local context.

Since the beginning of the DESD, there was a growing recognition of the importance of developing people's capacities, skills and competence to contribute to the transition towards greater sustainability (Wals, 2012). Accordingly, the discourse in EE/ESD shifted from an emphasis on developing specific knowledge and behavioural outcomes to developing specific competencies related to sustainability capability and agency (Barth, Godemann, Rieckmann, & Stoltenberg, 2007; de Haan, 2006; Jensen & Schnack, 2006; Rieckmann, 2012; Waas et al., 2012).

Many interpretations and definitions of competencies (or competences) for sustainability are found in the literature (Lambrechts et al., 2013; Lozano, Merrill, Sammalisto, Ceulemans, & Lozano, 2017). Over the last decade, several lists of competencies for sustainability have been proposed (see Barth et al., 2007; Brundiers & Wiek, 2017; de Haan, 2010; Rieckmann, 2012; UNESCO, 2014a; Wiek, Withycombe, & Redman, 2011). Two popular versions of sustainability competencies cited in the literature are those advanced by UNESCO (2014a) and Wiek et al. (2011). The UNESCO competencies are "critical and systemic thinking, collaborative decision-making, and taking responsibility for present and future generations". Wiek et al. (2011) conducted a wide literature review on sustainability competencies in HE and distinguished five key competencies: systems-thinking, anticipatory (or future) thinking, normative (or values) thinking, strategic (or action-oriented) thinking, and interpersonal (or collaboration) competency. A sixth competence of integrated problem-solving was

subsequently added that combines the five key competencies to address sustainability challenges and foster SD (Wiek et al., 2015).

The diversity of definitions, interpretations, intentions and specifications of competencies can create confusion among ESD practitioners (UNESCO, 2015a). Shephard, Rieckmann, and Barth (2018) conducted a hermeneutical analysis of various interpretations of 'competence' and 'capability' in ESD, and found inconsistencies that may hinder progress in achieving sustainability focused outcomes and citizenship. The authors considered particular contributions by Wiek et al. (2011), Wals (2010c) and de Haan (2010). In addition to Wiek's interpretation, Wals (2010c) focused primarily on social learning and the capacity for matching and switching perspectives (*Mirroring* and *Gestaltswitching*), while de Haan (2010) specified affective outcomes and critical thinking for students in compulsory (school) education. In their analysis, Shephard et al. (2018) found: "no consensus in this literature that relates intended outcomes, processes to support learning, and where described, methods to assure learning" (p16). The authors concluded the terms 'competence' and 'capability were problematic, due to concerns about the contestability of specifying behavioural outcomes and the importance of maintaining free choice and learners' self-determination'. It was suggested by Shephard et al. (2018) that educators distinguish between learning outcomes that are aspirational in terms of the willingness of learners to act, from those that are obligatory and formally assessed.

Meanwhile, HE increasingly adopted competency-based approaches to develop the knowledge, skills, attitudes and values in their graduate students to function in society (Stough et al., 2018). While the integration of competencies for SD in HE programs in Europe was regarded as an important step in advancing sustainability in HE in the region (Lambrechts et al., 2013), the outcome in Australia is less certain. In Australia, HEIs increasingly shifted their focus to graduate attributes or capabilities in response to government funding being linked more closely to performance indicators, such as employability of graduates (von der Heidt & Lamberton, 2011). General graduate capabilities in Australia include elements of skill components, attitudes, values, and dispositions required for sustainability, although the extent to which they are actualised in academic programmes is largely unknown (Sandri, Holdsworth, & Thomas, 2018; Thomas & Day, 2014). Further, attributes that are the least developed and most in need of attention are in the affective category (Kember et al., 2017), such as values education

(Shephard, 2008; Sipos, Battisti, & Grimm, 2008), which many academics consider outside their role (Down, 2006; Shephard & Furnari, 2012; Winter, Cotton, et al., 2015). Thus, there may be a policy-practice gap between the call by scholars and UNESCO for sustainability competence in graduates and actual development of competencies in HE.

Education for sustainability goals are premised on the assumption that SD requires transformation at the personal, social and cultural levels (UNESCO, 2015b). Accordingly, key aims of ESD are to develop student competence and potential agency to act towards sustainability (Rieckmann, 2017). As outlined by Chabay et al. (2009), the key learning requirements towards sustainability for tertiary students are disciplinary knowledge and skills, collaborative and cross-disciplinary capabilities, and the capacity as active citizens to participate in decision-making related to local and regional issues. Sustainability educators who attempt to foster such action-based outcomes face significant challenges because unlike disciplinary-based knowledge and skills, action-orientated learning outcomes are individualized and highly unpredictable (Blackmore et al., 2011). Agency is an emergent property that cannot be predicted from an educational intervention. While an expression of student agency is reported in some studies (Feriver et al., 2016; Kalsoom & Khanam, 2017), it often emerges in an 'ad hoc' fashion and is influenced by a range of factors, such as personal/professional interests and major life events (Barth & Timm, 2011; Dagiliūtė, Liobikienė, & Minelgaitė, 2018; Wiek, Farioli, Fukushi, & Yarime, 2012; Winter, Cotton, et al., 2015).

Enacting one's agency to pursue changes in systems, processes and practices is not simple. Agency is influenced by the quality of engagement between the actor and their structural context (Emirbayer & Mische, 1998), which may be blocked by structural and situational power. Wals (2015) notes that transitions towards sustainability rely on broader dimensions than individuals becoming more sustainable citizens, as behaviour is often restricted by structures, institutions and practices within the wider system. Structural conditions often pose obstacles to a person's sense of empowerment and meaningful agency for sustainability (Blake & Sterling, 2011; Cotton, Miller, et al., 2016; Cotton, Shiel, & Paço, 2016; Sterling, 2007). Lotz-Sisitka et al. (2015) argue that 'transgressive learning' is necessary for "radical system change or at least a disrupting of hegemonic moral, epistemological, among others, norms" (p76). Thus, in addition to developing graduates' agency for resilience and adaptive capacity in socio-ecological systems, it may also be necessary to develop their transgressive agency for disruptive

capacity in maladaptive systems that perpetuate unsustainability. (Lotz-Sisitka et al., 2015).

Beyond developing individual competency and agency, other scholars have highlighted the importance of collective efforts. Stevenson (2006) outlines a "need to balance the development of individual competency and agency, which is necessary but not sufficient for creating sustainable societies, with attention to collective agency, such as the role of social movements, and the politics of social change." (p284). Transformative agency refers to both individual agency and collective agency to act on situations towards a purpose (Sannino, Engeström, & Lemos, 2016). Transformative agency is emerging as an important learning outcome in ESD, where outcomes are not known in advance and new pathways (practices and processes) for sustainability are co-created (Lotz-Sisitka et al., 2017). The relationship between SE and both individual actions and wider system changes are discussed in sections 2.6 and 2.7.

In summary, the shift in the literature toward developing graduate competencies and agency emerged from the realisation that knowledge/awareness while necessary, was not sufficient to elicit actions, which in turn, were not adequate to create wider systems changes towards sustainability. Key graduate competencies for sustainability were identified and include critical and systemic thinking, collaborative decision-making, taking responsibility for present and future generations, and developing the agency to participate in wider change. Developing students' competencies and agency for sustainability often entail transformative learning and the shift in the discourse to this type of learning is discussed in the next section.

2.5 The shift from instrumental learning towards transformative learning

In a broad sense, transformative learning (TL) is the study of how human beings grow, change and live more deeply through various experiences (Tisdell, 2012). In SE, TL is espoused as a means to empower learners to challenge and potentially transform their mind-set and worldview (Rieckmann, 2017; UNESCO, 2015a). Transformative Learning is advocated in SE (Wals, 2010c, 2011) to create a paradigm shift towards a more holistic view involving systems-thinking (Wiek et al., 2011), to broaden and deepen perspectives on sustainability and education (Sterling, 2011), and to contribute to transitions towards sustainability. Having a holistic worldview would enable people to cope with complex systems and build their capacity and agency to transcend established ways of thinking and acting and create new systems (Wals & Blewitt, 2010).

Over the last decade, an increasing number of scholars have called for a greater emphasis on TL in SE (e.g., Barrett et al., 2016; Barth & Michelsen, 2012; Ferreira & Tilbury, 2012; Laurie, Nonoyama-Tarumi, Mckeown, & Hopkins, 2016; Lotz-Sisitka et al., 2015; Pavlova, 2012; Thomas, 2009; Winter, Cotton, et al., 2015). The related concept of transgressive learning (mentioned in the previous section) goes beyond TL and underlines learning as a means to disrupt the status quo and co-create new knowledge (Lotz-Sisitka et al., 2015).

The application of TL is particularly suited to tertiary SE that aims to develop students' competencies for sustainability. Holistic sustainability is a complex epistemology (Taylor & Snyder, 2012) characterised by uncertainty and indeterminacy. Sustainability issues require 'higher-order' or TL to deal with the complexity and uncertainty inherent in 'wicked' problems (Ryan & Cotton, 2013; Sterling, 2011; Wals, 2011). When sustainability issues are considered across multiple perspectives, geographic locations and timescales, a person's perspectives are likely to be disoriented and TL may occur (Lambrechts & Van Petegem, 2016). Thus, SE is expected to lead to TL, which enables learners to better cope with complexity, uncertainty and contested knowledge and to act autonomously (Wals, 2014).

In recent years, several studies have applied TL theory to investigate learning in EE (Chao, 2017) and in SE in HEIs (see Study 5 in Chapter 8). These studies adopted diverse approaches to conceptualise the construct of TL. The predominant approaches to TL were Sterling's (2011) conceptualisation of levels of learning based on Bateson's three levels/orders of change (Bateson, 1987), and Mezirow's (2000) theory of perspective transformation, both of which focus on cognitive changes in individuals. A fuller description of the Sterling/Bateson approach is provided in Study 3 (Chapter 6), while Mezirow's theory is described in Study 5 (Chapter 8). Other approaches to TL have included the 'conceptual change model' (Pintrich, Marx, & Boyle, 1993; Pugh, Linnenbrink-Garcia, Koskey, Stewart, & Manzey, 2010) and learning of 'threshold concepts' (Levintova & Mueller, 2015; Meyer & Land, 2003) among others (for a review of TL approaches, see Blake et al., 2013).

The theory of transformative learning (TL) is characterised by diverse theoretical perspectives and directions, which bring a rich complexity to the understanding of adult learning (Cranton & Taylor, 2012). These different strands share the notion of a 'reconstruction of experience' (Fuhr, Laros, & Taylor, 2017) or a deep shift in

consciousness (Dirkx, 2012). Key contributors to the development of TL theory are Mezirow (1991), Daloz (1986), Cranton (1994, 1996), Dirkx (1998), Boyd and Myers (1988), O'Sullivan (1999), Kegan (2000), Tisdell and Tolliver (2003), and Gunnlaugson (2007). These contributors bring different philosophical traditions and examine different facets of transformation in terms of process, outcomes and context (Cranton & Kasl, 2012). There is a tendency for scholars to think in dualisms and to write in terms of rational or extrarational processes, individual or social change, and independent or relational learning (Cranton & Taylor, 2012). While significant differences remain between these perspectives, there is general agreement on transformed outcomes in terms of different types of thinking, greater openness, deeper self-awareness, a changed worldview and altered behaviour (Stuckey, Taylor, & Cranton, 2013). Accordingly, different terms are used in the literature to denote the type of transformation. However, for the purposes of this thesis, the terms transformational learning, transformative learning, and perspective transformation will be used interchangeably. In summary, TL has proved to be a complex, multifaceted concept (Taylor, 2000) with different theoretical perspectives reflecting a focus on different roots and routes of transformation.

Mezirow (2000; 1991) is considered the primary architect of TL (Gunnlaugson, 2008; Merriam, 2004) and his theory on individual *perspective transformation* (PT) is the most influential in the field (Taylor, 2017). Mezirow's theoretical framework of PT is an outline of a 10-phase cognitive process triggered by a disorienting dilemma that challenges a person's existing frame of reference (i.e., worldview or mindset). Through a process of critical reflection on one's underlying values and assumptions and constructive discourse (dialogue) with self or others, the person transforms their problematic frame of reference and makes "an informed and reflective decision to act on his or her reflective insight" (Mezirow, 2012, p87). A frame of reference encompasses cognitive, conative and affective components (Mezirow, 2009) so critical reflection in TL can entail all three dimensions.

Mezirow's theory has been criticised over the years for the perceived shortcomings of its emphasis on TL as a rational and cognitive process of individual transformation. Mezirow responded to various criticisms of his original work (Cranton & Kasl, 2012) and subsequently became more inclusive of other perspectives such as the influence of emotions (Dirkx, 2001; Kroth & Cranton, 2014; Merriam, 2004), and the social and

cultural learning context (Baumgartner, 2001; Dirkx, 2006; Dirkx, Mezirow, & Cranton, 2006; Mezirow, 2000; Taylor, 2000; Taylor, 2007). Over time, Mezirow revised his theory to include new constructs and elaborated further on types of reflection, types of meaning schemes and perspectives, types of learning, etc., (for an exposition, see Kitchenham, 2008). Despite reservations of other scholars, Mezirow's theory remains the most widely used in TL research to analyse the experience of individual transformation. As stated by Newman (2014, p. 347): 'Mezirow's individualistic vision reigns supreme'.

It is not the intention of this thesis to contribute to theoretical debates on TL. Rather, the intention is to investigate the relationship between SE in HE and the incidence of TL outcomes. Hoggan (2016) conducted a recent review of the literature on TL (2003-2014) and found that reported learning outcomes spanned across several categories: worldview, self, epistemology, ontology, behaviour and capacity. These outcomes align closely with the intended outcomes of ESD identified earlier in Sections 2.1 and 2.4 of this review as knowledge, skills, attitudes, competencies and values for sustainability UNESCO (2015b). In this research project, learning outcomes are considered in the context of generic ESD learning goals, namely knowledge, the development of cognitive skills and competencies and motivation to take action towards sustainability (Rieckmann, 2017).

The conceptual congruence between TL and SE is based on several shared elements: both entail a range of potential changes in cognitive, conative and affective components (Mezirow, 2009) and provide an opportunity for learners to change their mindset, beliefs and behaviours (Sipos et al., 2008); both are viewed primarily as epistemic learning (Kegan, 2009; Mezirow, 1994) and lead to "seeing our worldview rather than seeing with our worldview." (Sterling, 2011, p. 23); both produce a range of learning outcomes including instrumental and communicative learning as well as individual and social actions; both are underpinned by personal and societal transformation (Leal Filho et al., 2018; Ryan & Cotton, 2013); and both are neither prescriptive nor predictable with outcomes determined by a constellation of personal, situational and contextual influences. Thus, TL is highly suited as a pedagogic approach to implement and assess learning outcomes in SE.

Mezirow's (2000) updated theory of PT has been chosen for this doctoral research due to its simplicity and congruence with the goals of ESD/SE, which are to build

graduates' knowledge, skills, competency and agency for sustainability. The goals of SE align with Mezirow's focus on TL as a cognitive, rational processes at the individual level. Mezirow's focus on individual, rather than collective learning outcomes, is also consistent with individual student participation in HE. The cognitive focus also aligns with current approaches in SE, which aim to develop cognitive skills and competencies in students (Aedo, Peredo, & Schaeffer, 2017). However, adoption of Mezirow's theory does not disregard the importance of the whole person, the Self as a total personality, as opposed to the Ego (Boyd & Myers, 1988). Nor does it dismiss the role of deep, intuitive and emotional responses beyond the cognitive rational processes (ego), that influence transformation and uphold transformative agency, particularly for actions such as environmental activism (Kovan & Dirkx, 2003). Yet, while it is acknowledged that transformation can be strongly driven (or prevented) by inner processes grounded in affective, emotional, spiritual and transpersonal dimensions (Dirkx, 2001), these are considered outside the scope of this doctoral research, which is focussed on the development of sustainability capabilities learned in HE. Mezirow's theory of PT focussed on an individual's progression through a transformative experience is considered the most appropriate for this research context of LfS.

Research in TL has been conducted using various theoretical frameworks (Taylor & Snyder, 2012) with methodologies based mainly on qualitative approaches. The use of quantitative techniques to research TL remains relatively sparse (Brock & Abel, 2012) and tends to be carried out in retrospect, where participants reflect back on their transformative experience. Studies of TL for sustainability in HE are based mostly on a positivist/post positivist orientation (Ling, 2017). Several studies have adopted a mixed-methods design to investigate the relationship between an intervention program designed to foster TL and outcomes in terms of perspective change, predominantly using Mezirow's conception (Taylor & Snyder, 2012). Study outcomes are generally explored through interviews and assessed through measures of various aspects of cognitive, affective or behaviour change (Cheney, 2010).

Research designs have expanded recently to include exclusively surveys and questionnaires (Taylor & Snyder, 2012). Kember et al. (2000) developed a four-scale questionnaire based on reflective thinking within Mezirow's (1991) model, to measure four constructs of habitual action, understanding, reflection and critical reflection. In recent years, the Learning Activities Survey (LAS; King, 2009) has become a

prominent tool to measure Mezirow's conception of TL across a range of settings. The LAS instrument is discussed more fully in Study 5 (Chapter 8). Some scholars (Taylor & Snyder, 2012) have questioned the scale's construct validity and factorial validity and offered an alternative scale (Stuckey et al., 2013). However, TL is a complex phenomenon and very difficult to measure, as highlighted by Merriam & Kim (2012), who suggest it may not be amenable to experimental or sophisticated statistical designs. There is no single, generic, widely accepted instrument or scale for researchers to capture every aspect of TL and compare results across studies. Perhaps this is not surprising given the multitude of levels on which TL occurs.

King (2009) always maintained the LAS was designed to serve as a pre-screening survey in a mixed methods approach for a sequential exploratory study. The LAS has since become an established instrument with its validity and reliability tested through many mixed methods studies on TL in adults (for example, Feriver et al., 2016; Kumi-Yeboah, 2014; Liodaki & Karalis, 2013; Nichols & Dewerse, 2010; Woodrow & Caruana, 2017). While the LAS was not intended to be used as an instrument to quantify TL (King 2009), several researchers have based their studies solely on the LAS and often modified the instrument to suit their embodied context (Brock, Florescu, & Teran, 2012; Brock, 2010; Caruana, Woodrow, & Pérez, 2015; Stone, Duerden, Duffy, Hill, & Witesman, 2017; Strange & Gibson, 2017). There was no evidence in the literature of research studies based on the LAS to investigate TL outcomes and/or processes for SE in an Australian HE setting, which represented a gap in the literature.

This section provided an outline of the shift in the field of SE towards a TL focus, to ensure graduates are better able to act autonomously and cope with the complexity and uncertainty in 'wicked' sustainability issues (Ryan & Cotton, 2013; Sterling, 2011; Wals, 2011). A discussion was provided of key approaches adopted in TL research, the prominence of Mezirow's theory of PT (TL), and the use of the LAS instrument to analyse TL outcomes. The next two sections provide an overview of the main theories used in the literature to analyse the relationship between individuals' sustainability learning and outcomes in terms of personal actions and societal changes respectively.

2.6 Linking learning outcomes to individual changes

Developing capacity and agency through TL that can result in a wide range of actions, including 'pro-environmental behaviours' (PEBs) constitutes the central concept or aim

of environmental and SE (Jensen, 2010). In this doctoral research, consideration of PEB extends beyond personal behaviour to include wider actions from agency.

Several explanatory models focus on psychological influences that result in pro-environmental concern and behaviour or lack thereof. Key models include the theory of planned behaviour (TPB; Ajzen, 1991), the norm-activation-model (NAM; Schwartz, 1977), and the value-belief-norm theory of environmentalism (VBN; Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). Steg and Vlek (2009) reviewed the effectiveness of these models to explain various types of environmental behaviours. They concluded that NAM and VBN theories were more successful in explaining low-cost (or low-effort) environmental behaviour and environmental intentions, political behaviour, environmental citizenship and policy support. The TPB was found to be more effective in explaining situations characterised by high behavioural costs or constraints on behaviour, possibly due to the consideration of a wider range of factors, such as non-environmental motivations and perceived behavioural control. By comparison, the NAM and VBN focus primarily on moral obligations to act pro-environmentally (Steg & Vlek, 2009).

In their seminal paper, Kollmuss and Agyeman (2002) collected and synthesised a large body of research to elucidate the development of environmental behaviour. They considered a wide range of influential theoretical frameworks and models and found no apparent correlation (a gap) between the possession of environmental knowledge and environmental awareness, and the display of PEB. The authors concluded that PEB is too complex to be represented by a simple model or diagram. Although many studies have been undertaken, no definitive explanation of behaviour has been found. Factors that influence PEB include demographic factors, internal factors (such as motivation, pro-environmental knowledge, awareness, values, attitudes, emotion, locus of control and responsibilities) and external factors (related to institutional, economic, social and cultural conditions) (Kollmuss & Agyeman, 2002). The knowledge-action gap has also been posited to stem from various deep-seated structural and psychological forces (Nolet, 2009) as well as social politics and history that add to the complexities of human social habitus (O'Donoghue & Lotz-Sisitka, 2002).

The conceptual framework guiding this PhD research was based on the VBN model, which is detailed in Section 3 (research methodology) and outlined in Studies 2 and 4 (Chapters 5 and 7). The model links values, norms and beliefs with a range of PEB

including agency, recognising that actions are influenced by contextual variables that include educational and social-structural factors. For example, a person's sense of self-efficacy or their perception of an external locus of control (sometimes characterised as "learned helplessness") moderates the relationship between their environmental concern and behaviour (Landry, Gifford, Milfont, Weeks, & Arnocky, 2018). Students' self-efficacy and beliefs in their understanding, thinking and capacity to act for sustainability are considered important for PEB and are influenced by student-centred transformative pedagogies (Evans, Tomas, & Woods, 2016; Holdsworth & Hegarty, 2016).

Education and learning are known to influence sustainability attitudes and behaviours. Higher levels of education in general are linked to greater environmental concern (Casaló & Escario, 2018) and behaviour (Chankrajang & Muttarak, 2017; Meyer, 2015, 2016; Vicente-Molina, Fernández-Sáinz, & Izagirre-Olaizola, 2013). While knowledge per se is not sufficient to lead to environmental action, it is important as one of many preconditions for taking action (Jensen, 2010). Education has an important influence on student beliefs about social norms (Felgendreher & Löfgren, 2017); their understanding of the extent and severity of environmental and sustainability issues (Blackmore et al., 2011; Jensen, 2010); their knowledge of the range of potential solutions available (Blackmore et al., 2011; Jensen, 2010); and their perceptions of the ability of individuals and groups to alter outcomes (Frisk & Larson, 2011; Jensen, 2010; Savelyeva & Douglas, 2017). Notably, PEB has been found to be influenced by learning that extends beyond formal education to areas of informal and non-formal education (Sterling, 2004c), as well as lifelong learning (Blewitt, 2006) that occurs in a cumulative and iterative manner. This concept of learning as a cumulative process in the wider context of a person's life, aligns with the concept of a total 'learning system' (Biggs, 1996; Biggs, 1993) discussed in Section 2.1.

Education and learning can influence the full range of PEB in the VBN. According to Stern et al (1999), PEB can be categorised into four types: 1) Personal or private-sphere behaviour change – for example, consumer choices; 2) passive acceptance of public policies that may depart from immediate self-interest – for example, voting for a political party that would increase environmental taxation or regulation; 3) low-commitment active citizenship that does not present significant risks - for example, writing letters to political decision-makers or contributing financially to pressure groups; and, 4) committed public activism – for example, participating in

demonstrations or direct involvement with pressure groups. The four types of PEB entail direct and indirect action at the individual and collective levels (Stern, 2000; Stern et al., 1999). This research study investigated the influence of education, particularly SE and sustainability learning, on all four types of PEB.

2.7 Linking learning outcomes to changes in social-ecological systems

Societal change has regularly occurred in different ways and speeds over time, and diverse models and frameworks offer different perspectives on the dynamic and evolutionary nature of social systems transformation (Blackmore et al., 2011; Reynolds, Blackmore, Ison, Shah, & Wedlock, 2018). Achieving greater sustainability requires both large-scale behavioural and structural change in social systems across all levels of society (Blackmore et al., 2011). Potential transitions to sustainability could be based on reformist (incremental, 'end-of-pipe' solutions), reconfiguration (system change or innovation) or revolutionary positions (systems transformation) (Geels et al., 2015). Sustainability transition (ST) theories identify links between knowledge, learning and societal change (Geels & Schot, 2007) and are considered in this research project.

This doctoral research considers ST theories to analyse the role of HEIs, particularly the development of graduate skills and agency to contribute to sustainability transitions. Graduates can contribute to societal sustainability transitions through any type of PEB identified in the VBN, namely: personal behaviours, environmental support and citizenship, behaviour in organisations, and activism. Sustainability transition theories are discussed in greater detail in Chapter 3.1 (Conceptual framework) and in Study 1 (Chapter 4), with a brief overview of ST included in the following paragraphs.

Sustainability transition theories deal with large-scale transformative change of complex systems that is fundamental, structural, or systemic in nature. Major changes are required to key socio-technical systems that fulfil societal functions (Köhler, Geels, Kern, Onsongo, & Wieczorek, 2017) but which currently contribute to unsustainable production and consumption patterns. Such shifts are known as "sustainability transitions" that necessitate major changes to underlying socio-technical systems and also require wider societal change in values, beliefs and governance (Kemp, Loorbach, & Rotmans, 2007).

Transition studies cover change at the level of sectors, whole-of-society and even systems of service provision and production/consumption. Further, transition studies are

particularly suited to ST as they explicitly cover characteristics that add to the complexity and uncertainty of transitions in socio-technical systems. These characteristics include *multi-dimensionality*, interdependence and non-linear co-evolutionary processes; a *multi-actor process* from a broad spectrum of society entailing many kinds of agency (including learning, sense making, conflict, etc.); a dialectic relationship between *stability and change*; a *long term process* divided into different phases (predevelopment, take-off, acceleration, and stabilisation (Loorbach & Rotmans, 2006); *open-endedness and uncertainty* in pathways and innovation processes; *values, vested interests, contestation and disagreement* among different actors and social groups; and, *the role of public policy* in shaping the directionality of transitions. Sustainability transitions are characterised by rigidity and inflexibility in institutional, infrastructural and practice elements that resist change(Grin, Rotmans, & Schot, 2010), and are sometimes referred to as 'lock-ins'(Darnhofer, 2015).

The main analytical frameworks in the ST field are the *Multi-Phase Concept*, the *Multi-Level Perspective* (MLP), *Technological Innovations Systems* approach (TIS), *Strategic Niche Management* (SNM) and *Transition Management* (TM) (Köhler et al., 2017). Of particular relevance to this doctoral research is that MLP, TIS and TM frameworks all focus on the role of knowledge, learning, and resistance (among others) as influential factors in the transition process (Köhler et al., 2017). As such, ST provide a valuable framework in this study to investigate the contribution of SE in HE to fostering student competence to enact their agency as individuals and as professionals in the societal ST process. Köhler et al. (2017) identify MLP as the most popular transition framework, which focusses on dynamics within and between three analytical levels of the system. These are (micro level) *niches* where radical innovations occur, (meso level) *socio-technical regimes* that represent the institutional structures of existing systems, which lead to incremental change and path dependence, and (macro level) *socio-technical landscapes* that represent exogenous influences on the system. This model of different levels within ST provides an analytical framework to investigate the potential role of individuals and groups (particularly in niches) to accelerate or resist system change.

The field of transition research and MLP in particular, has been criticised for not dealing explicitly with the issue of power, agency and politics, which can stifle innovation and change (see for example Meadowcroft, 2007; Shove & Walker, 2010; Smith & Stirling, 2008; Smith & Stirling, 2010). Researchers responded with a series of

theoretical and empirical studies of power and politics in transitions (see for example Avelino, Grin, Pel, & Jhagroe, 2016; Avelino & Rotmans, 2011; Block & Paredis, 2013), which became a major theme in ST research. Recent research focussed more closely on the role of agency, power and learning in ST research (Beers, Mierlo, & Hoes, 2016; Beers & van Mierlo, 2017; Farla, Markard, Raven, & Coenen, 2012; Hoes, Beers, & van Mierlo, 2016; Sol, Beers, & Wals, 2013).

Blackmore et al. (2011) state that "striving for sustainability involves learning to think and act systemically and knowing how to act and interact effectively and purposefully in situations experienced as complex, messy and changing" (p.54). Sustainability education in HE can contribute to the societal ST process in several ways. Societal effects that facilitate a transition include empowerment, social learning and social capital, which are shown to have synergistic effects and to bridge different levels from individuals to groups, niches and beyond (Schäpke, Omann, Wittmayer, van Steenbergen, & Mock, 2017). Creating and maintaining public support is crucial to holding the transition momentum and preventing backlash (Rotmans & Kemp, 2003) and HE can also contribute public support for ST through SE. Building social capital or capacity for 'transition' has also become a prominent feature in the goals of ESD programmes (Tilbury, 2011a). The process involves civil society, governments and professionals in demonstration projects that illustrate social practices more aligned with sustainable outcomes and which challenge existing unsustainable frameworks and practices (Tilbury, 2011a). However, such transgressive learning in socio-technical transitions does not come about easily because of lock-in mechanisms and tensions. Participants in innovative niches attempt to negotiate and work across ontologies as social learning situations, however such groups may face an "ontological impasse" when inflexible ontologies are coupled with structural power (Chaves, Macintyre, Verschoor, & Wals, 2017). While people do learn more from diverse perspectives, these are only productive if tensions can be overcome. Transformative learning can assist graduates to recognise potential tensions that may arise from social politics/history (O'Donoghue & Lotz-Sisitka, 2002), structural power (Chaves et al., 2017), and inflexible lock-in features of current systems (Loorbach, 2014). Beyond recognition of lock-in features, transgressive learning can play an important role in transitions by disrupting normalized unsustainable habits, if it leads to radical innovations in niches that can be upscaled (Chaves et al., 2017). In this way, TL can develop a graduate's "transformative agency" that focusses on modifying societal systems to become more

sustainable (Loorbach, 2014). Thus, SE in HE can facilitate the development of students' understandings, skills and competencies to enable them to participate directly or indirectly in sustainability change processes.

There is an increasing literature on the importance of learning, power and agency in ST studies. However, there is limited evidence of research linking learning outcomes from SE in HE with the development of skills and PEB that potentially contribute to ST (Blackmore et al., 2011; Krasny, 2009).

This section explicated the links between learning, individual actions and societal transitions towards sustainability and the role HE can play in enabling these dimensions of sustainability. A brief overview of ST theories was provided and connected to SE in HE.

2.8 Research aims

This review of the literature provided a summary update of the field of SE, particularly in the context of HE. Education, including HE, was identified as having an important role in sustainability. Sustainability education in HE was traced from an early focus on learning about the environment and SD intended to influence student attitudes and behaviour, towards a greater focus on developing their competence and agency to participate in societal adaptation and transformation for SD. In parallel, SE in HE shifted from instrumental models towards constructivist models of learning. Links between SE in HE and potential learning outcomes in terms of personal actions and agency for wider societal change were also discussed. The range of intended learning outcomes from SE has widened from knowledge, values and behaviour to include competencies and agency that enable students to participate both individually and collectively in the process of societal sustainability transitions.

The review identified a number of gaps in the literature. The five studies conducted in this doctoral research have worked towards addressing these gaps.

The gaps identified in the literature are as follows:

- Limited published studies on environmental and sustainability dispositions of tertiary international students in Australia

- Absence of studies investigating several aspects of sustainability learning outcomes across a variety of HE settings

- Very few studies investigating accumulated learning for sustainability over time

- No research studies using the LAS to investigate transformative learning outcomes/processes for SE in an Australian HE setting

The specific aims of this doctoral research project were as follows:

1)   To investigate tertiary students' sustainability perspectives in terms of their views, knowledge and behaviour prior to a tertiary education intervention;

2)   To investigate the relationship between sustainability education in the tertiary curriculum and students' sustainability perspectives, and identify the influences that moderate this relationship; and

3)   To investigate tertiary students' experience of transformative learning in sustainability education and identify the conditions that facilitate this type of learning.

The next section provides a discussion of the conceptual framework and methodological approach that guided the research undertaken in this doctoral study to address these specific research aims.

Chapter 3. Exegesis

3.1 Conceptual framework

This PhD research project investigates the contribution of HE to student LfS by examining the influence of SE on students' knowledge, views and attitudes, and the development of their competence and agency for different actions toward the environment and sustainability. The broad conceptual framework guiding the research links elements from several theoretical fields and is a response to calls for more research on links between sustainability learning in HE and learning outcomes in terms of wider socio-ecological changes (Blackmore et al., 2011; Krasny, 2009; Lotz-Sisitka et al., 2015). The conceptual framework links related theories in environmental psychology via Stern's (2000) Value Belief Norm model (focusing on individual environmental behaviour); in education/learning through interpretivism, constructivism and Transformative Learning (TL) via Mezirow's (1997) Perspective Transformation (PT) model (focusing on individual mindset/worldview and actions); and, in Sustainability Transitions (ST) via the Multi-Level Perspective/Transition Management theories (Geels & Schot, 2007; Loorbach & Rotmans, 2006; Rotmans & Kemp, 2003) (focusing on changes in complex socio-technical systems). These theories will be examined in detail in forthcoming sections. Collectively, the three theories guided the research approach that investigated how the current ad hoc implementation of SE in HE (as established in Chapter 2) influences LfS, how learning influences student knowledge, attitudes, behaviour, and competence and how these learning outcomes in turn, contribute to or detract from individual and wider societal transitions to sustainability. In summary, the conceptual synthesis connects the source of learning (HE and other influences), the type of learning outcomes (TL) and the occurrence of sustainability outcomes. The following provides an outline of the three theoretical strands, their combination into a broad conceptual framework, and an explanation of how it has guided this PhD research inquiry into the contribution of SE in HE on sustainability outcomes.

3.1.1 Influences on pro-environmental behaviour

Environmental psychology reveals that environmental behaviours are influenced by a range of personal, situational and contextual factors (Swami, Chamorro-Premuzic, Snelgar, & Furnham, 2011; Turaga, Howarth, & Borsuk, 2010) with multiple

motivations affecting behaviour in any particular setting (Steg & Vlek, 2009). The gap between environmental knowledge/awareness and pro-environmental behaviour is well known and documented and not surprisingly, no definitive answer to this gap has been found (Kollmuss & Agyeman, 2002). A change in attitudes may not necessarily be accompanied by behavioural changes due to a variety of situational and contextual constraints, lack of information, psychological barriers, or lack of skills (Griswold, 2007). Previous studies show environmental attitudes and behaviour are influenced by education and learning experiences (Turaga et al., 2010). Whilst SE in one semester is not expected to shift major environmental behaviours with high behavioural costs, it is conceivable that new student knowledge and altered worldviews or attitudes and personal norms (Klöckner, 2013) might alter minor behaviours such as recycling and energy saving (Raymond, Brown, & Robinson, 2011; Steg, Bolderdijk, Keizer, & Perlaviciute, 2014; Turaga et al., 2010) or progress students' LfS journey. Accordingly, the environmental psychology model adopted in this PhD research, the VBN (discussed in Section 2.6) was chosen for its explanatory power of low-cost/effort (minor) environmental behaviour that may be influenced by SE.

Description of Value-Belief-Norm model

The Value-Belief-Norm (VBN) theory of environmentalism (Stern, 2000) is based on social psychology theory and on evidence from a wide range of studies on the structure of values, beliefs, and attitudes on environmental concern and behaviour. The VBN theory links together personal values, worldview, and norm-activation theory to yield a range of environmental behaviours. In the original VBN theory, the components are linked through a causal chain of five variables that lead to significant environmental behaviours. As shown in Figure 3.1.1, the variables are personal values, the New Environmental (or Ecological) Paradigm (NEP) scale, beliefs about adverse consequences (AC) for valued objects and ascribed responsibility (AR) to reduce the threat, and personal norms for pro-environmental action.
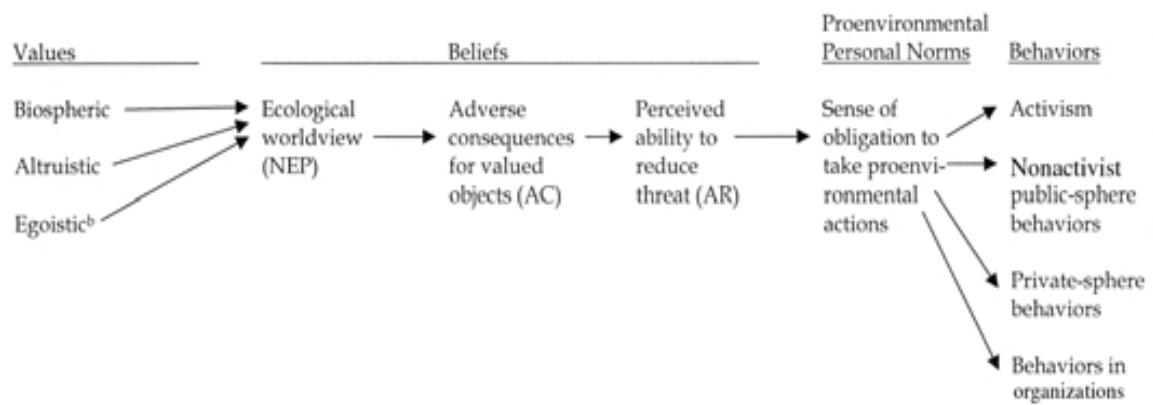
Figure 3.1.1 Original VBN theory of environmental behaviour by Stern (2000)

The three value orientations in VBN are biospheric, which is a concern about nature and the biosphere, altruistic is a concern about the welfare of other humans, and egoistic is a concern for power, achievement, and hedonism. Support for this categorisation of values into biospheric, altruistic and egoistic orientations as determinants of environmental behaviours has been found (De Groot & Steg, 2010; Steg, De Groot, Dreijerink, Abrahamse, & Siero, 2011). The NEP relates to general beliefs about human-nature relations and the NEP scale measures an ecological worldview where human activity and a fragile biosphere are seen as inextricably interconnected (Dunlap et al., 2000). While NEP is often used as a unidimensional construct to measure an ecological paradigm/worldview, the concept is amorphous, and many studies have shown NEP to be multidimensional (Dunlap et al., 2000; Hawcroft & Milfont, 2010). In addition to providing a measure of a person's ecological worldview, NEP also serves as a link between values and personal norms that influences a range of behaviours (Klöckner, 2013). In this PhD research, NEP was used as a single measure and as multiple variables of its component dimensions to identify more nuanced influences on student responses.

In the VBN, the main constructs of the norm-activation theory are awareness of need and awareness of consequences, while personal norms represent one's feelings or sense of moral obligations to take action. Further, the VBN model provides a very strong empirical accounting of all non-activist types of support for environmentalism (as described in Section 2.6) such as environmental citizenship, policy support, purchase and lifestyle behaviours (Stern et al., 1999). Another type of environmentally significant behaviour is influencing organisational actions, which together with Government, are the largest direct sources of environmental problems (Gardner & Stern, 1996). In the

VBN model, Stern (2000) distinguishes between significant environmental behaviour as either "private-sphere" or "public-sphere". Both types of action are required to achieve significant sustainability outcomes in a participative democracy. The full range of environmental behaviours were investigated in this research.

Environmental and sustainability behaviour arises from a complex interplay of causal factors, both general and behaviour-specific (Stern, 2000) and includes a range of personal and social influences (Gifford & Nilsson, 2014) and other situational or contextual factors (Steg & Vlek, 2009). Contextual or situational factors have also been shown to facilitate or constrain environmental behaviour and to influence personal motivations although few studies or theoretical approaches have considered contextual factors explicitly (Steg & Vlek, 2009). Contextual factors are considered in this PhD research project as influences affecting a person's worldview, their perceived ability/competence to reduce the threat (behavioural control) AR, and their choice of behaviour (Steg & Vlek, 2009). Through education, an individual not only gains knowledge about the extent and severity of environmental/sustainability issues, but is exposed to learning experiences that alter their perceptions of what is possible and can build their skills, competence and agency as individuals and professionals, to take private-sphere and public-sphere actions that alter sustainability outcomes.

3.1.2 Transformative Learning and Sustainability Education

The term SE is used to represent the array of philosophical approaches (aims) that focus on holistic sustainability (discussed in Section 2), and the range of teaching praxis (techniques) that seek to build skills, knowledge, and potential agency for sustainability. Sustainability education can be implemented in tertiary curricula in various ways that range from incremental inclusion (infusion) of sustainability topics in particular disciplinary units, to stand alone sustainability units in particular disciplinary programmes, to interdisciplinary units available to students across all disciplines (Ceulemans & De Prins, 2010; Lozano et al., 2015). Holistic sustainability is a complex epistemology (Taylor & Snyder, 2012; Winter, Barton, Allison, & Cotton, 2015) characterised by uncertainty and indeterminacy that can disrupt a person's frames of reference and prompt TL (Lambrechts & Van Petegem, 2016). Implementation of SE initiatives in HE can result in a wide range of learning outcomes in student knowledge/skills, attitudes/views, and behaviours. All types of SE implementation were considered in this research project.

The educational theory adopted in this research is focussed primarily on TL, which can accommodate the full range of potential learning outcomes from SE, consisting of instrumental, communicative, and transformative learning. This PhD research project is a response to calls by scholars for an increased focus on TL in HESD to create a paradigm shift towards a holistic view involving systems thinking (Keynan, Ben-Zvi Assaraf, & Goldman, 2014; Remington-Doucette & Musgrove, 2015; Sterling, 2010a; Wals & Rodela, 2014; Wiek et al., 2011), a stronger ecological orientation (Filho & Mannke, 2009; Kopnina, 2012; O'Sullivan, 1999; Sterling, 2010b) and for "further research to measure the transformation and the impact of education for sustainable development." (Lozano García, Kevany, & Huisingh, 2006, p. 759).

Description of Transformative Learning theory

The theory of TL has evolved rapidly over the last 40 years to become the most recognised theory of adult learning (Taylor, 2017) and Mezirow's theory of Perspective Transformation (PT) is by far the most influential and dominant perspective in the field (Gunnlaugson, 2008). Each person interprets the world based on their perceptions of experience, which create "frames of reference" (meaning structures/perspectives, habits of mind, mind-sets, worldview) that influence their thinking, beliefs, and actions (Mezirow & Associates, 2000). Transformative learning is the process of examining, questioning, and revising those perceptions (Cranton & Taylor, 2012) and "taken-for-granted" frames of reference and learning to "negotiate and act on our own purposes, values, feeling, and meanings rather than those uncritically assimilated from others" (Mezirow, 2000, p. 8).

Mezirow's theoretical framework detailed a 10-phase process for fostering TL in adult education leading to more open, more permeable, and justified meaning perspectives (Mezirow, 1981). The cognitive process of PT is triggered by a disorienting dilemma that challenges an existing frame of reference. Through a process of critical reflection on underlying values and assumptions and constructive discourse (dialogue) with self or others, the person transforms their problematic frame of reference and makes "an informed and reflective decision to act on his or her reflective insight" (Mezirow, 2012, p. 87). Changes in perspective may occur through a series of incremental changes in one's points of view or from a result of a sudden epochal change in worldview, which is arguably a rare event (Taylor, 2017). According to Mezirow (2000), "development in

adulthood may be understood as a learning process..(with transformation of meaning)..as one moves towards a fuller realisation of agency" (p.25)

The theory of TL is conceptualised in the constructivist paradigm, premised on the notion that meaning is constructed from a person's existing knowledge base and perception of the world, and new meaning is actively constructed through inquiry and self-reflection (Bouchard, 2008; Hoover, 1996). Several applications of constructivism are used in this study: Dewey's concept of reflection and education for social transformation (Dewey, 1996; Miettinen, 2000; Saltmarsh, 1996); Freire's (1970) concept of conscientisation and emancipation; and Mezirow's (1996) concept of TL that creates new perspectives, norms, beliefs and frames of reference (Mezirow, 2000). The notion of TL however, is not based simply on rational or affective or intuitive dimensions but an amalgam of each (Hart, 2015). Importantly, this type of learning can occur from a major life event or from several incremental and accumulative events, including education (Griswold, 2007, p. 46). In this study, TL could be reflected as changes in a student's worldview and/or attitudes and/or behaviour.

The theory of TL was chosen for this PhD research due to its alignment with the VBN model, its conceptual congruence with holistic SE, and the range of possible learning outcomes. Specifically, TL and SE entail potential changes in cognitive, conative, and affective dimensions (Mezirow, 2009; Sipos et al., 2008), providing learners with an opportunity to change their mindset, beliefs, and behaviours. While TL and SE are regarded as epistemic learning (Kegan, 2009; Sterling, 2011), both also encompass a wide range of learning outcomes beyond epistemic changes. Hoggan (2016) reviewed TL studies that were conducted during 2003-2014 and offers a typology of TL that encompasses changes across a wide range of domains. Through TL in SE, learners are better able to act autonomously and to deal with the complexity and uncertainty in 'wicked' sustainability issues (Ryan & Cotton, 2013; Sterling, 2011; Wals, 2011). Transformative learning experiences in SE have the potential to lead to an array of changes including beliefs, values, norms, behaviour, competency, and agency, all of which are considered in this conceptual framework.

3.1.3 Learning and agency for Sustainability Transitions

The conceptual framework guiding this study extends up from individuals and organisations to postulate how societal transitions occur, and considers the role of key sectors and institutions such as HEIs to resist or facilitate the transformation. The

inclusion of ST theory in the conceptual framework postulates how actions by individuals may directly and indirectly affect broader societal sustainability outcomes.

Description of Transition Management /Sustainability Transition model

The group of ST theories deal with large-scale transformative change of complex systems that are fundamental, structural, or systemic in nature. Sustainability issues posed by environmental, social, and economic crises are grand challenges that stem from unsustainable functioning of societal systems such as electricity, heat, transport and agro-food. Unsustainable production and consumption patterns in these socio-technical systems cannot be solved incrementally and require a change in systems. Transitions in socio-technical systems also require wider societal change in values, beliefs and governance (Kemp et al., 2007).

Sustainability Transition theories deal with transformation of complex systems, which can be illustrated by an S-curve that represents a non-linear quantum shift from one dynamic equilibrium to another. Transitions occur along phases of the S-curve (pre-development, take-off, acceleration, and stabilisation) as shown in Figure 3.1.2. These are gradual, long-term (25-50 years) processes of system innovation, in which society and its subsystems fundamentally change and reinforce developments in each another (Rotmans & Kemp, 2003). Scholars in the ST field have emphasised the importance of creating and maintaining public support during such long term processes of change to keep the process going and prevent backlash, (Rotmans & Kemp, 2003).
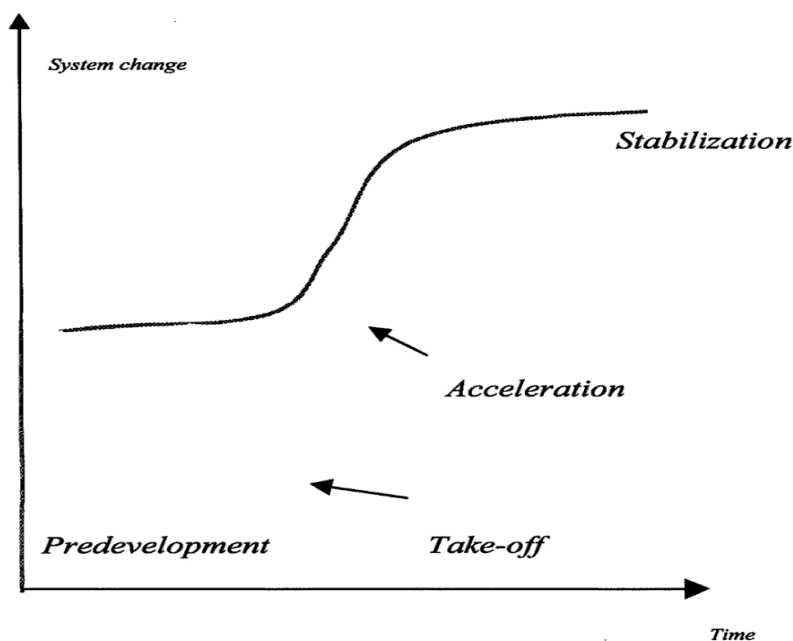

Figure 3.1.2 The different phases of a transition (Rotmans & Kemp, 2003)

Societal systems operate on three levels and transformations emerge from the complex interaction between actors on the three levels. These are the *macro* socio-technical level representing the broader landscape of exogenous factors, the *meso* socio-technical regimes level representing institutional subsystems that lead to incremental changes and path dependence, and *micro* level representing individual niches where radical innovations occur. In transitions research, the focus of analysis is at the 'meso' level of regimes (Geels, 2004), which complements sustainability issues at the 'micro' level (i.e., changing individual attitudes, motivations and choices (Köhler et al., 2017).

The complexity and multi-dimensionality of ST has seen the emergence of several conceptual frameworks, which encompass the broader characteristics of longitudinal, multi-dimensional and multi-actor processes. Of relevance to this PhD research is that key frameworks, namely the *Multi-Level Perspective* (MLP), *Technological Innovations Systems* approach (TIS) and *Transition Management* (TM) all focus on the role of knowledge, learning, and resistance (among others) by actors in the transition process (Köhler et al., 2017). The conceptual framework guiding this PhD research was the Transition Management (TM) model, that was developed by Rotmans and Kemp (2003) as a governance model to manage the transition process. In the TM model, depicted in Figure 3.1.3, ST is influenced by the dynamic integration of a complex set of societal cogwheels (subsystems or domains) that must move synchronously for co-evolution and transformation to occur.
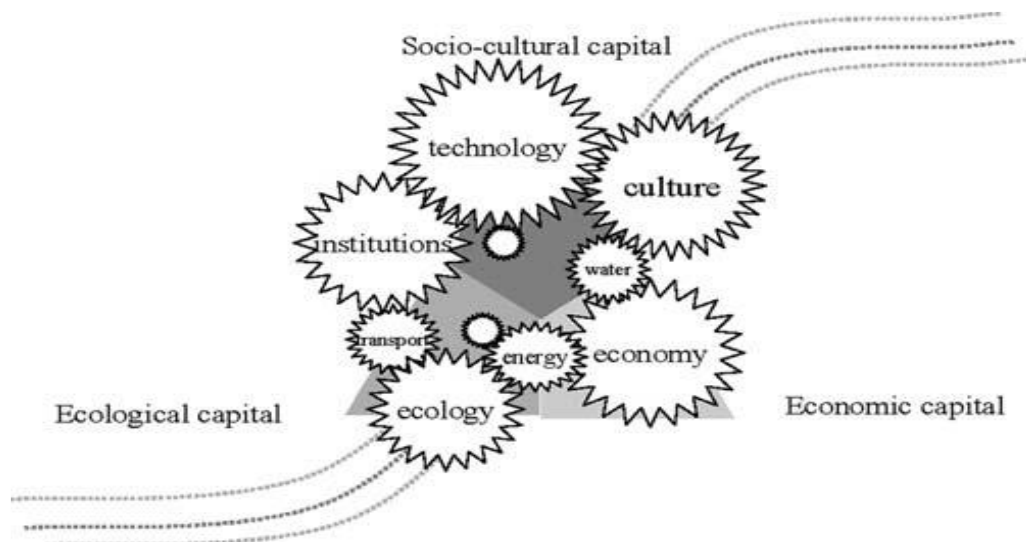

Figure 3.1.3 Transition as a complex set of societal cogwheels (Rotmans & Kemp, 2003)

Key cogwheels (domains) include business, education, government and civic society, media, arts/culture, and physical and institutional infrastructure, all of which require agency and cycles of collaborative (social) learning for change to occur (Loorbach & Rotmans, 2006; Rotmans & Kemp, 2003). Thus, ST of socio-ecological systems draw together notions of complex systems, co-evolution and learning at various scales: at the macro, meso and micro-levels (Stagl, 2007).

The field of ST theories has seen a shift in recent years towards a greater emphasis on agency, learning, and the link between them. Smith, Stirling, and Berkhout (2005) regard agency as the ability to make a difference and exercise political, economic, and institutional power to alter the balance of selection pressures or adaptive capacity of the system. Agency is included in the Multi-Level Perspective (MLP) (Geels, 2010, 2011) and is implied where actors create linkages between processes at different levels that increase structuration of activities in local practices (Geels, 2007). The issue of power, agency and politics has become a major theme in ST research and was explored in a series of theoretical and empirical studies (see for example Avelino et al., 2016; Avelino & Rotmans, 2011; Block & Paredis, 2013). Recent research also focussed more closely on the role of agency, power and learning in ST research (Beers et al., 2016; Beers & van Mierlo, 2017; Farla et al., 2012; Hoes et al., 2016; Sol et al., 2013).

In this PhD research, the contribution of HEIs to ST is considered at two levels: initially, at the broader meso or sectoral level through their institutional influence on societal transformation and subsequently at the narrower micro or individual level through their influence on student learning and action. At the meso level, the role of HEIs in knowledge construction and knowledge transfer renders them a prime sector in societal ST by providing key insights to major sectors (government, industry, NFP/civic, etc.) on barriers and enablers towards sustainability. At the micro level, HEIs create learning conditions and experiences for students to acquire relevant knowledge and develop relevant skills and competencies as well as agency for sustainability. As such, ST theories provide an important framework to consider the contribution of HE to fostering students' competence to enact their agency as individuals and as professionals in the societal transition process.

3.1.4 Broad conceptual framework

The broad conceptual framework guiding this PhD research project is a combination of the three theories outlined above. The framework conceptualises the influence of HE,

learning and other (situational and personal) factors on an individual's mindset and behaviour towards environment/sustainability (VBN), elaborates the learning process and types of learning outcomes from SE (via TL), and situates these outcomes in individual knowledge, behaviour, competency, and agency in terms of contributions to wider societal sustainability (via VBN and ST). An attempted consilience of the three theoretical strands into the broad conceptual framework is illustrated in Figure 3.1.4. While the overall PhD research project was informed by the broad conceptual framework from the outset, certain aspects have been foregrounded in different studies in the PhD.
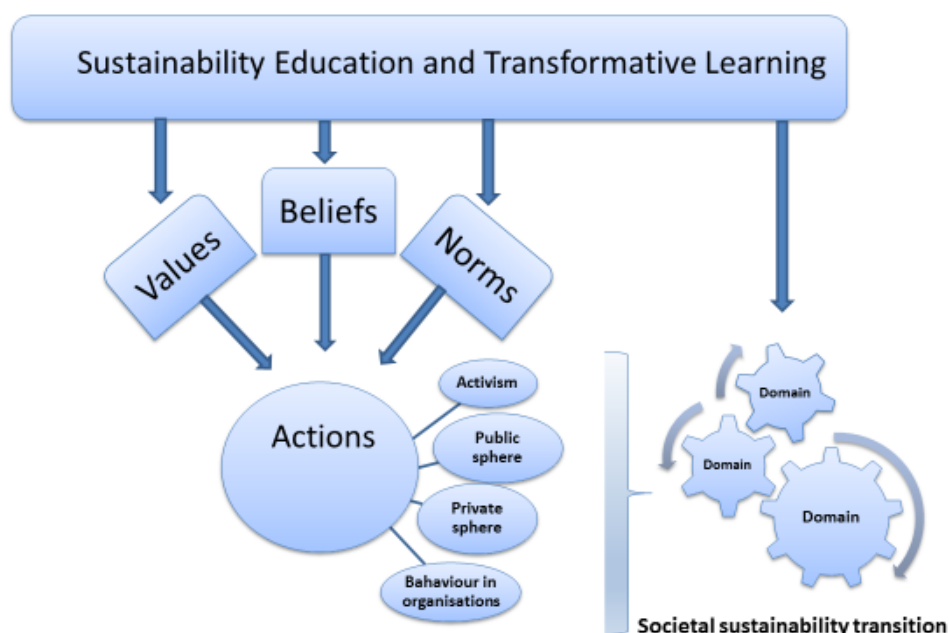

Figure 3.1.4 Broad conceptual framework linking three theories

Higher Education Institutions (HEIs) can contribute to sustainability through their two primary functions of research (knowledge "development") and teaching (knowledge "transfer") and through their consulting, community outreach and campus operations. As demonstrated in Section 2 (literature review), HEIs are expected to provide learning opportunities for students to critically reflect on their own values and assumptions and through research and experiential learning, to develop their competencies and agency to contribute to ST (Trencher et al., 2018). Indeed, international policy documents highlight the role of education in achieving more sustainable outcomes and focus on the development of learners as active citizens with political agency. Agency is a key aim of

SE, and this PhD research sought to contribute to the field by analysing how the development of agency is influenced by student learning experiences in HE, and how student agency might in turn, contribute to ST.

Students in HE are adults and in most advanced economies would be expected to know how Government works and how citizens can play an active role (Chawla & Cushing, 2007) in a participative democracy (Wals, 2010a). One aim of EfS is to foster the development of their democratic action competence for the environment and SD (Öhman, 2007). This includes a wide range of personal-sphere and public-sphere behaviours to enhance environmental and sustainability outcomes. As discussed in Section 2.6, Stern et al. (1999) categorised environmental behaviours into 4 groups, namely personal or private-sphere behaviour change, passive acceptance of public policies, low-commitment active citizenship and committed public activism. Drawing on evidence from a range of empirical studies, Stern (2000) posits that environmentally significant behaviour is influenced by four main types of factors: attitudinal factors (including norms, beliefs, and values), external or contextual forces (including social/cultural, economic/financial, physical/environmental, technological, and legal conditions), personal capabilities (including knowledge and skills, available time, resources, social status, perceived power, etc.) and habit or routine. The broad conceptual framework adopted in this study captures all four factors posited by Stern (2000) to influence PEB, the influence of SE on a range of learning outcomes (particularly TL) including competence development and the four types of private-sphere and public-sphere behaviours/actions that contribute to or detract from ST.

The three theories related to VBN, TL and ST are united by the common conceptual elements of learning, resistance, synergy/connection, and action/agency that provide insights into how SE in HE contributes to students' knowledge, attitudes, and behaviour towards sustainability. In TL theory, learning can manifest as instrumental, communicative, and TL or even as resistance; in the VBN model, learning can result in a change in values, beliefs, norms and behaviours; and in TM theory, learning features on multiple scales and includes individual learning, collaborative/social learning and organisational learning (Stagl, 2007). Resistance is evident in all 3 theories and can block or even reverse progress towards sustainability/transformation. Connection/synergy serves as a catalyst for change in all 3 theories. In TL theory, synergy is evident between aspects of a person's lifeworld, between instrumental and

communicative learning, between types of knowledge and between cognitive, affective, and conative outcomes. In the VBN model, the synergistic effect of values, beliefs, norms, and situational/contextual factors can inhibit or promote action. In TM theory, transformation is contingent on the connection/synergy between actors/agents in niches, between sectors/domains and between levels in the societal system. Finally, agency is a fundamental element in all 3 theories and is reflected in different levels of action. Agency may be an outcome of TL, is reflected in behaviour in the VBN and is a key input to TM. In summary, the broader conceptual framework connects common conceptual elements across related literatures in education (how people learn), attitude-behaviour relationships (how people act) and sustainability transitions (how society and socio-technical systems change).

By linking together the three theoretical fields of learning, personal behaviour change and societal change, the study sought to investigate how SE in HE contributes to individual and wider societal change towards sustainability. All three theoretical fields were brought together in the first paper (Study 1), which provided a review of the literature on environmental behaviour, types of learning and social change. The paper provided some discussion of how the three areas were related in terms of the influence of HE (particularly SE) on individual and organisational behaviour and in turn, on societal change towards sustainability. Studies 2-4 were guided by the VBN theory to investigate students existing worldviews and attitudes and the influence of demographic, situational and educational factors, particularly the role of SE in HE. Study 5 was guided by the TL theory to investigate the learning process and outcomes for students undertaking dedicated interdisciplinary SE units in HE. Beyond the learning process, Study 5 was guided by VBN and ST theories to investigate how specific learning outcomes were translated into personal behavioural changes, the emergence of agency and the development of particular competencies for sustainability.

The combination of the three theories in the conceptual framework proved useful to the design of studies and to the interpretation of results regarding the efficacy of SE in HE to contribute to personal change and to wider societal change to sustainability. The three theories considered as a single framework adds value to SE in this way.

3.2 Methodological framework

This section describes the epistemological stance guiding the overall PhD research, the methods/tools of data collection and analysis, methodological development/evolution between the studies, and ethical approvals for each stage.

3.2.1 Research Design

Epistemologies adopted in EE/ESD range from factual to interpretive. Accordingly, a wide range of research methodologies and techniques are used including 'empirical-analytic' investigations, interpretive case studies, participative action research and critical analyses and reinterpretations (Gough, 2014). Sustainability has varied and multiple meanings, so this PhD research project adopts an interpretive paradigm with a constructivist approach (Creswell, Hanson, Clark Plano, & Morales, 2007). An interpretivist approach was chosen as the research seeks to understand motives and actions, which requires a focus on interpretation, social context and local circumstance (Hughes & Sharrock, 1997). Constructivism is related to adult learning in HE, where new meaning is contextualised within a learner's existing knowledge and experience.

A mixed methods approach was adopted within and across the three stages of the PhD research project to provide useful insights (Johnson & Onwuegbuzie, 2004) and to cross-validate the study findings (Steckler, McLeroy, Goodman, Bird, & McCormick, 1992). This methodology is consistent with the chosen epistemological stance of Interpretivism and Constructivism, as qualitative findings provide insights and contextual perspective to better understand and interpret quantitative findings. In stages 1 and 2, pre-post surveys were used while stage 3 was based only on a post-test survey. Surveys in all stages consisted of open and closed questions (i.e., concurrent mixed methods) to triangulate the findings and provide further insights into students' experience of LfS.

The following is a description of the research design, data sources and analysis for each stage of this PhD research project.

Stage 1 – Initial Literature Review and Learning for Sustainability Studies

Research in Stage 1 was undertaken as three studies and reported in separate publications. These consisted of secondary research for the initial literature review and primary research for a Pilot EfS study and Case study investigating students and academics' knowledge, views, attitudes, and behaviours towards sustainability. The

primary research was conducted at one HEI (at CQUniversity) for which ethical approval was obtained.

The initial literature review study (Study 1, Chapter 4) drew on secondary data and combined various theoretical streams that included conceptions of sustainability, learning and pedagogy for sustainability, business education, psychology, and social psychology of environmental behaviour, organisational change/learning and change in complex systems (Sidiropoulos, 2011).

The Pilot EfS study (Study 2, Chapter 5) investigated and compared different types of SE interventions on international tertiary students' environmental and sustainability attitudes and knowledge (Sidiropoulos et al., 2013). It was an empirical two-stage, action research study conducted at two campuses of CQUniversity. The sample consisted of international students enrolled in undergraduate or postgraduate programmes or ESL courses and comprised several thousand students with a total of 267 completed responses. The types of sustainability interventions consisted of course-specific introductory sustainability seminars, courses with sustainability elements already embedded in course curricula, and courses with no elements of sustainability. The influence of these interventions on student environmental and sustainability attitudes and knowledge was assessed using a short pre-post survey based on a validated scale, the NEP, and several open questions. For a full description of instruments and the survey used in this study, see Paper 2 (Chapter 5). The NEP scale was chosen as it is the most widely used measure (Dunlap, 2008) of an individual's value-based environmental worldview/attitudes along a spectrum from anthropocentric to ecocentric perspectives. Anthropocentric concerns focus on the utilitarian value of nature for maintaining and enhancing the quality of life for humans while ecocentric concerns centre on the intrinsic value of plants and animals (Schultz, Zelezny, & Dalrymple, 2000). Survey data was analysed quantitatively and qualitatively (open ended responses) to explore students' initial sustainability perceptions and to evaluate changes over time. Quantitative data was analysed using SPSS and included descriptive and inferential statistics such as t-tests, analysis of variance (ANOVA), Cronbach's alpha, and Chi square tests.

The case study (Study 3, Chapter 6) extended the findings from the pilot study to include students' sustainability behaviour and longer-term impacts from SE after 12-18 months (Sidiropoulos, 2014). This case study is a detailed account of the researcher's

own EfS praxis in tertiary business education over an 8-year period (2005-2013) and reports the influence of these SE interventions on tertiary students' sustainability views, conceptions, and behaviour over this time. The sample consisted of several thousand international and domestic students enrolled in business units taught or coordinated by the researcher at CQUniversity. Research data was a synthesis of empirical results from surveys in Study 2 (pilot study), course feedback and class discussions as well as initial survey results from Study 4 (multi-university study).

Stage 2 – Learning for Sustainability in a Multi University Context

Findings from Stage 1 informed the research approach in Stage 2, in which a large multi-university, multi-country EfS research study was conducted to extend the analysis from the pilot study and case study, and to provide a larger and richer sample for generalisation of results (Sidiropoulos, 2018). The study investigated the influence of sustainability curricular interventions across a wider variety of disciplinary, institutional, and geographical settings. The aim was to examine the coherence of students' sustainability dispositions before and after intervention and to identify the influence of SE in the curriculum.

Research in Stage 2 was also based on the VBN theory of environmentalism (Stern, 2000). The constructs of environmental worldviews were measured by the Inclusion of Nature in Self scale (INS) and beliefs were measured by the NEP scale. The INS scale is a measure of the perceived relationship between cognitive representation of self and nature (Schultz, 2001). Both scales are reliable and validated instruments commonly used in research studies in environmental psychology and education (Harraway et al., 2012; Hawcroft & Milfont, 2010). Student attitudes were also measured by the Hierarchy With Nature (HWN) scale developed by the researcher. For a full description of instruments used in this study, see Paper 4 (Chapter 7). The VBN model was chosen as it indicates possible points of intervention by tertiary education and allows investigation of the campus as a living laboratory for formal and informal learning about sustainability. The intention was to allow a holistic examination of tertiary students' dispositions and behaviour towards the environment and sustainability, and to assess the influence of SE, including the possibility of deep or transformative LfS. The survey instrument was developed by a consensus of staff at various participating universities who considered the concepts and scales to be consistent with the intended research.

Empirical data was collected using an online two-stage survey to provide easier and cheaper access to a larger sample size across diverse locations (Steckler et al., 1992). Data on student knowledge, views, attitudes, and behaviour towards sustainability was collected with pre-post surveys in each term/semester during 2013-15. A quasi-experimental design was adopted to collect data from EfS participants and non-EfS participants (Steckler et al., 1992) with convenience sampling used to provide a wide representation of courses, disciplines and locations. In total, several thousand students enrolled in 9 HEIs located in Australia, Malaysia and Italy participated in the study, providing a total of 1,422 completed responses. Courses were nominated in a range of disciplines (engineering, architecture, business, sports medicine, health, biological sciences, education, etc.), across modes of study (on-campus, distance education and mixed mode), locations, countries, and types of SE interventions that allowed the collection of a larger, richer dataset. Full copies of the pre-post surveys used for the EfS and control groups are provided in Appendix A1 and Appendix A2 respectively.

The dataset was analysed using SPSS and included descriptive and inferential statistics such as t-tests, ANOVA, analysis of covariance (ANCOVA), and Cronbach's alpha as well as non-parametric tests and partial correlations. Statistical tests were conducted to identify the types of student LfS (e.g., incremental, or transformative), the incidence of learning across the cognitive and affective learning domains, and the moderating influences of personal, situational, and contextual factors on these learning outcomes. The SPSS analysis addressed research aims 1 and 2 by focussing on cross sectional and longitudinal data analysis respectively. Cross sectional data analysis investigated differences in student dispositions at one point in time through individuals' scores for various aspects of sustainability orientations: attitudinal scales such as NEP (and component items) and INS; 10 items for self-reported behaviour; and measures of perceived importance of sustainability. The analysis also explored the relationship between each of these aspects with the potential influence of gender, age, mode of study, level of study, discipline of study and institution, country of study, home country and group (EfS or control). Longitudinal data analysis used matched responses to investigate changes in student dispositions over the term. These included changes in individual students' pre and post scores for various aspects of sustainability orientations (as above) during their SE experience and investigated the relationship between each of these aspects and the various moderating factors (as above). Qualitative analysis entailed the interpretation of various opened ended responses.

Stage 3 – Transformative Learning in Sustainability Education units

The third stage was informed by findings from the multi-university study, which showed that several "intervention" courses/disciplines in Stage 2 were associated with significant cognitive shifts in student perceptions/attitudes towards sustainability. Research in Stage 3 investigated how exposure to SE units contributed to TL and identified factors that moderate this type of learning. The third stage also adopted a concurrent mixed methods approach to achieve triangulation of emergent themes (King, 2002).

Convenience sampling was used for two selected SE courses in Stage 3. Participating institutions in Stage 3 were University of Southern Queensland (USQ) (which were the same units as Stage 2), CQUniversity, Macquarie University (MQU) and La Trobe University (LTU). However, only data collected from USQ and LTU during Term 1 in 2017 was sufficiently representative for analysis. The USQ unit (environmental science) and the TLU unit (business for sustainability) were both stand-alone, dedicated SE units that were widely available across their institutions. Students enrolled in these units (both on-campus and by distance education) had access to their university's course websites where the Unit Co-ordinators introduced the research study and invited all students to participate voluntarily by following a weblink to the online survey. When students clicked the weblink, they were directed to a protected online website (Survey Monkey) and provided with an information sheet that explained how the research was conducted. Students were advised that all information was collected anonymously and treated in strict confidence. The information sheet also emphasised the voluntary nature of student participation in the study and their ability to withdraw at any time. If they agreed, they simply clicked and entered the survey itself. Both Unit Co-ordinators were blind as to which students participated in the study and did not have access to any information that could be used to contact or identify individual respondents. Participants completed a post-test online survey, using an abridged version of the stage 2 survey. Approximately 1000 students enrolled in undergraduate sustainability units at LTU and USQ in Australia were invited to participate in the study, which yielded 301 completed responses. The survey was completed at the end of term/semester and covered sustainability worldviews, knowledge and behaviour, cognitive shifts in attitudes and learning and included the Learning Activities Survey (LAS), which is a validated instrument for assessing TL made up of 14 questions (King, 2009). For a full

description of instruments used in this study, see Paper 5 (Chapter 8). Full copies of the surveys used at LTU and USQ are provided in Appendix B.

Data was analysed quantitatively and qualitatively to evaluate changes in student sustainability dispositions and to assess the incidence and extent of TL. Quantitative data analysis with SPSS included descriptive and inferential statistics such as t-tests, ANOVA and Cronbach's alpha, particularly for respondent's LAS score of TL, as well as non-parametric tests and partial correlations. Qualitative data analysis of open-ended questions provided deeper insights to complement findings from quantitative analysis. The aim was to identify the incidence of TL as indicated by students' cognitive shifts in attitudes, and other affective and conative learning outcomes indicated by the Learning Activities Survey (King, 2009) that had been augmented with supplementary questions. Both types of analysis addressed research aim 3

3.2.2 Methodological Development

This section focusses on methodological development during the overall PhD research project in terms of minor amendments to data collection and analysis processes in Stages 2 and 3. As an evolutionary progression of enquiry, the research approach was informed by learning from earlier stages, and methods were adapted accordingly from one study to the next. Findings that emerged from the pilot study and case study situated in one institutional context in Stage 1, led to a wider quasi-experimental study to generalise the findings of SE versus regular education in Stage 2, and finally to a narrower explanatory study to investigate TL outcomes from dedicated SE units in Stage 3. For example, earlier studies found that while there was a 'no change' result for NEP scores following SE, certain NEP elements did respond to SE as per Jowett et al. (2013) and Teisl et al. (2011) and these were investigated further in subsequent studies in this thesis.

In the multi-university study (Study 4), pre-post survey data was collected over 5 separate terms/semesters during which time the research instrument was modified slightly. For example, demographic questions were initially positioned at the beginning of the survey. However, many students exited the survey immediately after completing these questions, which yielded null responses. To ensure salient information was captured from participants, demographic questions were repositioned to the end of the survey, and more prizes were offered as inducements to encourage survey completions.

The TL study (Study 5) commenced in 2016 but extremely low response rates meant that meaningful and representative samples were unable to be collected from any of the three participating universities (USQ in Term 1, MQU in Term 2, and CQUniversity in Term 3). In 2017, the researcher developed closer working relationships with unit coordinators at USQ and LTU to ensure there was a stronger connection between the research survey and student reflection and learning in their SE courses. At LTU, educators provided adequate time and opportunity in tutorial classes for students to reflect on their learning experience during the term and to complete the on-line survey, which significantly boosted response rates compared to the previous year. More prizes were also offered to encourage student participation in the survey.

In parallel with the functional elements of methodology were the stages of progressive publication of individual studies, which had implications for the methodology. The publication process provided invaluable feedback from external journal reviewers around the world, who were experts in the field and afforded broader perspectives beyond the supervisory team (Merga, 2015). Challenges posed by the reviewers and their in-depth critique contributed to the scholarly research and editing of papers, which often entailed further data analysis that altered the scope and depth of journal articles. Reviewers' feedback added substantial value whether articles were accepted subject to major changes or were required to be revised and resubmitted. The final thesis product benefitted from journal reviewers' expertise that improved the research outcomes.

3.2.3 Ethics Approval

Stage 1 – Initial Literature Review and Learning for Sustainability Studies

Ethical approval was obtained from CQUniversity for all research conducted in Stage 1, including research with students and teachers in the pilot and case studies. Letters from co-authors of one joint publication in Stage 1 are provided for Study 2 in Chapter5.

Stage 2 – Learning for Sustainability in a Multi University Context

Ethical approval for data collection was obtained from the host institution CQUniversity, with reciprocal approval granted by all participating universities for the period of data collection and for the use of data for publication in research reports, conferences, and other publications. Data was collected centrally to maintain data integrity. All other members of the research team at CQUniversity withdrew their interest in sole or joint authorship of publications and CQUniversity granted the

researcher a non-exclusive, worldwide licence to use, copy and reproduce the data for this PhD research.

Stage 3 – Transformative Learning in Sustainability Education units

Research was conducted in accordance with the Australian Code for the Responsible Conduct of Research (Code) (NHMRC, ARC, & UA, 2007), the National Statement of Ethical Conduct in Human Research (National Statement) (NHMRC et al., 2007) and Victoria University (VU) policies. Ethical approval was obtained from VU and all participating institutions. Conduct of research with humans could potentially create physical and psychological harm (Johnson & Christensen, 2012) however ,this research was regarded as "low risk" as all subjects were aged over 18 years and there was minimum risk of harm other than inconvenience. The researcher remained conscious of the ethical issue of the power imbalance between students and educator/institution and the potential for students to feel coerced into participating in the research and/or giving the 'right' answer (Fernandes & Randall, 1992). Therefore, all communication with students emphasised the voluntary nature of the project and students were provided full information to exercise their informed consent: a central principle of the regulations governing social research (Howe & Moses, 1999, p. 24).

3.3 Publications framework

3.3.1 Outline of the research

The thesis is based on research conducted in five studies reported in journal articles either published or under review (see List of Publications). The thesis consists of nine chapters with Chapters 4 to 9 representing one study each, as shown in Figure 3.3.1. Chapters 4 to 8 are presented as publications and Chapter 9 is a journal manuscript. The research design was an evolutionary and emerging progression of inquiry that investigates the contribution of tertiary education to students' LfS, specifically as shifts in their cognition and behaviour towards sustainability. It represents the researcher's personal journey through an initial literature review, a pilot study, a case study, a multi-university study and a transformative learning study that reveals the potential of TL theory to provide unique insights into adult learners' experiences with SE. This section provides an outline of each study and connections between the studies.
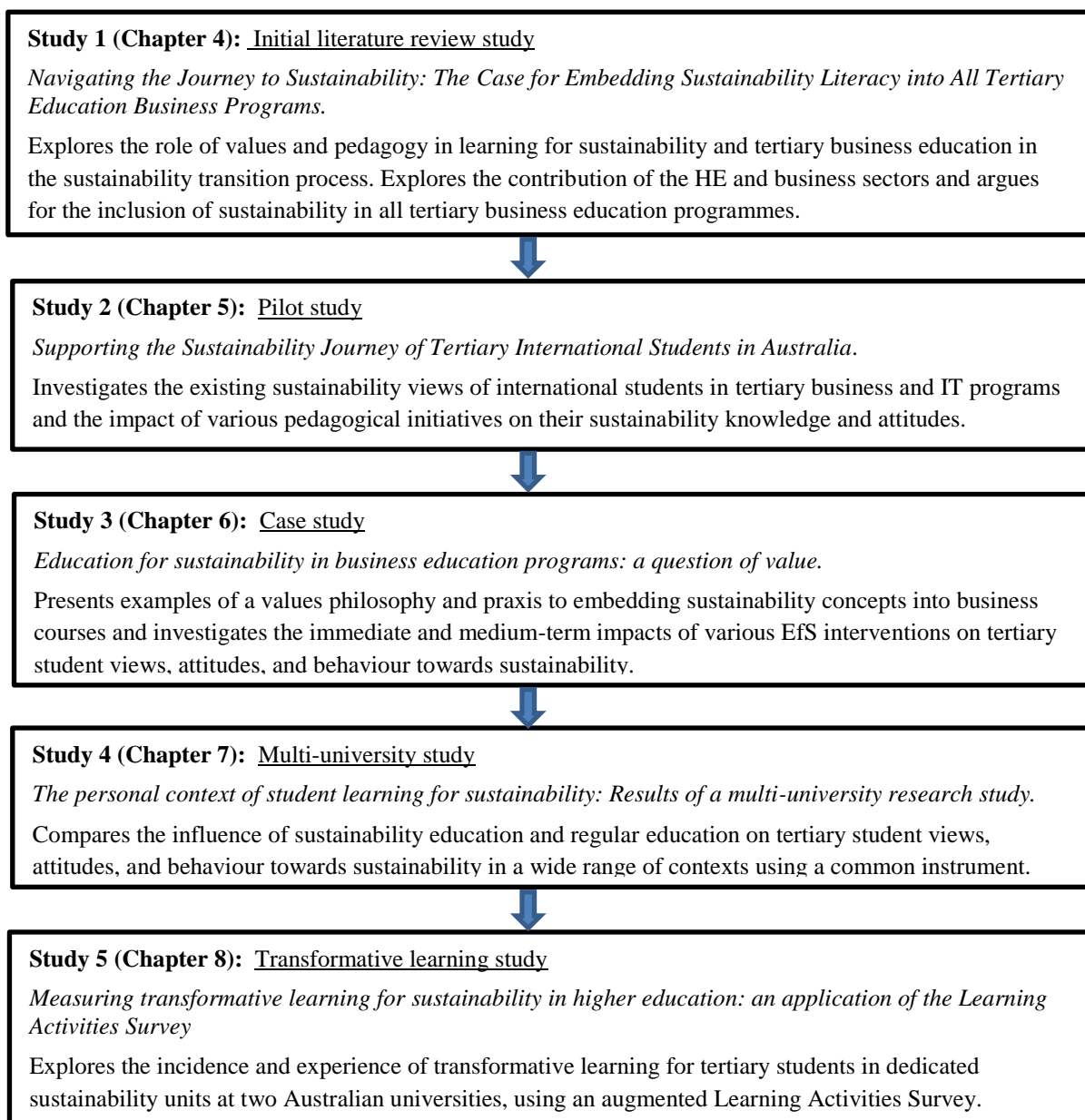
Study 1 (Chapter 4): Initial literature review study

Navigating the Journey to Sustainability: The Case for Embedding Sustainability Literacy into All Tertiary Education Business Programs.

Explores the role of values and pedagogy in learning for sustainability and tertiary business education in the sustainability transition process. Explores the contribution of the HE and business sectors and argues for the inclusion of sustainability in all tertiary business education programmes.

Study 2 (Chapter 5): Pilot study

Supporting the Sustainability Journey of Tertiary International Students in Australia.

Investigates the existing sustainability views of international students in tertiary business and IT programs and the impact of various pedagogical initiatives on their sustainability knowledge and attitudes.

Study 3 (Chapter 6): Case study

Education for sustainability in business education programs: a question of value.

Presents examples of a values philosophy and praxis to embedding sustainability concepts into business courses and investigates the immediate and medium-term impacts of various EfS interventions on tertiary student views, attitudes, and behaviour towards sustainability.

Study 4 (Chapter 7): Multi-university study

The personal context of student learning for sustainability: Results of a multi-university research study.

Compares the influence of sustainability education and regular education on tertiary student views, attitudes, and behaviour towards sustainability in a wide range of contexts using a common instrument.

Study 5 (Chapter 8): Transformative learning study

Measuring transformative learning for sustainability in higher education: an application of the Learning Activities Survey

Explores the incidence and experience of transformative learning for tertiary students in dedicated sustainability units at two Australian universities, using an augmented Learning Activities Survey.

Figure 3.3.1 Research conducted in this thesis

3.3.2 Study One – initial literature review study

Study One is an initial literature review that aimed to provide a broad perspective on the influence of HE on student LfS in the context of personal and societal change. The study investigated key conceptions of sustainability, different types of learning and pedagogical approaches as well as an exploration of the role and progress of personal and cultural values for sustainability around the world. Additional aims of the study were to describe how complex societal systems transform, discuss the role and progress of the business sector and HEIs, particularly tertiary business schools in facilitating the ST process. The study linked disparate fields in psychology, social psychology, education/learning and societal transformation to connect the field of adult LfS in HE

with individual transformation and social change. In particular, the study linked the role of tertiary business education in fostering individual LfS and agency to facilitate societal transformation. The study was limited in scope to the business sector and to business education programmes as these were in the researcher's field of interest. The study recommended that SE be embedded in all business education programmes and educators were advised to identify and locate their students' current knowledge and perspectives to scaffold student LfS. These recommendations were adopted in all subsequent studies conducted in this PhD research project, which are empirical investigations of key influences on students' sustainability perspectives and the influence of tertiary education. The four subsequent papers in this thesis aimed to provide empirical information on tertiary students' sustainability perspectives in terms of their views, knowledge, attitudes and behaviour towards sustainability and to compare the effects of "regular education" and "sustainability education" in a variety of settings and over time.

3.3.3 Study Two and Three – situated pilot study and case study

Studies Two and Three were informed directly by the findings from Study One, which were presented to staff at CQUniversity, where the researcher was employed as an academic. Both Studies Two and Three were situated in the same university. Study Two aimed to explore the nature of existing sustainability views, knowledge and attitudes of international students in ESL courses and in tertiary business and IT programmes; and to compare the impact of regular versus SE and between types of SE pedagogical initiatives on these aspects of students' sustainability perspectives. The study was conducted at two campuses over two semesters in 2011.

Study Three is a case study describing the researcher's pedagogical approach to SE in various business courses and demonstrates the use of values as a lever to include SE in the curriculum. Another aim was to investigate the influence of escalating educational interventions on students' sustainability perspectives. The study expanded the scope of inquiry from Study Two to include students' environmental/sustainability behaviour and any changes to their attitudes and behaviour after an extended time of 6, 12 and 18 months after their exposure to SE. This was the first study in the thesis to demonstrate the cumulative effect of SE repetition on students' sustainability perceptions and the persistence of these effects on individual behaviour. However, the limited scope and small sample sizes restricted generalizability of findings.

3.3.4 Study Four – multi-university study

The main aims of Study Four were to substantially increase the sample size and expand the scope of inquiry to explore the sustainability perspectives of tertiary students in various disciplines and levels of study in Australia, Italy and Malaysia. The scope was broadened to investigate students' prior knowledge, their perceptions of the importance of sustainability and graduate skills required, as well as their awareness of campus sustainability activities. Results indicated students were influenced by a wide variety of factors in their studies (both regular and SE) and by other aspects of their lifeworld, with comparatively stronger effects of SE on their cognitive perceptions and attitudes towards sustainability as well as a heightened ecological view and a closer connection to nature. The study provided useful insights into the diverse but evolving nature of students' sustainability views and attitudes, and the comparative influence of SE versus regular education in the current ad hoc approach to SE in HEIs in several countries.

3.3.5 Study Five – transformative learning study

The fifth and final study was informed by findings from Study Four and narrowed the focus of inquiry to explore the TL potential of dedicated sustainability units at two universities in Australia. The introductory SE units were compulsory for most participants with units also selected as electives. The study provided insights into factors that contributed to changes in students' worldviews, attitudes and behaviour as well as the development of their skills for systems/complex thinking, team work/collaboration and various types of advocacy for sustainability.

In summary, the four empirical studies were complementary as each focused on different aspects of the principal research aims guiding the overall PhD research project. These studies provided varying depth and breadth of different aspects of students' sustainability perceptions and changes therein from their exposure to various educational interventions. Further, the studies attended to participants situated in a variety of settings to assess students' initial sustainability perceptions and the influence of regular tertiary education and SE over time.

This chapter provided information about and connection between the five studies conducted as part of this thesis and justification for the conceptual framework, research design, sampling frame and instruments used. These five studies are now presented as published papers and as a submitted manuscript in Chapters 4 through to 8.

Chapter 4: Study One

4.1 Paper (Initial literature review study)

Chapter 5: Study Two

5.1 Paper (Pilot study)

Declarations by Co-Authors

GRADUATE RESEARCH CENTRE

DECLARATION OF CO-AUTHORSHIP AND CO-CONTRIBUTION: PAPERS INCORPORATED IN THESIS BY PUBLICATION

This declaration is to be completed for each conjointly authored publication and placed at the beginning of the thesis chapter in which the publication appears.

1. PUBLICATION DETAILS (to be completed by the candidate)

Title of Paper/Journal/Book:

Surname: First name:

College: Candidate's Contribution (%):

Status:

Accepted and in press: Date:

Published: Date:

2. CANDIDATE DECLARATION

I declare that the publication above meets the requirements to be included in the thesis as outlined in the HDR Policy and related Procedures – policy.vu.edu.au.

Signature   **Date**

3. CO-AUTHOR(S) DECLARATION

In the case of the above publication, the following authors contributed to the work as follows:

The undersigned certify that:

1. They meet criteria for authorship in that they have participated in the conception, execution or interpretation of at least that part of the publication in their field of expertise;

2. They take public responsibility for their part of the publication, except for the responsible author who accepts overall responsibility for the publication;

3. There are no other authors of the publication according to these criteria;

4. Potential conflicts of interest have been disclosed to a) granting bodies, b) the editor or publisher of journals or other publications, and c) the head of the responsible academic unit; and

5. The original data will be held for at least five years from the date indicated below and is stored at the following **location**(s):

Name(s) of Co-Author(s)	Contribution (%)	Nature of Contribution	Signature	Date

1 April 2016

To whom it may concern,

I have been requested to document my contribution to the following paper, of which I was co-author : Sidiropolous, L., Wex, I., Sibley, J. (2013). *Navigating the sustainability journey of tertiary international students in Australia.* Australian Journal of Environmental Education, Issue 1, Volume 29.

Liz Sidiropolous was the principal author of the paper and her contribution constituted approximately 45%. Liz provided the theoretical framework and survey instruments and was responsible for most of the qualitative analysis and interpretation of results. Liz further completed the literature review, the conclusion and the recommendations.

My contribution to the paper constituted approximately 35%. I organised and conducted the on-campus surveys at the Sydney Campus of CQUniversity, analysed the data and assisted in the interpretation and analysis of results.

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1 April 2016

To whom it may concern,

I have been asked to document my contribution to the following paper: Sidiropoulos, L., Wex, I., Sibley, J. (2013). *Navigating the sustainability journey of tertiary international students in Australia*. Australian Journal of Environmental Education, Issue 1, Volume 29

The principal author of the paper was Sidiropolous. My contribution was the analysis of previously collected survey data and the reporting of findings. I undertook the following tasks:

- Formatting the datasets to create an integrated dataset for analysis
- Statistical analysis (descriptive and predictive)
- Write up of the statistical analysis, including tables and charts (as appropriate).
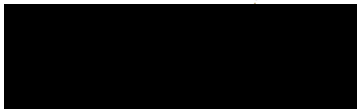
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Supporting the Sustainability Journey of Tertiary International Students in Australia by L. Sidiropoulos, I. Wex, J. Sibley was published in the peer review journal, *Australian Journal of Environmental Education, 29/1, 52-79, 2013.*

It is available from: https://doi.org/10.1017/aee.2013.15

Chapter 6: Study Three

6.1 Paper (Case study of sustainability infused curriculum)
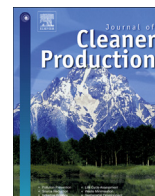
Education for sustainability in business education programs: a question of value

CrossMark

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ABSTRACT

This paper posits that sustainability is essentially a question of value, a notion that is situated within the context of an individual, organisational and community perspective. Each person or group interprets sustainability through their own value lens, so messages promoting sustainability need to be positioned according to the receptivity (value driver) of the audience. Individual and social values around the world are reviewed both theoretically and empirically and the case is made to integrate sustainability concepts into all tertiary education business programs. The focus of this paper is on Education for Sustainability (EfS) in tertiary business programs for mixed student cohorts. The author outlines a particular pedagogical philosophy and praxis using values to incorporate sustainability concepts into business courses taught to international and domestic students. Practical examples are provided for courses in Economics and Marketing at diploma, undergraduate, and postgraduate levels, during the period 2005–2013. These demonstrate a variety of possibilities to integrate discussion of values for sustainability such as cleaner production and consumption as well as social equity into the curriculum, depending on the teacher's influence on curriculum content and assessment. Educational practices range from incremental integration (such as class discussion of curriculum topics) to course-specific introductory sustainability seminars to deeper integration of sustainability into course curriculum and assessment. Student feedback indicating the impact of these escalating interventions on their views, attitudes and behaviour towards sustainability is also discussed. Finally, the paper concludes with suggested pedagogies for educators to navigate their students learning journey.

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1. Introduction

Human values are an important driver of their behaviour. Meglino and Ravlin (1998) suggest that "values have been considered as needs, personality types, motivations, goals, utilities, attitudes, interests, and nonexistent mental entities." Values can be regarded as the principles that dictate what's important to us as individuals (Caprara et al., 2006; Dietz et al., 2005; Hemingway, 2005), families (Moore and Asay, 2008), companies (Alas et al., 2006; Argandona, 2003), society (Gowdy, 1997; Kilbourne et al., 2002), and how we choose to use our resources (Brown, 1984; Wals and Jickling, 2002). We attach value and dedicate resources to whatever creates benefits for ourselves or for other valued persons or things (Stern, 2000) and generally do not value those things that create benefits for non-valued others or the natural environment, least of all if they come at some irrecoverable cost to us. Value

also represents the use of our resources: we define it, create it, measure it, brand it, trade it, accrete it and store it. That is the role of business and the purpose of tertiary business education programs is to provide individuals with knowledge and skills to achieve this efficiently and legally. In doing so, educators can also build graduates capabilities to conduct business ethically and to select options that contribute towards long-term sustainability.

A variety of definitions and measures of sustainability exist (Glavic and Lukman, 2007; Lozano, 2008) and these appear to vary depending on the values of the individual, organisation and community. The terms sustainability and Sustainable Development (SD) are technically different with SD viewed as the journey or process to achieving sustainability (Lozano, 2008). Sustainability interpretations include Triple Bottom Line (TBL) reporting (Elkington, 1997), Corporate Social Responsibility (CSR), the Brundtland Definition of SD (WCED, 1987), The Natural Step (Robért, 2002), Natural Capitalism (Lovins et al., 1999), etc., each with varying degrees of adoption and acceptance. The most popular is the Brundtland Commission definition of SD, namely: "development that meets the

needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p. 43). The on-going debate on the definition of SD and what constitutes human "needs" in all countries now and in the future, remains a vexed and challenging question that goes to the essence of values and reflects the importance of context in the journey to sustainability. In any particular country, a series of cascading influences creates the context for its unique sustainability journey, depending on its history, culture, traditions, local institutions, infrastructure, resource challenges, national wealth and level of economic development (Wals, 2009).

All graduates require skills in ethical competence and sustainability and education is a crucial component in developing students' critical capabilities to participate in SD (Barth et al., 2007). Accordingly, in 2002, the UN established the Decade of Education for Sustainable Development (DESD) for the period 2005—2014 and appointed UNESCO (UNESCO, 2005) to integrate SD into all academic subjects (Reid and Petrocz, 2005), via a holistic inter- and trans-disciplinary approach with a clear focus on values and ethics (UNESCO, 2009 cited in Lambrechts et al., 2013). The approach adopted in this paper draws on Sterling (2010), whereby the term Education for Sustainability (EfS) is used interchangeably with Education for Sustainable Development (ESD) and where sustainability is interpreted as "both a process and a broad direction" (Sterling, 2010, p. 512). In the author's view, sustainability is a value, a space, a skillset and a mindset and EfS is focussed on providing individuals with "knowledge, skills and understanding necessary to make decisions based upon their full environmental, social and economic implications" (DEWHA, 2009, p. 4) and to create sustainable alternatives as individuals, households and organisations. This paper describes the author's experience in integrating EfS into tertiary business courses during the period 2005—2013.

The remainder of the paper is organised into four sections. Section 2 provides a theoretical foundation of social values and Maslow's Hierarchy of Needs (individual) to establish the case for integrating EfS into all Higher Education (HE) business programs. In Section 3, there is an overview of both theoretical and practical approaches to conceptions of sustainability and sustainability education. Section 4 provides an outline of the author's teaching context and methodology of EfS with practical examples of using a values approach to incorporate EfS in the context of tertiary business programs, particularly to international students in Australia. Section 5 presents results from student surveys and discussion of the impact of these EfS pedagogies on students' knowledge, views and behaviour regarding sustainability as well as some reflections on the author's EfS praxis. Section 6 provides concluding comments and recommendations for tertiary educators.

2. Theoretical framework − the values context

In Schwartz's Values Theory, ten motivationally-distinct basic values are derived relating to "three universal requirements of the human condition: needs of individuals as biological organisms, requisites of coordinated social interaction, and survival and welfare needs of groups" (Schwartz, 2007, p. 1). The ten values of self-direction, stimulation, hedonism, achievement, power, security, conformity, tradition, benevolence, and *universalism* are divided into four opposing dimensions: *self-transcendence* (*universalism*, *benevolence*) vs. *self-enhancement* (*achievement*, *power*), and *openness to change* (*hedonism*, *stimulation*, *self-direction*) vs. *conservation* (*tradition*, *conformity*, *security*). Universalism is the value most closely related to sustainability in more urbanised countries. The structure of these basic values was validated in 67 countries around the world, although there is little evidence whether the same value theory applies to more isolated tribal groups with minimal

exposure to urbanisation, mass media, and the market economy (Schwartz, 2007).

Another value framework is Maslow's (1970) theory of motivation and personality, which yields a hierarchical list of needs for an individual with physiological needs at the bottom and psychological needs at the top of the hierarchy: sustainability is thought to manifest at higher levels of motivation. In Maslow's theory, these needs are defined as goal states that motivate and drive behaviour and are sequenced in order of priority from lowest to highest, namely: physiological needs, safety needs, belongingness needs, self-esteem, and self-actualisation. Maslow (1954) contends the hierarchy of basic human needs is a cultural universal but notes behaviour is also determined by biological, cultural and situational factors (Maslow, 1943). Udo and Jansson (2009) confirm a global hierarchy of needs among 132 nations similar to Maslow's hierarchy at the individual level and demonstrate that "nations that are struggling to survive are less concerned with environmental sustainability than advanced and stable nations" (2009, p. 3700).

However, Hofstede (1984) argues that Maslow's theory was primarily derived from Western thought characterised by individualist cultures, so may not apply to collectivist cultures where "interdependence is valued over the individual" and "esteem and self may never be realised, as the individual is viewed as non-conforming" (Wachter, 2003, p. 68). Culture influences an individual's behaviour within the family, with peers, friends and the community. Societies with capitalist and competitive systems such as North America, Northern and Western Europe promote the personal self, I, and individual success whilst societies with a collective social orientation in Asia, Africa and South America promote *belonging* (Seeley, 1992 cited in Wachter, 2003; Triandis and Suh, 2002).

Both Schwartz and Maslow value theories are integrated into a common framework and used in the World Values Survey (WVS), an ongoing study conducted every 5 years investigating changing values and their impact on social and political life. Beginning in 1983, the WVS is now combined with the European Values Study and collectively covers 97 societies, representing 90% of the world's population in industrial and industrialising countries. It provides a comprehensive measurement of all major areas of human concern and is constructed across two dimensions: (1) Traditional vs. Secular-Rational values and (2) Survival vs. Self-expression values, which collectively account for over 70 percent of the cross-national variance in a factor analysis of the ten indicators. The Traditional vs. Secular-Rational dimension reflects the influence of religion and a range of closely related orientations, while the Survival vs. Self-expression dimension is linked to the transition from industrial to post-industrial societies where an increasing share of the population has grown up taking survival for granted and seeks greater expression. In almost all industrial societies, orientations have shifted from Traditional toward Secular-Rational values and from Survival toward Self-expression values, which in turn, give high priority to environmental protection. In such societies, there is a high value on individual freedom and self-expression, as well as activist political orientations, which are all attributes "the political culture literature defines as crucial to democracy" and similar to attributes necessary for a new paradigm in SD (Inglehart, 2009). A convergence of sustainability "values" around the world is also evident in other surveys (Pew Global Attitudes Project and World Bank surveys, 2007, cited in Burke, 2008; Johnson Controls, 2010; Shen and Tatsuyoshi, 2008; Supply and Demand Chain Executive, 2010). However, differences in societal values still remain between countries, shaped by their cultural heritage (Inglehart and Baker, 2000 cited in Kates and Parris, 2003).

Reporting on WVS findings, authors such as Barrett (1996), Redclift (1992) and Inglehart (2009) comment on the challenge of

environmental "stewardship" by poorer agrarian-resource depen-dant countries, which often have no choice but to take immediate economic benefit at the expense of the long run sustainability of their livelihoods" (Redclift, 1992, p. 398). Choices often come at the expense of other people and the environment, as witnessed by persistent poverty and widespread environmental damage in these countries (UNDP, 2007). According to the World Bank (2007, p. 3), "Growth is reducing poverty, but not everywhere or always sus-tainably" and for some nations, "the sources and quality of growth (unsustainable resource extraction; accumulating pollutants) un-dermine environmental sustainability and future growth potential".

Even in relatively wealthier countries, values are "a necessary but not sufficient condition" to activate sustainability behaviour (Verplanken and Holland, 2002), which is also influenced by problem awareness and personal norms (Nordlund and Garvill, 2003) and requires policy changes and a cultural shift (Huppes and Ishikawa, 2009). Hofstede (1984) demonstrates that cul-tural values do change over time and shift towards individualism as wealth increases. Other contributing factors are changes in the socio-economic environment, institutions and the lived experience of different generations including educational experiences.

Evidence indicates strong impressions formed during a person's formative (teenage) years can have a life-long impact on a person's values, attitudes and behaviour although students' values and value-orientations also affect their engagement with sustainability education at school (Uitto and Saloranta, 2010). While a causal link between higher education and the basic value of "universalism" and care for the environment is not established, activating values does cause behaviour change (Schwartz, 2007). This suggests EfS activities for tertiary students could have an impact in coming years, particularly if carefully positioned to account for differences in student values for the environment and sustainability (Field and Tunna, 2009).

Educators should not assume students have similar knowledge or views about sustainability, but instead must identify and gradually develop the sustainability literacy of their students. Australian students live in a society with a generally stable gov-ernment, several publicly funded services and strong social secu-rity (welfare) systems, ensuring that "basic needs" in Australia are secured. This affords the "luxury" of directing individual and col-lective resources towards community concerns. In terms of Mas-low's hierarchy of needs, Australians have progressed towards higher levels of human expression and fulfilment. Domestic stu-dents are also generally aware of sustainability practices such as "recycle, reduce and reuse" and environmental issues such as global warming and resource degradation through both formal education e.g., Year 12 (VCE) Economics and Business Management subjects (VCAA, 2007) and general public discourse (Fitzpatrick, 2009).

As a tertiary business educator to local and international stu-dents from non-Western cultures and also from developing econ-omies, the author has observed lower levels of environmental awareness and action in international students. Given the potential impact of EfS, it is imperative that all students have an opportunity to develop an appreciation of (values), a disposition towards (atti-tudes) and a capability (skills) to make choices that contribute to sustainability (social and environmental good) instead of further detracting from it. The next section provides a discussion of various approaches to sustainability education.

3. Pedagogy for sustainability – the praxis

According to cognitive psychology, we are continuously con-fronted with a vast flow of information and individuals filter through this information according to our *schema*, which de-termines what we "see" and what we "ignore" (Knoedler and Underwood, 2003). Traditional disciplinary approaches are either independent of the student's value systems or are groun-ded in an implicit single-value system (Dale and Newman, 2005). As Schumpeter elegantly pointed out "Ideologies are not simply lies; they are truthful statements about what a man thinks he sees" (Schumpeter, 1949 cited in Knoedler and Underwood, 2003).

Conceptions of sustainability and their associated learning and teaching implications are context driven and vary considerably. Wals and Jickling (2002) suggest "there are multiple perspectives in sustainability, education for sustainable development, and education for sustainability and multiple perspectives on the way educators should interpret these ideas" (2002, p. 222). Lozano (2008) reviews the three most used and critiqued sustainability representations, namely the Venn diagram (three interconnecting circles with sustainability represented in the area of overlap), three concentric circles (outer circle represents the natural envi-ronment, the middle circle is society and the inner one is the economy), and the Planning/Sustainability Hexagon, (depicting relationships between the economy/money trade, the environ-ment, the individual, group norms/culture, technical skills, and legal/political and planning systems). Lozano is critical of these representations as they are steady-state, lack full integration among different aspects and do not consider dynamic perspec-tives. Nevertheless, such representations can assist people to grasp the different aspects of SD and sustainability (Strachan, 2009).
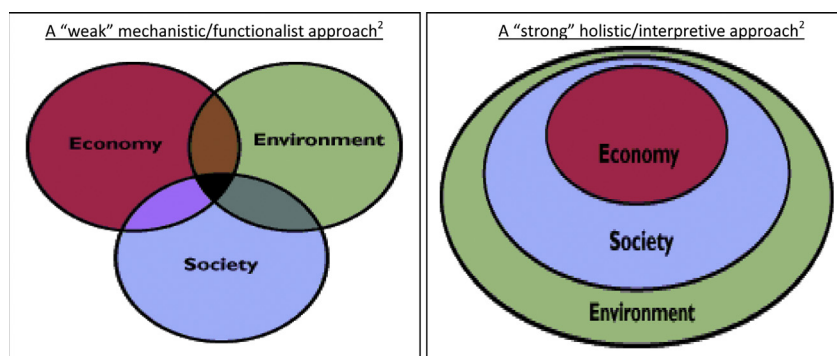

Fig. 1. a and b. Weak and Strong Forms of Sustainability.

Sterling (2011) developed a theoretical framework for sustainability education based on Bateson's three 'levels of learning' (1973 as cited in Sterling, 2011) that examine the paradigms in which learning occurs. This framework is combined with two contrasting views of sustainability, namely the Venn diagram and the three concentric circles (described above) as illustrated in Fig. 1a and b.

The "weak" view of sustainability (SANZ, 2009) shown in Fig. 1a, takes a functional (instrumental) or linear, mechanistic approach of modifying existing systems and processes to achieve relatively easy gains ("low hanging fruit") from minor or behavioural changes. This reflects a largely conformative, 'business as usual' approach, producing results that are often limited and short term. The emphasis is on efficiency and effectiveness, where "environmental sustainability becomes a variable to be operationalized" (Porter and Cordoba, 2009, p. 328) and system optimisation can be achieved by tools such as life cycle analysis (LCA). From a business perspective, this corresponds to the Three Pillar or Triple Bottom Line (TBL) approach underlying many efforts in CSR promulgated by the business sector and reflecting shareholders' values. From an educational perspective, this corresponds with Bateman's Level 1 or first-order learning or 'doing things better' and occurs within the existing dominant paradigm, for example classical scientific disciplines and research efforts aimed at complex global issues such as sustainability (Kastenhofer et al., 2011 cited in Orecchini et al., 2012). This approach is described as Education *about* Sustainability, a content–led, externally focussed pedagogy delivered through transmissive pedagogies and within an agreed framework of values and purpose.

Second-order change, described by Bateson as Level 2 learning, is situated between the two extremes represented in Fig. 1a and b. It is concerned with 'doing better things' and recognises the limits of the dominant paradigm and the existence of other paradigms. This level is more challenging and involves the learner or organisation critically examining and possibly changing their underlying values, beliefs and assumptions. It leads to a reformative result (Sterling, 2011) and corresponds to Education *for* Sustainability (EfS), a learning approach based on reflection and critical thinking, consensus building and partnerships, and building the learner's capability for action and change.

An extreme ecological or "strong" view of sustainability represented in Fig. 1b, gives primacy to the biosphere, which in turn subordinates both social and economic systems (SANZ, 2009). This holistic (nested) view seeks to restore balance between natural and artificial forms of capital and necessitates a transformation of our systems and processes. It is represented in Bateson's theory as third-order change and entails Level 3 learning or 'seeing things differently' and leads to paradigmatic change. Level 3 learning recognises the existence of alternative paradigms at once, i.e., the context of contexts (Sterling, 2011). From an educational perspective, epistemic learning corresponds to Education *as* Sustainability. There is often resistance by the learner as it challenges their underlying beliefs and assumptions, and leads to a restructuring of mental models (Juárez-Nájera et al., 2006), usually at a higher order of complexity and often over a long period of time. However, transformative learning is difficult and the degree of learning depends on the learner's state of readiness and the quality of the learning environment (Sterling, 2011).

The emergence of a new scientific paradigm called sustainability science represents such a transformative approach, which can assist to achieve a sustainability transition (Clark and Dickson, 2003). Sustainability science focuses on understanding the systemic nature of dynamic nature-society interactions and investigates the interrelationships with local ecosystems and human systems, which influence vulnerability or resilience. With a problem-oriented approach and an emphasis on adaptive management and societal learning, it "can address complex problems in a trans-disciplinary manner and make use of a network of structured scientific knowledge" (Orecchini et al., 2012, p. 59). It is based on collaboration between government, researchers and industry, and entails different ways of knowing and learning in co-production of knowledge, co-learning of outcomes and co-evolution of complex systems and their environment.

Key elements in developing sustainability literacy as identified by various researchers (Blewitt and Cullingford, 2004; Filho, 2002; Filho and Carpenter, 2006; Galea, 2004, 2007; Gough and Scott, 2007) are modifying curriculum content, experiential and social learning (Trip and Muzzin, 2005), systems thinking, interdisciplinarity (Matthews, 2005), connecting curriculum to local contexts (business/NGOs), taking a critical approach, and a strong research programme (Waas et al., 2010). These elements are echoed in Australia's National Action Plan for EfS (DEWHA, 2009), which is based on the principles of transformation and change, lifelong learning, systems thinking, envisioning a better future, critical thinking and reflection, participation, and partnerships for change.

A range of methodologies have emerged for teaching sustainability literacy. Holmberg and Samuelsson (2006) suggest that both separate courses/programs focussed on SD and the integration of an SD perspective throughout the study program are necessary to achieve sustainability literacy in HE. Lozano (2008 cited in Ceulemans and De Prins, 2010), identifies four approaches for integrating SD into curricula: "adding-on" elements of SD into selected courses such as governance and business ethics; specialist cross-disciplinary SD courses and programs; embedding sustainability principles into core subjects in every program (Sherman and Hansen, 2010); and offering SD as a specialisation within a program of study. This framework is consistent with the four quadrant matrix model proposed by Rusinko (2010) and also align with the four levels of sustainability integration outlined by Scott and Gough (2006), namely denial (no change), "bolt-on" approaches (Education *about* Sustainability), "build-in" approaches (Education *for* Sustainability) and curriculum redesign (Education *as* Sustainability).

Achieving sustainability is a paradigm shift towards a holistic view which involves systems thinking: one that fosters dynamic mutual learning of the meaning of sustainability both for individuals and for the systems in which they are embedded (Steiner and Posch, 2006). Accordingly, several authors (Burandt and Barth, 2010; Dale and Newman, 2005; Fenner et al., 2005; Lukman et al., 2009; Martin, 2005, 2008; Steiner and Posch, 2006; Wals and Jickling, 2002) have independently concluded that traditional transmissive educational processes are of very limited use and argue that an integrative, systems approach is the most powerful (and necessary) learning model to foster development of SD literacy (both skills and capabilities), as it involves applied learning in an open-ended, enquiry-based, practical problem–based scenario.

Teaching sustainability as a core generic capability or competence for graduates is also gaining momentum (Fadeeva and Mochizuki, 2010; Thomas et al., 2009). Key competencies for SD identified by more than 70 ESD experts from Europe, UK and Latin America are systemic thinking, anticipatory thinking and critical thinking (Rieckmann, 2012). In Australia, Thomas et al. (2009) propose four generic skills in the tertiary business curriculum: critical thinking, teamwork, ethics and sustainability. Further, Correia et al. (2010) argue students also need to achieve scientific

literacy, particularly in taking a holistic perspective into traditional specialised curriculum.

It is also important to have a common conceptual basis to introduce SD into different courses (Bergea et al., 2006). For example, CSR is a potential framework to introduce SD outcomes into and across different disciplines (Ceulemans and De Prins, 2010; Sherman and Hansen, 2010). More generally, the concept and praxis of cleaner production (CP) can demonstrate the transition to more sustainable societies, with each discipline investigating their contribution to key environmentally aspects such as resource and energy use, emissions and closed-loop systems (Bonilla et al., 2010). Another contextual framework is the analysis of impacts by each discipline on economic, social/cultural and environmental sustainability (Pappas et al., 2013).

Researchers also emphasise the importance of focussing on students' actual values and behaviours to motivate more sustainable behaviours and improved problem solving (Pappas et al., 2013; Sipos et al., 2008). As stated by Lozano García et al. (2006, p. 760), "Success on the journey toward sustainable development requires an approach to education that strengthens the application of values, especially integrity and fairness and the awareness that people share a common destiny". This sentiment is echoed by Shephard (2008, p. 95) who suggests a central element of EfS is "a quest for affective learning outcomes of values, attitudes and behaviours". This can be achieved when teachers provide students with "experiences which lead to greater awareness of social and moral responsibilities", particularly those which generate "greater self-awareness of personal value systems and a willingness to revise them…towards sustainability" (Sibbel, 2009, p. 79).

Finally, teachers are ultimately "responsible for the introduction of the subject of SD to their students" (Ceulemans and De Prins, 2010, p. 646). Each teacher has an opportunity to introduce sustainability topics (Lidgren et al., 2006) that are appropriate to their student cohort, environment and institutional orientation towards sustainability (Glavic and Lukman, 2007). Initiatives to assist teachers in such endeavours include teacher manuals (Ceulemans and De Prins, 2010), and professional development programs (Barth and Rieckmann, 2012; Huisingh and Mebratu, 2000). The next section demonstrates how the author has integrated SD across a variety of business courses in their particular institutional and teaching context.

4. Methodology

The author teaches at Central Queensland University (CQUniversity) in Australia, a multi-campus tertiary institution operating a distributed learning model across several campuses. In 2011, CQUniversity recorded one of the highest percentages of international student enrolments in Australia, accounting for almost 50% of taught courses in Business and IT programs (CQU, 2011). Most courses in Business, Accounting and IT programs do not contain EfS-related material, although a few do include ethics and sustainability in the curriculum. As all courses and programs at CQUniversity are managed centrally, teachers are unable to alter course content, assessment and learning outcomes.

When the author began teaching in 2004, sustainability was not embedded in any core tertiary business course and sustainability literacy was neither specified as a core learning outcome nor a generic graduate attribute. Despite the growing discourse regarding sustainability in Australia, in government policy (ALTC, 2009; DEWHA, 2009), in certain professions (ABDC, 2012; Hancock et al., 2010), by employer groups and also by some tertiary educational institutions (Lee et al., 2013), EfS remains at the periphery of the curriculum in HE (Hill, 2013) and the author's

institutional context for teaching business courses has remained largely unchanged.

This paper focuses on EfS to international students predominantly from non-Western cultures and also from developing economies, particularly the Indian subcontinent, China, North Asia and South East Asia and to a lesser extent, Latin America, Africa and Eastern Europe. In this context, the intention of EfS is to raise the importance of SD (encompassing environmental ecosystems and social justice) and to create interest and concern for the values, effects and consequences of current production and consumption on sustainability outcomes.

The pedagogy adopted by the author is predicated on the educational theory of constructivism, where students construct new understanding based on their existing knowledge and through inquiry and self-reflection (Education Week on the Web, 2001; Hoover, 2003). The author explicates the values that underpin each discipline and encourages students to clarify the discipline values (and their own), to critically evaluate the linear and reductivist cause-and-effect of orthodox management theory in favour of a systems approach and to think creatively about solving real-world problems. Student learning is gradually escalated along the cognitive domain of Bloom's Taxonomy of Educational Objectives: knowledge, comprehension, application, analysis, synthesis and evaluation (Bloom, 1984) and also designed to engage across different learning modes (linguistic-verbal, logical-mathematical, musical-rhythmic, spatial-visual, bodily-kinaesthetic, intrapersonal, inter-personal and naturalist) identified in Gardner's Multiple Intelligences (Gardner, 2004). In the author's observation, newly arrived international students are initially confused, challenged and resistant to this learning approach because they regard knowledge as clear and certain and are accustomed to a transmissive mode of education. However, after studying in Australia for several years or being in several of the author's courses, students become accustomed to this approach.

Students need opportunities to explore the relevance of sustainability to their studies and to their intended field of professional practice (Sibbel, 2009). Given the current institutional context and student cohort, the author's discipline-specific approach is *to include sustainability aspects in every course*, as opposed to teaching "sustainable development literacy" through inter-disciplinary approaches, which are beyond the author's influence. By extending the theoretical framework in each discipline, student's perspectives are widened to explicitly consider sustainability issues both in principle and in practice. This is achieved by choosing relevant examples, creating case studies and extending classroom discussion to sustainability considerations. The case study approach is particularly useful to study sustainability issues as it promotes skills of critical analysis and thinking and challenges students to examine their own value system (CMEC, 2008). Relevant case studies are carefully selected to ensure the content is culturally appropriate and locally relevant, one of the key principles of ESD listed in DESD (UNESCO, 2005). Depending on the author's influence over course curriculum and assessment at the time of intervention, the approach has varied from "incremental" inclusion of sustainability topics in the curriculum, to conducting course-related introductory sustainability seminars, and finally to integrating sustainability more deeply into course assessment. The remainder of this section illustrates how disciplinary contributions to sustainability have been integrated into introductory courses in Economics and Marketing.

4.1. Incremental inclusion of sustainability topics

4.1.1. Economics
Economics is the study and practice of how people choose to use resources and the impacts of those choices on

"efficiency" and "welfare", so this is an ideal realm to introduce the impact of economic choices on social and environmental sustainability. Arguably, it is in this realm that we decide the overall balance of costs and benefits that accrue to individuals and to society at large and determine the balance towards sustainable living.

In economics, EfS has been discussed both directly (explicitly) and indirectly (implicitly). Direct effects relate to curriculum topics that explicitly consider impacts of economic behaviour on sustainability such as *externalities*, *public goods*, and *common resources*, whereas indirect effects relate to topics which implicitly consider the impacts on sustainability such as the *economics of the political market place*, the exercise of *market power* and the impact of *market deregulation* (Layton et al., 2009). The topics considered for class discussion depend on the availability of topical and relevant case studies each term. Readily identifiable sources are used such as daily newspapers or business reports and verified by official or government documents. Students identify various social and environmental costs, investigate causes of the problem and analyse possible remedies and implementation challenges. Students appreciate how sustainability problems largely result from individuals pursuing their personal values, how these differ from social values, and the importance of other measures such as regulation to explicitly prevent and redress the deleterious effects on social and environmental sustainability.

4.1.1.1. Explicit effects on the environment. For externalities, local sustainability issues are chosen. In 2005/2006, the issue was the depletion of fishing stocks in Australian waters and Federal Government policy to repurchase fishing quotas, with discussion focussed on the need for greater regulation to maintain sustainable catches in the future. The case was introduced from a newspaper article by Khadem and Marino (2005), shown in Appendix A and included in lecture slides shown in Fig. 2.

In 2007, the topic was economics of household/domestic water use management in Australia. The class discussed the Victorian State Government policy designed to expand water supply and reduce demand. Students critically discussed the efficacy of the free market system for environmental sustainability, reasons why these measures were implemented and alternative measures possible. The case was introduced from a newspaper article by Ker (2007a), shown in Appendix B. In 2007/8, the case study involved extension of water use management policies to the industrial sector, including the introduction of transferable water quotas to allocate water use to its highest "market value". Causes and alternative measures were

also explored. This case was introduced from a newspaper article by Ker (2007b), shown in Appendix C and incorporated into lecture slides in Fig. 3.

In 2009, the class discussed the case study of Australia's proposed emissions trading scheme (Carbon Pollution Reduction Scheme) as part of the government's policy response to climate change mitigation and ensuring environmental sustainability in the long run. In 2010, students reviewed a UN sponsored report that estimated the external (environmental and social) damage caused by USA's top 500 firms in 2008 at $US 2.15 trillion, equivalent to around 50 per cent of revenue and representing a significant proportion of corporate profits (Trucost, 2011). Students investigated possible causes and recognised that laissez-faire economics in Western countries combined with modern management practices may result in a "zero-sum game" in some countries, where economic value is extracted along the supply chain rather than created through a sustainable systems approach.

4.1.1.2. Implicit effects on the environment. Each term, the class discussed conventional measures of economic welfare (i.e., Gross Domestic Product or Gross National Product), and critically evaluated their adequacy to indicate overall welfare for individuals or society. Students compared alternatives such as Human Development Index (HDI) and Sustainable HDI and examined social welfare and environmental impacts associated with economic growth and development. Since 2009, specific cases of economic, social & environmental impacts were explored in Asian and African countries, as well as developments in Australia such as the oil spill in Queensland in 2009, on-going expansion in mining in regional areas and the Great Barrier Reef, and hydraulic fracturing (fracking) of gas extraction since 2011.

In 2008, the case study used to illustrate the economics of the political market place was the Australian Federal Government's (green) discussion paper on climate change and the proposed Carbon Pollution Reduction Scheme, as well responses by various interested parties and finally the government's (white) policy paper. Students learnt that in Australia, the government's final position reflected the balance of power across multiple stakeholder groups (conservation groups, employer groups, specific industries with high energy use, labour unions, scientist lobby groups, etc.), and the promulgation of their stated "values".

4.1.1.3. Explicit effects on society. In 2008, discussion focussed on the enormous negative externality of the global financial crisis (GFC) on society, through payment of historically high government assistance and bailouts of banks and industry, falling confidence by

Fig. 2. Teaching sustainability in economics through common resources and overfishing.

Fig. 3. Teaching sustainability in economics through common resources and freshwater.

consumers/manufacturers/retailers and investors, rising unemployment and general economic malaise. In 2009 and 2010, students discussed the GFC impact on employment in Australia, in particular the rise in "under-employment" as opposed to "unemployment" as employers sought to retain their staff and "share the pain" across the labour force during this cyclical economic downturn.

4.1.1.4. Implicit effects on society. In terms of social sustainability, reference is made to the growing casualisation of the Australian workforce and the impact on employee risk and uncertainty and on consumer welfare. Students explored the implicit trade-off made by society between the value of greater economic efficiency (more output) of a flexible labour market vs. the value of greater social equity (more security) and the difficulty in balancing these respective values. This topic was based on an article in The Age newspaper and also incorporated into lecture slides presented in Fig. 4.

4.1.2. Marketing

Marketing is about the creation of value and the favourable positioning of products (goods, services, people, ideas and causes) to provide that value in the minds of consumers and decision makers (Solomon et al., 2011). Sustainability marketing represents the application of the TBL approach or the 3Es (environment, equity and economic pillars) of sustainability into marketing strategy. A detailed guide to incorporating sustainability elements into the 4Ps (products, price, place, promotion) of marketing theory is provided by Bridges and Wilhelm (2008) as well as Borin and Metcalf (2010).

In the context of the Australian market, emphasis is given to Australians who value both environmental and social goods, as evidenced by the way people use their own scarce resources (time, physical energy and money) to voluntarily add to public "capital". Individuals also choose to purchase from, work for and invest in organisations with strong performance in CSR (Morris, 2008). Students are asked: "What are the values of consumers who choose these "green products" or volunteer their time? How do organisations tap into this goodwill towards the environment and other people?" Answers vary but centre around creating and marketing products (goods, services and causes) and other activities that satisfy this value for consumers. The following examples demonstrate how this value for sustainability was discussed and explored in class.

4.1.2.1. Creating green products. In the case study of Toyota's premiere hybrid vehicle, the Toyota Prius, students considered reasons why such a "green" product was created, the likely target market, the role of "opinion leaders" in influencing consumer attitudes and thus consumer acceptance of this product, and the way in which marketers tap into these values held by targeted consumers. The information was based on an article in the RACV monthly magazine, *Royalauto*, where RACV compared the vehicle to its major competitors (Hill, 2009). Another example used in semester 1 2009 was the success of IBM in reducing energy use of its computer products, using actual IBM data (Pipella, 2009). In 2012 and 2013, the class studied the Lifestyles of Health and Sustainability (LOHAS) market of "socially conscious" consumers (Modium Group, 2011) and investigated factors that impede such consumers from taking intended action towards sustainability.

Fig. 4. Teaching sustainability in economics through labour markets.

4.1.2.2. Brand image and CSR. In terms of creating brand image and brand value, discussion focussed on how organisations can tap into customers desire to be treated fairly and with respect. However, from a company perspective, "responsible business is seen as primarily an extension of corporate communications" and not integrated into "other parts of the business that are considered far more powerful and strategically valued" such as sales and marketing, which do not always practice ethical customer relations (Cooper, 2009, p. 36). Students recount their own experiences with companies and investigate the impact of ethical behaviour on the organisation's financial performance and more broadly, on its TBL performance.

4.1.2.3. Volunteering activities. Australians spend a considerable amount of time volunteering, particularly for established charities with an estimated 34 per cent participating in 2006. International students are genuinely surprised to learn the Australian subculture known as Generation Y (18–24 year olds) has a strong orientation towards volunteering and "doing good" for community and environment. In 2006, this category represented 32 percent of all volunteers in Australia (Dempsey, 2009). Class discussion is focussed on drivers of this behaviour such as social and personal norms and values.

4.2. Introductory EfS seminar

In 2011, a Pilot Introductory EfS seminar program was implemented at two campuses of CQUniversity for classes in Business and IT programs at diploma, undergraduate and postgraduate levels. This entailed a 20–30 min, in-class, introductory EfS seminar to students related to their course. Students were introduced to sustainability concepts and challenges and the role of graduate skills in their future professional practice, shown YouTube videos of sustainability behaviour by business leaders and their peers (young adults), encouraged to adopt personal sustainability behaviours and also assisted to connect their individual courses/programs to sustainability outcomes in terms of environmental, social/cultural and economic capital. The Power Point slides used in the EfS seminar are presented in Appendix D.

4.3. Integration of sustainability into course assessment

As Course Coordinator for various economics and marketing courses, the author has availed the opportunity to embed sustainability issues into curriculum topics and assessment items, which affects all students enrolled in these courses across CQUniversity.

In 2011, postgraduate economics students investigated the carbon tax and analysed various approaches to pollution mitigation and global climate change. Students were also asked to critically evaluate the adequacy of marginal cost pricing theory to deal with systemic issues such as ecosystem destruction and global warming.

In diploma marketing (2011) and undergraduate marketing (2012) courses, students investigated sustainability in production and marketing and were tasked with working in groups to formulate and present a marketing strategy proposal for an environmentally friendly (green) consumer product for the Australian market. Students integrated sustainability issues using the 3Rs of Reduce, Reuse and Recycle (and Rethink) as well as the 3Es of Economy, Equity (social) and Environment into the 4Ps of marketing strategy. To assist students and teachers, the author provided additional curriculum material related to the LOHAS market segment, ecological footprints, cleaner production, LCA (Life Cycle Management or cradle-to-cradle), accreditation systems, social enterprises, etc.

5. Results and discussion

The author observed students becoming more aware of sustainability issues over time and even shifting their attitudes towards sustainability as a result of these educational activities. However, this is anecdotal and observation of student participation in classroom discussion might be quite different from students' real impressions. Further, even if heightened awareness seems evident, it may not necessarily lead to more action for sustainability (Arbuthnott, 2009; Pappas et al., 2013; Stir, 2006). Various student surveys were conducted during 2011–2013 to identify the impact of such interventions on student views about sustainability. These were conducted immediately after the course and also after 12–18 months. A total of 342 surveys were collected with response rates varying from 2 to 40% across different interventions and cohorts. Survey results and discussion are presented in the following sections.

5.1. Incremental inclusion of sustainability topics

Online surveys were conducted immediately after the Economics and Marketing courses for students enrolled at Melbourne campus in 2013. Participants were asked to define sustainability and SD and describe the impact of classroom discussions on their sustainability views, attitudes and behaviour.

For two separate cohorts totalling 106 postgraduate Economics students in 2013, only 10 participated (9.4% response rate). In relation to conceptions of sustainability, 40% did not answer, 20% referred to generic notions of sustainability and 60% referred to sustainable use of resources. Regarding conceptions of SD, 40% did not answer while 60% clearly identified the need to balance economic, social and environmental needs and in most responses, the balance of current and future needs. When students were asked how their perceptions and attitudes to sustainability had changed during the course, only 5 students responded (4.7% response rate), of which 20% indicated no change in views, 20% stated their pro-sustainability views were strongly confirmed and 60% reported views had changed considerably.

For two separate cohorts totalling 56 undergraduate Marketing students in 2013, 22 students participated (40% response rate). In relation to student conceptions of sustainability, 27% did not answer while the remainder showed mixed degrees of understanding. In relation to conceptions of SD, 40% did not answer while 27% provided responses that considered economic development balanced with social and environmental considerations. When students were asked how the course impacted on their perceptions and attitudes towards sustainability, the response rate dropped to 16%, of which 44% reported no change at all; 44% reported their pro-sustainability views were strongly confirmed; and only 12% reported their views had changed considerably.

On-line surveys of other Economics and Marketing cohorts conducted 6–12 months after completing their courses (in 2012–2013) suggest positive impacts of the course persist and do not 'decay':

○ It broaden my knowledge and make me to realize the effect of lack of orientation on sustainability is more dangerous than I ever think off. It makes me to be self cautious and think of what the future may look like if sustainability is not taking serious
○ Sustainability is an issue that every one of us need to be aware of and by the discussions I have surely got much broader view of the concept of Sustainability and it has completely changed my behaviour to look at things. Now a days, before doing anything I think of its long-term impact on environment starting from using electricity to driving.
○ Sustainability discussion made me think a lot. Further made me realize the small good things we do now will brighten the future

of the world.....it's not a overnight process to cultivate results but a long term journey.......for example using recyclable products, and eco friendly products....even most of the time I try to use eco friendly products....but there are times I fail to do so

○ The major impact that the discussions about sustainability was that now I'm actually thinking about making Sustainability management my future career, which I consider that demonstrates how important those discussions where, because now that I think deeply, it could actually change my life.

○ Social responsibility affected me the most. Because my personal view is every organization must think of the consequence to the society before they produce or promote their products.

In terms of future actions towards sustainability, sustainability behaviours also persist:

○ I will control my wastage of electricity by using only when I need it. Also will save on fuel usage.

○ Continue recycling, buying environmentally friendly products, trying to influence my friends and family.

○ Use recyclable bags, use eco friendly products most of the time

○ will try to increase greenery as much as possible where I can and will avoid wasting recyclable things

Results suggest the respondent's age may contribute to their conceptions of sustainability and SD, as well their personal orientations towards sustainability issues. Both influences appear to moderate the impact of sustainability education, which is consistent with literature (Sidiropoulos et al., 2013). However, views expressed by some students do not reflect the whole student cohort. While the interventions have clearly affected some students, the overall results are mixed and the approach is weak (limited) in altering student views and perceptions towards sustainability. An important caveat is that although the immediate impact is weak, it broadens student knowledge and raises issues for discussion that would otherwise not be included in the disciplinary discourse.

5.2. Introductory EfS seminar

Surveys consisting of open-ended questions and the New Ecological Paradigm scale (Dunlap, 2008) were conducted to develop an understanding of the sustainability attitudes and knowledge of international students. The NEP scale measures attitudes across five hypothesised facets of an ecological worldview, namely: limits to growth, constraints of nature, anti-anthropocentrism (a rejection that humans have domination over nature), balance of nature (emphasising susceptibility of ecosystems to human interference), anti-exemptionalism (a rejection that humans are exempt from nature) and eco-crisis (resulting from human interference). These surveys were conducted in both participating and non-participating EfS seminar classes and also in classes with and without sustainability topics in the curriculum.

After the seminar, student responses indicated a stronger belief in human exemptionalism and greater confidence in human ingenuity/science to solve ecological problems, coupled with heightened environmental awareness and concern for the balance of nature and limits to growth. These represent a more 'utilitarian' view of balancing the needs of nature and humans, and suggest students adopted the main tenets of modernity towards the environment (Sidiropoulos et al., 2013).

Results from the Pilot EfS study demonstrate that students respond differently to the same type of EfS intervention, based on differences in age, gender and culture. In terms of overall results, student feedback suggest approximately 40% of respondents report no change in sustainability views, 30% report reinforcement of

existing pro-sustainability views, while around 30% indicate a shifting of views towards sustainability. An interesting finding is the EfS introductory seminar had a similar impact on students' environmental awareness and values as embedding assessment topics in the course curriculum (Sidiropoulos et al., 2013; Vann et al., 2006).

5.3. Integration of sustainability into course assessment

An on-line survey was conducted immediately after the undergraduate marketing course in 2012, in which students created a marketing plan for a "green" product (see Section 4.2). For a total cohort of 502 students enrolled in the course at CQUniversity, 33 students participated (6.5% response rate). Responses were mixed in terms of the impact of the course on their sustainability views: 18% indicated no change although their stance towards sustainability was not stated; 30% indicated a firming/confirmation of existing pro-sustainability views; and 52% reported their views had changed towards sustainability and the role of marketing in creating sustainable outcomes. Responses from the latter group include:

○ Maybe at first people would just think to preserve the environment in complicated ways, but in fact, it can be started from a marketing course.

○ It changed my perception, and show me how much influence I can have on people and way that I can make more people to be aware to our environment and for green products.

○ I am much more aware of the sustainability issue and also the impact that non-biodegradable products have on our environment. I do believe I will be more conscious of these issues in future. I thought this was a valuable way to include this issue in the subject.

○ I have become more aware of the different techniques involved in working towards creating a sustainable environment such as reuse, reduce, recycle. Furthermore,… I became more aware of all the different factors which need to be considered when creating and marketing a sustainable product.

Students were also asked how they thought the marketing course related to issues of environmental sustainability and social responsibility. Around 25% did not respond or stated they did not see any relationship between the marketing course and sustainability, while 75% of respondents saw a direct relationship between the course assessment/content and sustainability outcomes. Indicative responses from the latter group include the following:

○ The assessment directly related to these issues as it opened up all the work involved to target the social responsibility that people feel is required to create a sustainable environment.

○ Having to choose a 'green' product for the presentation enabled us to research environmentally sustainable products and practices and to identify the target market that purchases these goods and services…. As far as the social responsibility aspect of the course was concerned, I think this should have been given more emphasis

○ With the encouragement to create environmentally friendly products, it is certain marketing course can be one solution to the issues related to the issue of environmental sustainability and social responsibility

○ It succeeded in making all of the subjects' students more aware of and more knowledgeable of this growing concern. It made me, as an individual, more aware, through research, of the ways that I can reduce my impact on the environment and how I can purchase biodegradable and environmentally friendly products without really too much effort.

○ I think the marketing course relates to many different issues of environmental sustainability and social responsibility. The main point of concern is the way marketers develop and illustrate a particular product to a potential consumer, and educate them on the environmental effects of the product, as well as the responsibilities, as a customer, we need to take when purchasing, using, and disposing of the product

The same student cohort was surveyed again 18 months after course completion to reassess the impact of this particular intervention. Only 12 students participated (2% response rate), of which 20% reported no impact at all, 10% indicated no change to existing pro-sustainability views and 60% reported the positive impacts of this particular intervention persisted and in some instances, mutually reinforced sustainability topics in other courses:

○ When I was preparing for the assignment, I had a basic understanding of sustainability, but it was the first time I approached it from an organisational view, or even a marketing view. It allowed me to look more in depth into the issue, further than how do I myself impact the sustainability of the environment. After the course, I did look at organisations more closely to see if they were practicing environmental sustainability.

○ I must admit when I first started this topic, I'd only thought of sustainability as recycle, reuse, reduce. And then during the course I started to think re-engineering, re-think, re-establish, etc. Basically anything, even something as small as tea bags can be re-packed, or re-processed using sustainable packaging, or greater sustainable methods of production.

○ Other modules since your Marketing one, sustainability has been a buzzword, and the further along this path I travel, I am re-programming my brain to think of new ways and new ideas to limit mine and my families global footprint.

○ The topics covered in marketing really opened up my eyes to the impact consumers can have purely through the products and services they choose.

Changes in student's sustainability behaviours also persisted in 40% of respondents:

○ I am more conscious of which products I buy now, and how they are marketed, particularly the environmental targeting products. I hold organisations to a higher standard and boycott those brands which do not practice sustainability.

○ Re-think my actions and help other to learn that sustainability is a whole work/life change that could make a big difference to alot of people.

○ I now always try to purchase products which might donate to a charity (environment or other), or find something that is created in a sustainable matter. This is only done to an extent as price and quality is still a large factor, but if products are similar, I will choose the most sustainable one.

○ ..food. We are fairly low in our household waste anyway, but watch it more now.

○ It made me, as an individual, more aware, through research, of the ways that I can reduce my impact on the environment and how I can purchase biodegradable and environmentally friendly products without really too much effort.

These results suggest integration of sustainability into course assessment fostered values for sustainability and had a stronger impact on students both immediately after the course and over time, compared to the introductory EfS seminar and to a lesser extent, the incremental inclusion of sustainability topics in classroom discussion. Therefore, as more elements of sustainability are introduced into the curriculum and subsequently assessed, the more powerful is student learning for sustainability. This is not surprising given the greater student engagement and motivation related to course assessment. Overall, the impact of EfS is influenced by the strength of intervention (i.e., degree of integration into course curriculum/assessment), student's personal interest in sustainability issues and general influences such as age, gender, culture, etc.

Throughout the period of teaching tertiary students (2004–2013), the author gained valuable insights into student views, attitudes and behaviour towards sustainability and the impact of various educational interventions. These experiences contributed to an individual learning journey of critical reflection and re-examination of assumptions and practices, and the trialling of new approaches that recognises the importance of context and motivation in creating powerful learning experiences for students.

6. Conclusion

This article demonstrated how the notion of values (from multiple perspectives) can be used as a lever to introduce EfS into tertiary business education programs, irrespective of the educators control over curriculum and assessment. Examples were provided for economics and marketing to demonstrate how sustainability can be integrated by focussing on creating value for diverse groups of an organisation's stakeholders. These were discussed for various types of educational interventions namely, an incremental integration of sustainability topics in classroom discussion, the inclusion of a course-related introductory sustainability seminar, and deeper integration of sustainability topics in course assessment.

The study found these interventions do impact on student views, attitudes and behaviour towards sustainability. The key findings are threefold: first, escalating the level of integration into courses increases student engagement and results in stronger impacts on students sustainability views, attitudes and to a lesser extent their behaviour; second, the impact on students varies by age, gender and culture; and third, increasing student knowledge and attitudes towards sustainability, while necessary, is not sufficient to stimulate more sustainable behaviours. Yet, survey results are mixed and at best, only indicative. More systematic research is required using a common instrument to collect information regarding students' existing views, attitudes and behaviours towards sustainability and to investigate the impact of different EfS interventions at different levels of study, in different disciplines, in different countries and over time. Such a study is currently being undertaken at CQUniversity as part of a multi-university EfS research study.

Sustainability is a learning journey and each educational intervention contributes towards building greater understanding and orientation towards sustainability. An educator with curriculum control is strongly encouraged to embed sustainability as a core element of assessment. An educator with little or no influence over course curriculum or assessment, can still contribute to their students learning for sustainability. A suggested approach is to conduct a course-related introductory EfS seminar and supplement with class discussions of sustainability topics throughout the curriculum.

APPENDIX A

Nassim Khadem and Melissa Marino, 24 Nov 2005, *"Fisheries crisis plan to hit prices",* http://www.theage.com.au/news/national/fisheries-crisis-plan-to-hit-prices/2005/11/23/1132703252137.html, **viewed on 25 November 2005**

Fish could soon become even more expensive.
Photo: *John Woudstra*

By Nassim Khadem and Melissa Marino
November 24, 2005

Consumers can expect to pay more for their favourite fish as the Federal Government prepares to buy back as many as 600 commercial fishing licences in a $220 million package bid to rejuvenate dwindling stocks.

The Commonwealth has allocated $150 million to buy back about half of its 1200 fishing licences, to ease pressure on 17 overfished species. They include orange roughy, oreo, silver trevally and deepwater shark, which will not be fished at all after 2007. The number of blue eye trevalla, blue grenadier, blue warehou and gummy and school shark fished will also be cut. The package comes as a response to recent calls from the fishing industry to help struggling fishermen leave the industry, leaving those remaining to become more profitable. The industry has been under pressure because of high fuel prices and cheap imports.

"We want to reduce the number of boats and increase the number of fish," federal Fisheries Minister Ian Macdonald said. "The industry is in such a state that there will be many lining up to offer their licences to the Commonwealth." The Victorian fishing industry welcomed the buyback, as a way to allow struggling fishermen to leave the business with dignity. Tim Mirabella, Seafood Industries Victoria chairman, said the move was about conserving already "tightly managed" fish stocks, but also about ensuring the industry remained viable. Mr Mirabella said tighter fish quotas and increased operating costs had made times hard for many fishermen. While the buy-back could cut employment opportunities, he said the industry's future would be more stable in the long term - and fisheries within three nautical miles of the coast would not be affected.

Ian Knuckey, scientific adviser to the South-east Trawl Fishing Industry Association said the package would lead to a viable fishing industry and ecologically sustainable fisheries, with sustainable catch limits. A spokesman for Victorian Agriculture Minister Bob Cameron said the issue of overfishing was a problem in Commonwealth waters. Senator Macdonald said that all Commonwealth-managed fisheries could apply for the package, but the Government was focused on areas where overfishing was a problem, particularly off the south-east coast. "We will be taking the (licences) that are most advantageous to us - that is the cheapest ones that are offered to us," Senator Macdonald said. He said the remaining $70 million would be to offset the impact on onshore businesses, helping skippers and crew seek new jobs and training, and generating new opportunities in fishing ports.

"We are making the tough decisions today so that we do have a fishing industry tomorrow," he said. "The industry has been very keen to have some package to get rid of the number of players in the industry. My fairly extensive contact with fishermen around Australia in the last 12 months tells me that there are many of them just hanging on by their fingernails." Senator Macdonald admitted prices could rise, and it would lead to greater imports of fish. About 50 per cent of fish consumed in Australia is imported

Restaurateurs agreed. Peter Canal, co-manager of Canal's Seafood in Carlton, said the law of supply and demand meant prices would inevitably rise. "Consumers can expect that the species that they're used to eating, certainly the ones that are going to be reduced in quota, will go up in price." The Commonwealth manages about 17 per cent of licences in the south and 25 per cent of licences in the east. The rest are state licenses.

Senator Macdonald said he would meet state fisheries ministers to try to reduce licences in overfished areas. The Fisheries Management Authority's Richard McLoughlin said the catch limits would allow fish stocks to recover. The Government will also cap the number of hooks used each year.

With ORIETTA GUERRERA-

Figure A.1. Original story "Fisheries Crisis Plan to Hit Prices" included in Economics lecture slides in Fig. 2.

APPENDIX B

Melbourne gets great water escape
Peter Ker
March 23, 2007

MELBURNIANS may have evaded the city's harshest level of water bans after the State Government yesterday delayed the onset of stage 4 restrictions. In a move that saved suburban football leagues from a disastrous 2007 season without any watering of ovals, Premier Steve Bracks announced a new intermediate level in the tiered water restriction system.

Melbourne has been on stage 3 restrictions since January 1, but will now move to the new stage 3A on April 1. The city will remain at that level until at least August 1, irrespective of weather patterns. It means Melbourne will not progress to the stage 4 restrictions in May, as previously predicted by Water Minister John Thwaites. Stage 4 prohibits outdoor watering of gardens and sporting grounds and was supposed to be implemented when Melbourne's water supplies fell to 29.3 per cent of capacity. Storages were 32.5 per cent full last night. Stage 3A will see watering times cut by half, with manual watering systems allowed to be used only between 6am and 8am on designated days. Automatic systems can be used between midnight and 2am on designated days. Councils will be allowed to water one in four sports grounds and will be forced to cut back their water use by 25 per cent.

Mr Bracks denied the Government was "making things up" on the run. "Water authorities have advised us there is more significant savings to be gained by moving to a modified stage 3 restriction as of April 1," he said. Mr Thwaites said the situation would be reviewed before August, with stage 4 a possibility in spring if the city's water situation remained dire. Sporting clubs and members of Victoria's $1.4 billion gardening and nursery industry applauded the move yesterday. Fitzroy Reds Football Club president Craig Little said stage 4 restrictions would have been devastating for grounds such as his club's Brunswick Street Oval home. "Once stage 4 came in, the chance of grounds recovering to a reasonable standard was pretty remote," he said. A two-week delay to the start of the season has been imposed on most suburban football leagues because of the drought, and Mr Little said his club would now start negotiations with the local council to ensure Brunswick Street was one of the 25 per cent of ovals that retained watering. The future of stage 4 restrictions within Melbourne's water conservation strategy appears uncertain after yesterday's move, with some industry groups lobbying for the permanent abolition of stage 4. Nursery and Garden Industry of Victoria chief executive Steven Potts said: "This is wonderful for our industry to survive through to spring." Victorian Athletics League chief executive Mark Howard said the total watering ban under stage 4 was unrealistic. "If stage 4 came in we would be screwed," he said.

State Opposition Leader Ted Baillieu said the creation of stage 3A was "a panic measure", and country Victorians would be amazed that Melburnians had escaped the sort of strict measures forced upon many towns through summer. "3A, 3B, 3C, what happens at 3Z? We will get to the bottom of the alphabet before we get any honesty and frankness out of John Thwaites," he said.

Mr Bracks also announced that the top 1500 industry water users would be forced to develop water saving plans.

With **DAVID ROOD**

Figure B.1. Original story "Melbourne Gets Great Water Escape" used in Economics class in 2007.

Peter Ker, 2 April 2007, **"Water trading a step closer",**

http://www.theage.com.au/news/national/water-trading-a-step-closer/2007/04/01/1175366078749.html#, viewed on April 2, 2007.

April 2, 2007

WATER wastage by industry would be curbed under a radical trading scheme that could soon be applied to some of Melbourne's biggest water users. A feasibility study commissioned by the State Government into "water trading" for big business comes after Premier Steve Bracks announced last month that Victoria's top 1500 industrial water users would be forced to adopt plans to cut wastage.

Victoria's government schools are also under renewed pressure to review their use of water, with more than 1300 schools being told to commit to a water-efficiency program. But water trading looms as one of the most significant changes to the current system, under which industry uses an estimated 30 per cent of Melbourne's drinking water supplies.

The feasibility study — being carried out by Melbourne's three major water authorities in partnership with the State Government — was inspired by increasing acceptance of carbon-trading programs to cut greenhouse gas emissions.

Under carbon-trading schemes, large industrial polluters are allowed to emit a certain amount of greenhouse gas, and can "sell" back their unused allocation if they emit less gas than their entitlement. Conversely, companies that exceed their emission entitlements are forced to buy extra entitlements.

Commercial trading of water is already practised in rural Victoria between farmers and irrigators. South-East Water managing director Dennis Cavagna confirmed that a similar system was being investigated for industry in Melbourne.

PETER KER

Figure C.1. Original story "Water Trading a Step Closer" used in Economics lecture slides in Fig. 3.

Figure D.1. Power Point Slides for Pilot Introductory EfS Seminar in 2011.

Figure D.1. *(continued)*

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Chapter 7: Study Four

7.1 Paper (Multi-university study)

The personal context of student learning for sustainability: Results of a multi-university research study

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A B S T R A C T

The UN Decade of Education for Sustainable Development (DESD, 2005—2014) was an important framework and catalyst for increasing Sustainable Development (SD) efforts within academic institutions, worldwide. Tertiary institutions began to embed sustainability into the curriculum, although the extent has varied within and between institutions with many adopting an ad hoc approach. Previous studies of student learning outcomes were generally limited in scope and reported mixed results. Few studies systematically investigated the influence of sustainability education (SE) on student views, attitudes and behaviour across a range of contexts. This study adds to the field by using a common instrument that explored how SE contributed to student learning across multiple disciplines, institutions and countries. A quasi-experimental approach was adopted with tertiary students in 'intervention' and 'control' units. Data was collected using an online two-stage pre-post survey and included the Inclusion of Nature in Self (INS) and New Ecological Paradigm (NEP) scales and measures of selfreported behaviour. A series of snapshots of pre-test and post-test perspectives were taken across various terms of study during 2013—2015. Students' initial sustainability perspectives were found to be influenced by personal and educational factors such as gender, age, "culture" and discipline of study. Environmental worldviews were characterised by jointly strong ecocentric and anthropocentric orientations that represented a "utilitarian" view of human-nature relations. After controlling for pre-test scores, SE significantly increased post-test scores for several NEP dimensions compared to the control group however, the effect was weak and moderated by students' personal and educational context. Students exposed to SE also reported a cognitive shift in their attitudes/perceptions to sustainability that was linked to an increased INS score. The ad hoc approach to SE, combined with students' strong utilitarian worldview and mixed effects of SE indicated learning outcomes were far from certain and probably weak. The paper argued for a rethink of current educational approaches towards a more coherent and targeted educational strategy and concluded with recommendations for policy and praxis to enhance student learning for sustainability in higher education.

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1. Introduction

Higher Education Institutions (HEIs) are expected to take a leadership role in producing future leaders capable of managing sustainability challenges underpinned by social, cultural, economic and environmental developments (GUNI, 2012). Over the last two decades, many institutions have signed declarations, charters, partnerships and accreditation standards that commit them to contribute to sustainability through their curriculum, campus operations, research projects and community engagement activities

(Fisher and Bonn, 2017; Lozano et al.,2014a). An important recent initiative was the UN Decade of Education for Sustainable Development (DESD, 2005—2014), which had the goal of integrating the principles, values and practices of Sustainable Development (SD) into all aspects of education and learning (Holmberg and Samuelsson, 2006). It was an important framework and catalyst for increasing SD efforts and many HEIs around the world have begun to embed sustainability into key functional areas, initially in operations and gradually into their curricula. Three years after the DESD, one might ask how these HEI efforts are contributing to student learning.

HEIs often struggle in their attempts to integrate sustainability into and across functional activities, particularly in their teaching

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and learning practices (Fisher and Bonn, 2017; Leal Filho, 2014). While many Australian universities have publicly endorsed goals and values related to sustainability, the commitment is not usually reflected in their vision, mission and graduate attributes (Lee et al., 2013). Furthermore, the integration of Education for Sustainable Development (ESD) into curricula is mostly weak or non-existent (Fisher and Bonn, 2017). Recent global surveys show the extent of ESD varies within and between HEIs (Lozano et al., 2014a) and are often implemented in an ad hoc, laissez-faire manner. Assessment of student learning outcomes are usually reported for a limited range of impacts and the effects are mixed (Shiel et al., 2015). Case studies are usually related to specific interventions in particular institutions and are often focused on unique characteristics of individual programs, limiting the direct comparability between studies (Stern et al., 2014). Some empirical studies used a common metric to report the influence of ESD on attitudes or behaviour but few have relied on a common instrument to report student views, attitudes and behaviour across a range of contexts (Sammalisto et al., 2016; Zsóka et al., 2013). In a review of the UN DESD, Leal Filho (2014) reaffirmed the need to describe, document and disseminate state-of-the-art initiatives, empirical research and projects on ESD and concluded it still remains to be addressed in a systematic way. ESD researchers have also called for more longitudinal studies (WEEC, 2015).

This paper reports the results of a multi-university research study designed to systematically explore the relationship between Sustainability Education (SE) and tertiary students' worldviews, attitudes and self-reported behaviour towards sustainability. It used a common instrument across multiple disciplines, institutions and geographic locations in Australia, Europe and Asia. The study investigated the influence of tertiary education and SE (particularly when implemented in an ad hoc manner), by taking a series of snapshots at the beginning and end of term, during the period 2013—2015. The findings provided further insights into the evolving nature of students' sustainability perspectives and the contribution of higher education to student learning outcomes in the cognitive (thinking) and affective (valuing) domains (Reeves, 2006; Shephard, 2008; Shephard et al., 2015b). Results may be relevant to decision makers for the development of policy on ESD and for educational praxis.

The remainder of this paper is structured as follows. Section 2 provides a review of literature on students' knowledge, attitudes and behaviour towards sustainability, the integration of sustainability in the tertiary curriculum and the influence of sustainability education on students' sustainability perspectives. Section 3 presents an outline of the theoretical framework guiding this study. Section 4 describes the overall research design, research methods and limitations of the study. Section 5 presents the results and discussion of cross-sectional analysis of student data collected at the beginning of term (pre-test) and longitudinal (or diachronic) analysis of matched pre-post data collected across the term. Conclusions are drawn along with proposals for future research directions in Section 6.

2. Literature review

2.1. Environmental attitudes and behaviours

Environmental attitudes and concern for environmental issues have been investigated by researchers for several decades. Environmental behaviours are influenced by a range of personal, situational and contextual factors (Boeve-de Pauw et al., 2011; Franzen and Vogl, 2013; Swami et al., 2011; Turaga et al., 2010) with multiple motivations influencing behaviour in any particular setting

(Steg and Vlek, 2009). In a review of research over the past 30 years, Gifford and Nilsson (2014) identified no less than 18 personal and social influences on pro-environmental concern and behaviour: childhood experience, knowledge and education, personality and self-construal, sense of control, values, political and world views, personal goals, felt responsibility, cognitive biases, place attachment, age, gender and chosen activities, religion, urban—rural differences, norms, social class, proximity to problematic environmental sites and cultural and ethnic variations. Such a multiplicity of individual and social influences complicated any certainty of predicting whether a given person will be concerned about the environment or act in pro-environmental ways, even less so their response to sustainability education.

2.2. Integration of sustainability in the curriculum

An integrated curriculum maximises coherence when integration occurs both vertically and horizontally in the curriculum (Drake and Burns, 2004). Ceulemans and De Prins (2010) offered such a framework to discuss integration of SD into the Higher Education (HE) curriculum. Horizontal integration occurs when SD concepts are interwoven into individual existing courses across the curriculum and vertical integration occurs when separate dedicated SD courses are added into the curriculum. Researchers have identified many barriers to such an integrated approach, including multiple interpretations and the complex multidisciplinary and contested nature of SD (Aznar Minguet et al., 2011; Gale et al., 2015). Instead, HEIs have adopted a range of approaches, namely:

1. Elements of SD are "added-on" to selected courses within a program;
2. Specialist cross-disciplinary SD courses are introduced within existing programs;
3. Sustainability principles are embedded into core subjects of a program (Sherman and Hansen, 2010);
4. SD is offered as a specialisation within an existing program of study; and,
5. SD is offered as a dedicated program (Lozano et al., 2014b).

A vast body of literature has developed in the realm of ESD in HE. In a review of current research trends in HE for SD, Barth and Rieckmann (2015) categorised the field into four foci: exploratory studies, explanatory studies, descriptive studies and conceptual papers. Key topic areas included integrating SD into HE curricula (Burns, 2015; Ceulemans and De Prins, 2010; Gagnon et al., 2010; Pellicer et al., 2016; Verhulst and Van Doorsselaer, 2015), theories of teaching and learning (Lozano et al., 2014b; Pappas et al., 2013; Stubbs, 2013), barriers and drivers faced by curriculum developers and educators (Bessant et al., 2015; Ferrer-Balas et al., 2010; Huckle and Wals, 2015; McKeown, 2015) and key outcomes in terms of student knowledge, attitudes and behaviours (Gough and Gough, 2016; Hasslöf et al., 2016; Tuncer and Sahin, 2016).

This paper follows Sterling (2004) in adopting the term "Sustainability Education" (SE) as a catch all phrase for environmental education (EE), education for sustainability (EfS), ESD, environmental and sustainability education (ESE) and variants thereof. The literature on evaluation studies of SE is dominated by empirical and descriptive studies of specific approaches and individual initiatives in particular institutions. Previous case studies reported mixed impacts from specialised sustainability courses as well as integration of sustainability elements/concepts and pedagogy into mainstream courses such as Business, Engineering, Design and Education: McMillan et al. (2004) found formal coursework in introductory environmental studies had a positive effect on

students' environmental values; Karol and Mackintosh (2011) reported weak impact of a more transformative approach in a sustainable design course; Teisl et al. (2011) found significant changes in students attitudes after attending environmental literacy courses, although the direction of change depended on the instructor; and Remington-Doucette et al. (2013) found sustainability competencies developed differently in students with different disciplinary affiliations following an introductory sustainability course. These studies focussed on one aspect of environmentalism such as knowledge, or worldviews or behaviour. The most common measure of worldviews in evaluation studies was the New Ecological Paradigm (NEP) developed by Dunlap et al. (2000).

As the UN DESD drew to a close, studies used NEP to compare environmental worldviews of students in different disciplines and to examine the influence of their programs over time (Benckendorff et al., 2012; Harraway et al., 2012; Kuo and Jackson, 2014; Shephard et al., 2015a). Cross-sectional and longitudinal analyses showed significant differences in pre-test as well as post-test NEP responses that varied by discipline of study and demographic factors, principally gender. In some studies, students held a weaker pro-ecological stance after completing regular courses (Harraway et al., 2012); other research revealed little or no changes in attitudes after sustainability education (Dagiliūtė and Liobikienė, 2015; Jowett et al., 2013; Mintz and Tal, 2013; Rideout, 2014; Yavetz et al., 2009); some reported a mixture of responses (Dagiliūtė and Niaura, 2014; Felgendreher and Löfgren, 2017; Fisher and McAdams, 2015; Sidiropoulos et al., 2013) while a few reported improved self-efficacy and self-reported behaviours (Mullenbach and Green, 2016; Sidiropoulos, 2014). More recent studies addressed several aspects of students' attitudes and behaviour, again with mixed results. Fernández-Manzanal et al. (2015) found no change in behaviours in Spanish students; Robinson (2015) reported no behaviour change for UK students; Zareie and Navimipour (2016) found a positive effect on behaviour in Iran; studies by Nisiforou and Charalambides (2012), Hiller Connell and Kozar (2012) and Sammalisto et al. (2016) reported significant changes in students' knowledge over time but not in behaviour; while Zsóka et al. (2013) showed a strong relationship between the intensity of environmental education and the level of environmental knowledge and action.

When this multi-university study was conceived in 2012, few studies had evaluated pre-test and post-test measures of student worldviews, attitudes and behaviours across a range of countries. It was distinguished by including multiple measures of worldviews for tertiary students in different courses, disciplines, institutions and countries so it filled a gap in the literature. The specific objectives of the study were:

- To determine tertiary students' sustainability perspectives in terms of their worldviews, attitudes and behaviours prior to a tertiary education intervention
- To investigate the influence of demographic, educational and situational factors on students' sustainability perspectives
- To assess the relationship between tertiary sustainability education and students' sustainability perspectives and identify the influences that moderate this relationship.

3. Theoretical framework

Previous studies showed environmental attitudes and behaviour were influenced by various factors including education and learning experiences (Turaga et al., 2010). Notwithstanding the difficulty in establishing a causal link between education and pro-environmental behaviour (Vicente-Molina et al., 2013; Zsóka et al.,

2013), this study was premised on the proposition that Sustainability Education provides learning experiences that may alter student worldviews, attitudes and some types of environmental behaviour such as recycling and energy saving (Raymond et al., 2011; Steg et al., 2014; Turaga et al., 2010).

Accordingly, the study was informed by a conceptual framework that combined theories in environmental psychology and education. The study was guided by an established model of environmental behaviour, the Values Belief Norm (VBN) model (Stern, 2000), though not in a strictly linear fashion. The gap between environmental knowledge/awareness and pro-environmental behaviour is well known (Kollmuss and Agyeman, 2010) and a change in attitudes may not necessarily lead to changes in behaviour due to a variety of situational/contextual constraints, lack of information, psychological barriers, or lack of skills (Griswold, 2007).

The VBN model was chosen because it offered a comprehensive framework that conceptualised the influence of peoples' values, beliefs and situational factors on their pro-environmental behaviour. The model links value theory, specifically environmental worldviews, to beliefs, to norms/norm-activation theory and to environmental behaviour. It indicates possible points of influence by Sustainability Education on students' beliefs and potentially on their behaviour. In this study, the constructs of environmental worldviews were measured by the Inclusion of Nature in Self (INS) scale (Schultz, 2002) and beliefs were measured by the NEP scale (Dunlap et al., 2000). These scales are reliable and validated instruments, commonly used in research studies in environmental psychology and education and both are outlined further in the next section.

4. Research methods

4.1. Context for the study

This study builds on a Pilot Education for Sustainability study conducted in Australia in 2011, where tertiary educators investigated the influence of an introductory sustainability seminar and regular curricular interventions on students' pre-post knowledge and views about sustainability. Results showed students held different initial sustainability perspectives and responded differently to the same treatment (intervention) based on their gender, age, home region (culture) and level of study (Sidiropoulos et al., 2013). Findings were presented at the 2012 Australian Association for Environmental Education (AAEE) conference and a subsequent call was made across various channels inviting HEIs to participate in a wider study. Nine institutions from Australia, Malaysia and Italy participated in a wider study during 2013—2015. Ethical approval was obtained from the host institution CQUniversity, with reciprocal approval granted by all participating universities.

4.2. Survey design and methodology

The survey was developed by a consensus of staff at various participating institutions. It consisted of open and closed questions to determine students' worldviews, attitudes and behaviour towards sustainability and to assess the influence of demographic, academic and situational factors. Participants were asked about the importance of sustainability to their programme, their profession and their everyday lives: responses were scored as Unimportant (1), Slightly Unimportant (2), Don't Know (3), Slightly Important (4) and Very Important (5). The relationship with nature was assessed through several scales (INS, NEP). Self-reported behaviour was measured through statements on the frequency of personal self-reported actions for sustainability, with each item scored as

Never = 1, Rarely = 2, Occasionally = 3, Often = 4, Always = 5. Information was collected on demographic (age, gender, home region), educational (discipline of study, level of study) and situational characteristics (country of study, years in study country, mode of study). Pre and post surveys consisted of the same questions to enable comparisons over time. In addition, the post-test survey included a question on whether students experienced any cognitive changes in their views or perspectives about sustainability and the environment during the term.

4.2.1. Scales of environmental attitudes and worldview

The NEP scale is the most widely used measure (Dunlap, 2008) of an individual's value-based environmental worldview/attitudes towards the environment. It is widely acknowledged as one of the most reliable multi-item to measure peoples beliefs about the natural world in quantitative research (Lundmark, 2007). The scale was developed to measure endorsement of a coherent cognitive structure along a spectrum from an ecological view (ecocentrism), where humans are viewed as part of nature to a human dominant view (anthropocentrism), where humans are viewed as rulers of nature (Kopnina, 2011). The former view reflects the Dominant Social Paradigm (DSP) of individualism, free enterprise, endless progress, growth, abundance, confidence in science, and one that is contributing to environmental degradation, while the latter reflects the New Ecological Paradigm with nature a limited resource, delicately balanced and adversely affected by modern industrialised societies.

Ecocentric concerns center on the intrinsic value of plants and animals while anthropocentric concerns focus on the utilitarian value of nature for the benefit of humans (Schultz et al., 2000). The NEP scale contains 15 items rated on a 5-point Likert scale (strongly agree, mildly agree, unsure, mildly disagree, strongly disagree): each item is scored on a scale of 1—5, with the highest value corresponding to the most ecocentric response. The eight odd-numbered items indicate a pro-ecological view and seven even-numbered items indicate a pro-anthropocentric view. The NEP scale comprises five facets of an ecological worldview: limits to growth, based on constraints of nature; anti-anthropocentrism, is a rejection of human domination over nature; balance of nature, is the fragility and susceptibility of ecosystems to human interference; anti-exemptionalism, is a rejection of humans being exempt from constraints of nature; and eco-crisis, is the damage of human interference.

The NEP is not without its critics. Previous studies showed mixed results in terms of cross-cultural validity of NEP with lower levels of internal consistency in China, Latin American and Eastern European countries, suggesting it was not always translatable outside Western countries (Erdoğan, 2009; Kopnina, 2011). The main reason is the DSP and NEP were conceptualised in the United States and studies in Western countries supported a polarisation between anthropocentric and ecocentric worldviews. However, this polarisation is not universal and other studies suggest some integration of these two worldviews. Corral-Verdugo et al. (2008) showed the ecocentric view is compatible with anthropocentric beliefs in some cultures, as borne out by studies of Brazilian, Japanese and Mexican participants, and they suggest a conciliation of the eco-anthropocentric dichotomy. Dunlap et al. (2000) acknowledged variability of environmental perceptions in different contexts and suggested NEP be used as a multidimensional tool, to document variation in the structure and coherence of an ecological worldview across different cultures/contexts and any changes over time. Despite its shortcomings, using NEP as a single measure remains the "gold-standard" measure of environmental concern (Hawcroft and Milfont, 2010).

In this study, a range of aggregate NEP scores were used and complemented by two other indicators of an individual's relationship to nature. Students' connectedness to nature was measured by the 'inclusion of nature in the self' (INS) scale, which indicates 'the extent to which an individual includes nature within his/her cognitive representation of self' (Schultz, 2002). The scale consists of seven pairs of circles and respondents are asked to choose the pair that best represents the connection between their "self" and "nature". The INS scale is shown in Fig. 1 with scoring ranging from A = 1 to G = 7.

4.3. Sample selection

A quasi-experimental design was adopted (Steckler et al., 1992) with convenience sampling used to provide a wide representation of courses, disciplines and locations. Courses were included from a range of disciplines (engineering, architecture, business, sports medicine, health, biological sciences, education, etc.), modes of study, locations/countries, and also covered a range of approaches to SE. Malaysia and Italy were included in the study as their students were enrolled in Architecture & Engineering courses that were included in Australia. This allowed for a comparison of
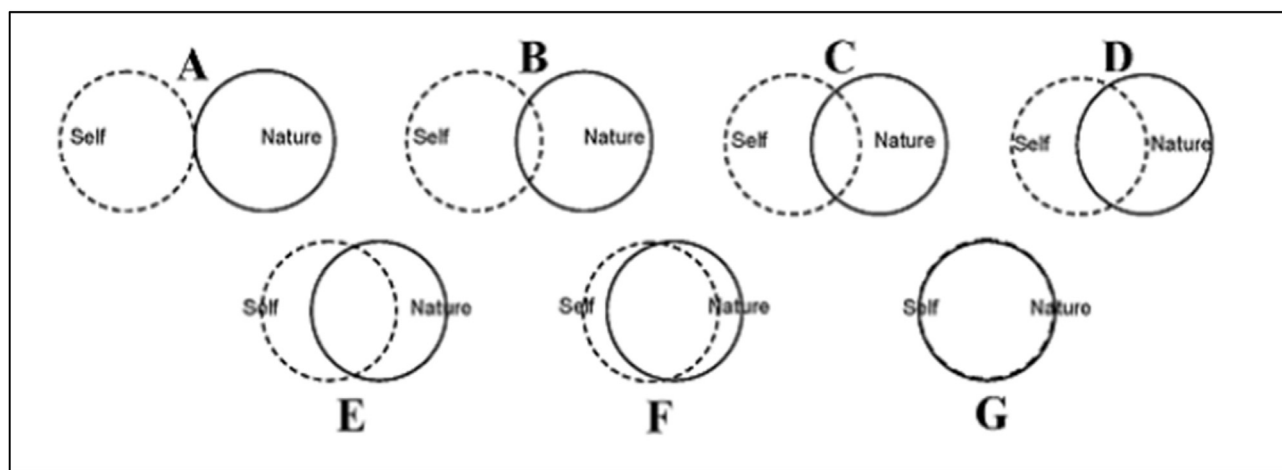
Fig. 1. Degrees of interconnectedness with nature (INS; Schultz, 2002), Students' relationship with the natural environment in terms of hierarchy (dominance) was also explored in a Hierarchy with Nature (HWN) scale, as proposed by the researchers (Sidiropoulos et al., 2014) and shown in Fig. 2. Responses were scored for each set of circles from "nature-within-self" = 1 (A), "nature-equal-self" = 2 (B) and "self-within-nature" = 3 (C).

Fig. 2. Hierarchy with Nature (HWN) scale.

responses within a particular discipline across different geographic contexts. Course coordinators allocated their units either to an "intervention" or "control" cohort based on course content: students in intervention groups were exposed to sustainability concepts that represented at least 10 percent of course content and/or assessment, while control groups had no element of sustainability. In most locations, samples were drawn across comparable "intervention" and "control" cohorts preferably within the same programme of study, although this was not always possible. Overall, the intervention cohort was representative of the "ad hoc" or laissez-faire approach to SE in HE (Leal Filho, 2014; Lozano et al., 2014a).

4.4. Data collection and statistical analysis

Data was collected online with Survey Monkey using the pre and post-test surveys at the beginning and end of term. Students were assured of their confidentiality and anonymity and participated voluntarily, so responses were genuine. Survey Monkey used batches of student emails to generate a confidential web link for each student. Computer generated matching processes were then employed across 18 data sets from 7 institutions to match pre and post-test responses, thus maintaining the integrity of anonymity and confidentiality of data at all times. The full dataset comprised 1449 unique responses: 810 were pre-test only (Stage 1), 210 were post-test only (Stage 2) and 429 were matched pre-test and post-test (Stages 1 & 2). Cross-sectional analyses were conducted on data from pre-test only (Stage 1) and matched pre-post responses (Stages 1 & 2), while longitudinal analyses were performed on matched pre-post responses (Stages 1 & 2).

Exploratory data analysis was conducted to investigate the data in terms of consistency, normality, skewness, kurtosis, missing values, etc. The incidence of missing values ranged from 14 to 24 percent for individual items in cross sectional data while in longitudinal data, the range was 7.5–12 percent for pre-test and 7–9 percent for post-test responses. Scores for aggregate and average measures of NEP and overall self-reported behaviour were calculated only if 80% + of individual items were answered with missing data not replaced by means. This was due to the level of missing values from within individual responses and the wide variability of responses between participants. This approach was considered more robust and expected to provide more reliable results (Pallant, 2016). In total, around 20 percent of cases were excluded from the cross-sectional sample. For the longitudinal sample, 11 percent were excluded in the pre-test data and 7 percent in the post-test data.

Statistical analyses were performed with the use of SPSS v22 for WINDOWS (SPPSS Inc., Chicago, IL). Quantitative data analyses comprised descriptive and inferential statistics including a variety of parametric and non-parametric tests as required by normality of the data. Tests included correlations, t tests, analysis of variance, analysis of covariance and non-parametric tests (Chi-squared,

Wilcoxon Signed-Rank tests, Mann-Whitney U tests). All tests were examined for significance at P values of alpha = .05. Post−hoc comparisons between groups were made using Tukey's HSD test for equal variances or Games-Howell test for unequal variances (Pallant, 2016). Reliability of various NEP scales were tested using Cronbach's alpha, where 0.7 indicated an acceptable value and Cohen's standard was used to evaluate the strength of relationships, or effect size (Pallant, 2016).

Pre-test data was analysed cross-sectionally to investigate students' baseline worldviews, attitudes and behaviour and to assess the influence of demographic, educational and situational factors. Matched pre-post data was analysed longitudinally to investigate changes in student perspectives over the term and to assess the influence of SE and demographic, educational and situational factors.

4.5. Limitations

Methodological limitations of this study relate to the representativeness of the sample and the generalisability of results, as follows:

- Lack of comparability in disciplines (except Architecture & Engineering) across the three countries;
- Lack of comparability in levels of study across disciplines;
- Lack of comparability in treatment groups (intervention and control) across institutions;
- Self-selection bias in respondents who completed the survey on-line;
- Variable student response rates across courses, levels and locations (2−75% in matched data); and
- Highly variable rate of missing values across dependent variable scores.

As with other educational research studies, this study was constrained by the nature of students that were accessible and the distribution of potentially confounding characteristics across the sample (Tolmie et al., 2011). Further, results reported here refer to quantitative analyses, which do not always capture the nuances of subtle changes in students' sustainability perspectives. Analysis using mixed/merged methods is preferred to "qualify" the results and provide greater depth and insights into student learning for sustainability (forthcoming paper).

Notwithstanding these limitations, the study encompassed several disciplines, levels and modes of study across a range of countries, providing a large sample size (1239 respondents) that made it possible to conduct both descriptive and inferential statistical analysis and draw some general conclusions. While small sample sizes in some disciplines and self-selection bias limited the ability to draw strong inferences on the influence of SE in all settings, the study provided some useful insights.

5. Results and discussion

5.1. Cross−sectional analysis of pre-test data

The cross-sectional sample (N = 1239) was drawn from Australia (86%), Italy (10%) and Malaysia (4%). Table 1 shows the educational composition of the sample by "treatment" group in terms of discipline, level and mode of study. Courses were categorised into five broad discipline groups with some imbalance in the sample between control and intervention cohorts across disciplines and countries: Architecture & Engineering was the only discipline represented in all three countries; Arts students were all in intervention units while Education students were all in control units. The sample was also skewed in terms of level of study: Tertiary Preparation (TP) respondents were all located in Australia and enrolled in science (intervention) courses while PhD students were all in Italy in Architecture & Engineering (control) courses.

Table 2 shows the demographic profile of respondents by treatment group in terms of age, gender and home region. Gender distribution was typical of distance (off-campus) enrolments, particularly in regional universities (such as CQUniversity and USQ) in Australia although gender was more evenly balanced for cohorts in Italy and Malaysia. Main country of residence, i.e., where students lived most of their life, was used as a proxy for home culture, with countries grouped into regions of similar values according to the World Values Survey (WVS). The WVS showed a pronounced culture zone pattern where countries with similar cultures (grouped as English speaking, Confucian, Islamic, Latin American, etc.,) clustered around key values associated with sustainability

Table 1
Educational profile of survey participants in the pre-test sample by group.

Type of group[a]	Control	Intervention	Total
Discipline of Study			
Accounting, Business Management & IT	288	251	539
	52.4%	40.1%	45.8%
Science	154	118	272
	28.0%	18.8%	23.1%
Architecture & Engineering	60	183	243
	10.9%	29.2%	20.7%
Arts	1	70	71
	.2%	11.2%	6.0%
Education	47	4	51
	8.5%	.6%	4.3%
Total	**550 (48.6%)**	**626 (53.2%)**	**1176 (100%)**
	100.0%	100.0%	100.0%
Level of study			
Tertiary Preparation (TP)	2	18	20
	.4%	2.7%	1.6%
Undergraduate (UG)	400	557	957
	71.4%	84.1%	78.3%
Postgraduate (PG)	139	85	224
	24.8%	12.8%	18.3%
PhD	19	2	21
	3.4%	.3%	1.7%
Total − level of study	**560**	**662**	**1222**
	100.0%	100.0%	100.0%
Mode of study			
Off campus	165	248	413
	29.5%	37.3%	33.7%
Mixed mode - both	6	18	24
	1.1%	2.7%	2.0%
On Campus	388	399	787
	69.4%	60.0%	64.3%
Total − mode of study	**559**	**665**	**1224**
	100.0%	100.0%	100.0%

[a] Differences in the totals for each variable within each group reflect the number of students who provided information.

Table 2
Demographic profile of survey participants in the pre-test sample by group.

Type of group[a]	Control	Intervention	Total
Age group			
Less than 18 years	32	18	50
	7.3%	3.5%	5.3%
18-24 years	179	246	425
	41.1%	48.0%	44.8%
25 - 40 years	193	170	363
	44.3%	33.1%	38.3%
More than 40 years	32	79	111
	7.3%	15.4%	11.7%
Total	**436**	**513**	**949**
	100.0%	100.0%	100.0%
Gender			
Male	167	213	**380**
	33.1%	36.3%	34.8%
Female	338	373	**711**
	66.9%	63.7%	65.2%
Total	**505**	**586**	**1091**
	100.0%	100.0%	100.0%
Home Region - main country of residence			
Australia, NZ, UK, USA, Canada	212	312	524
	49.3%	61.4%	55.9%
North Asia (China, Taiwan, Vietnam, South Korea, Hong Kong, Japan)	73	43	116
	17.0%	8.5%	12.4%
European Union	50	63	113
	11.6%	12.4%	12.0%
Subcontinent (India, Pakistan, Nepal, Bangladesh, Sri Lanka)	42	27	69
	9.8%	5.3%	7.4%
South Asia (Malaysia, Indonesia, The Philippines, Singapore, Thailand)	23	39	62
	5.3%	7.7%	6.6%
Africa, Middle East	16	16	32
	3.7%	3.1%	3.4%
Latin America	7	5	12
	1.6%	1.0%	1.3%
Other (Russia, Belarus, Pacific Islands, PNG)	7	3	10
	1.6%	.6%	1.1%
Total − Main country of residence	**430**	**508**	**938**
	100.0%	100.0%	100.0%

[a] Differences in totals for each variable within each group reflect the number of students who provided information.

such as universalism and self-expression (Inglehart and Welzel, 2010).

Discipline of study was skewed across regions with Accounting, Business Management and IT accounting for almost all students from North Asia, the Subcontinent and Latin America. Age distribution was skewed with almost all respondents under 18 years of age being from Anglo-Saxon countries, while all PhDs were from EU.

Students' sustainability perspectives are presented in three sections, namely their worldviews/attitudes, self-reported behaviours and the relationship between worldviews/attitudes and self-reported behaviours. Table 3 presents a summary of significant effects of demographic, educational and situational factors on various scores with differences between groups represented by a tick.

5.1.1. Worldviews and attitudes

5.1.1.1. Importance of sustainability, INS and HWN. Students rated the importance of sustainability to their study programme, profession and everyday lives. For the Architecture & Engineering cohort located in three separate countries, no significant differences were found by country of study for any score of importance of sustainability, although responses varied significantly by age, gender, home region and level of study. For the overall cross-sectional sample, respondents in Australia reported higher scores than in Italy and Malaysia (F = 3.246, df = 2, p = 0.039 with an

Table 3
Significant differences in mean scores between groups (factors) in the pre-test sample.

SCORES	Group	Gender	Age	Home region	Level of Study	Discipline of study	Country of study	Years in study country	Mode of study
Average NEP	√**	√**	√**	√**	√**	√**	√*	√**	√**
INS			√**	√*	√**			√*	
HWN			√**		√*	√*			
NEP- Limits	√**		√**	√**	√*	√**	√**		√**
NEP- Dominance	√**	√**	√**	√**	√*	√**	√**	√**	√**
NEP- Balance	√**	√**	√**	√**	√*	√**	√**	√**	√**
NEP-Constraints	√**	√**	√**	√**	√**	√**	√*	√**	√**
NEP-Ecocrisis	√**	√**	√**	√**		√**		√**	√**
Average ECO Orientation	√**	√*	√**	√*		√**			
Average HUMAN Orientation	√**	√**	√**	√**	√**	√**	√**	√**	√**
Importance of sustainability-study programme		√*	√*		√*		√*	√**	√**
Importance of sustainability-profession			√**		√*	√**		√**	√**
Importance of sustainability-everyday life			√**		√*	√*		√*	
Behaviour - total			√**	√**		√**	√**	√**	

A variety of parametric tests were used to compare means including one-way ANOVA t tests (normal data), as well as non-parametric tests such as Kruskal-Wallis and Mann-Whitney U Test (skewed data).
√*Sig at 0.05 level, √**Sig at 0.01.

Eta = 0.078) for the importance of sustainability to their study programme. Level of study also influenced scores for the importance to their study programme (F = 3.334, df = 3, p = .019 with an Eta of 0.01); their profession (F = 3.395, df = 3, p = .017 with an Eta of 0.01); and everyday lives (F = 3.079, df = 3, p = 0.027 with an Eta of 0.01).

Fig. 3 shows responses for the importance of sustainability by discipline of study. Significant differences were detected in importance to their profession (n = 991, F = 4.016, df = 4, p = 0.003 with an Eta of 0.127) and everyday lives (n = 990, F = 2.499, df = 4, p = 0.041 with an Eta of 0.100) with no differences detected by study programme.

Fig. 4 shows the distribution of student responses for the personal HWN scale, where A represents the left diagram, B the middle diagram and C the right diagram. The results suggested students generally did not view nature as subordinate to themselves

however, the result may differ depending on whether respondents interpreted "self" as relating to them personally or as representing all of humanity.

Significant differences in HWN scores were observed by discipline of study (n = 881, F = 2.696, df = 4, p = 0.030, eta = 0.110), although no differences were observed in INS scores.

Gender differences were not found for any measure of the importance of sustainability, INS or HWN scores. However, respondents' age group was a significant factor with mean scores for all measures rising with age:

- the importance of sustainability to their study programme (F = 3.233, df = 3, p = 0.022 with an Eta of 0.101), their profession (F = 4.319, df = 3, p = 0.005 with an Eta of 0.117) and everyday lives (F = 7.687, df = 3, p = 0.000 with an Eta of 0.156);
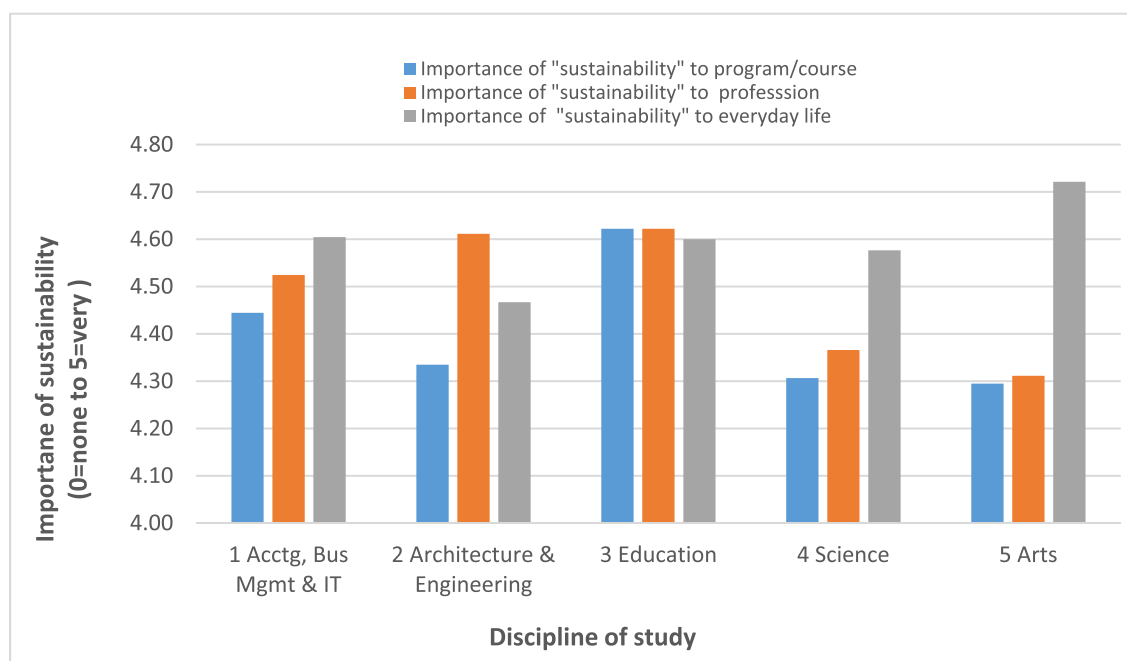

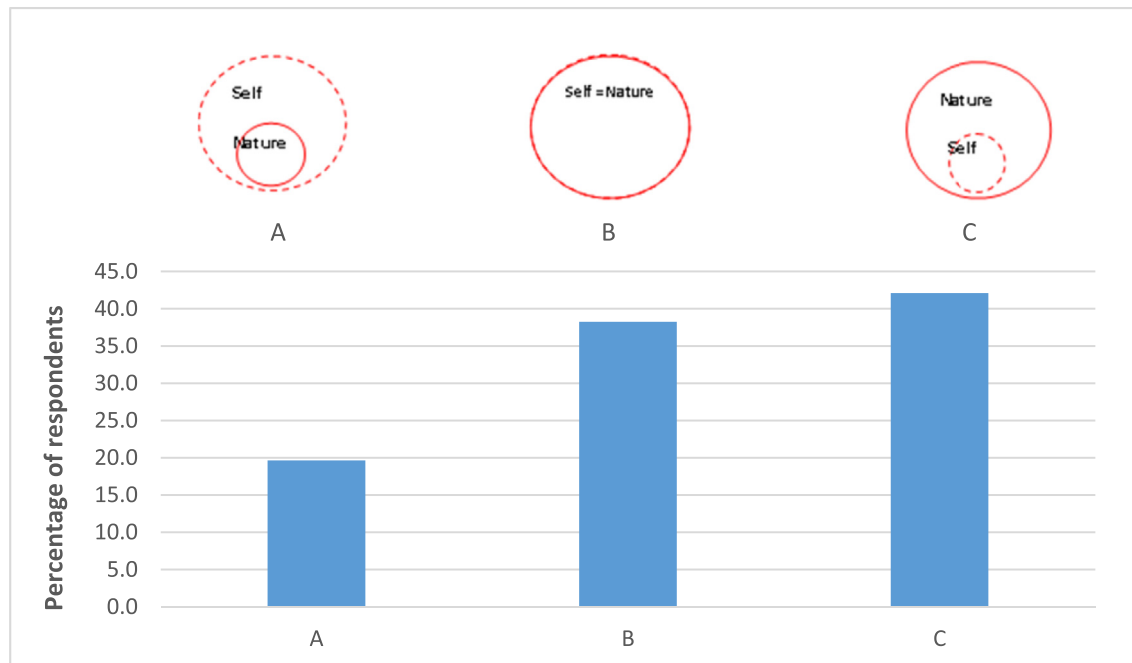**Fig. 3.** Importance of sustainability scores in the pre-test sample by discipline.

Fig. 4. Distribution of personal hierarchy with nature (HWN) scores in the overall pre-test sample.

- the INS score (F = 4.851, df = 3, p = 0.002 with an Eta of 0.125); and
- the HWN score (F = 4.822, df = 3, p = 0.002 with an Eta of 0.127).

Home region (culture) also revealed significant differences for the importance of sustainability to their programme (F = 2.448, df = 7, Eta2 = .018) and for INS scores (F = 2.178, df = 7, p = 0.034 with an Eta of 0.117).

5.1.1.2. NEP scores. Table 4 presents results of nine types of NEP scores and related Cronbach's alpha scores across the pre-test sample. Given the high incidence of missing data for individual NEP items, aggregate scores for Total NEP, ECO orientation and HUMAN orientation were used to calculate Cronbach's alpha scores and not for further analysis.

Student environmental attitudes were not polarised between ecocentric and anthropocentric orientations. Instead, views were jointly strong in ECO (4.01) and HUMAN (3.10) orientation that represented an "instrumental" or "utilitarian" view, with nature valued in terms of benefits to humans. Cronbach's alpha scores for reliability of the total NEP scale (0.776) and for ecocentric (0.744) and anthropocentric (0.789) orientations confirmed the strong 'utilitarian" view. This view was also reflected in Cronbach's alpha scores for each of the five dimensions of NEP where views were strongly aligned with Anti-Anthropocentrism or Dominance

(0.624) and Eco-Crisis (0.513) but there was much less coherence for Limits to Growth (0.374), Balance of Nature (0.366), and Anti-Exemptionalism or Constraints (0.356). This finding contradicted the claim of a shift in the SD discourse from an anthropocentric to a more ecocentric worldview (Baker, 2006). Instead, it revealed a convergence characterised by an increased sensitivity to environmental damage and a growing confidence in human ingenuity to overcome environmental limits or constraints. The finding concurred with the earlier pilot study (Sidiropoulos et al., 2013) and confirmed other research reporting a growing 'anthropocentric environmentalist' or 'utilitarian' view in students around the world (Bechtel et al., 2006; Corral-Verdugo et al., 2008; Dervisoglu, 2010; Erdogan, 2013; Erdoğan, 2009; Kuo and Jackson, 2014; Teisl et al., 2011), and particularly in developing/transitional economies.

Gender had a pervasive effect across several demographic and educational contexts. Females reported significantly higher scores for Average NEP (M = 3.68, SD = 0.53, n = 607) than males (M = 3.48, SD = 0.53, n = 345), F(1,951) = 31.22, p = 0.000. Gender differences were most pronounced in the Average HUMAN Orientation score for females (M = 3.22, SD = 0.81) compared to males (M = 2.89, SD = 0.78); F(1,952) = 36.58, p = .000) although the effect was small (Eta2 = .04) (Pallant, 2016). The same pattern was observed for all NEP dimensions and most behaviour items. It was evident across age groups (except under 18 years) and discipline groups (except the control cohort in science) but not in different cultures. These findings confirmed studies of marked gender

Table 4
Mean scores for various NEP measures and Cronbach's reliability scores in the pre-test sample.

	Total NEP	Average NEP	LTG Limits	AA Dominance	BN Balance	AE Constraints	Eco-Crisis	ECO orientation	HUMAN orientation
Pre-test (mean)	53.63	3.61	3.24	3.78	3.83	3.40	3.78	32.05 (4.05)	21.69 (3.10)
SD	8.21	0.54	0.76	0.88	0.70	0.72	0.78	4.88	5.72
n	966	966	968	968	966	968	964	957	968
Cronbach's Alpha	0.776	—	0.374	0.624	0.366	0.356	0.513	0.744	0.789

Total sample (n = 1239), Intervention (n = 586), Control (n = 505).

differences in pro-environmental stance and behaviour (Dijkstra and Goedhart, 2012; Erdogan, 2013).

Respondents aged over 40 years had significantly (p < .005) higher scores than all other age groups for Average NEP scores and for all NEP dimensions. Significant differences in Average NEP scores were found across age groups, F (3,943) = 23.95, p = .000) with a moderate effect (Eta2 = .07). The overall results revealed a notable dip in Average NEP scores for early/young adults (18–24 years) as shown in Fig. 5. Post-hoc comparisons showed scores for students aged 18–24 years (M = 3.51, SD = 0.52) was significantly lower than in the 25–40 years group (M = 3.61, SD = 0.51) and people over 40 years (M = 3.98, SD = 0.57), but not different from students under 18 years (M = 3.63, SD = 0.52). The same dip pattern was observed in the Average HUMAN Orientation score but not the Average ECO Orientation or INS scores, both of which increased progressively with age.

This dip in scores may reflect the nature of the sample with a high proportion of North Asian students (lowest NEP scores) in the 18–24 years group and a high proportion of females (highest scores) in the under 18 group. Another possibility is that it may be symptomatic of a more widespread "early adult dip", akin to the "adolescent dip" found in 14–16 year olds (Olsson and Gericke, 2016). It could represent a "life cycle" or "stage of life" effect (Arnett, 2000) where young adults are emerging into adulthood and navigating great change (Rindfuss, 1991; Wallace, 1995) and possibly less concerned with environmental and social issues. However, cross-national studies have indicated such a life stage is more pronounced in countries with strong individualistic cultures compared to collectivist cultures (Arnett, 2000). Alternatively, the
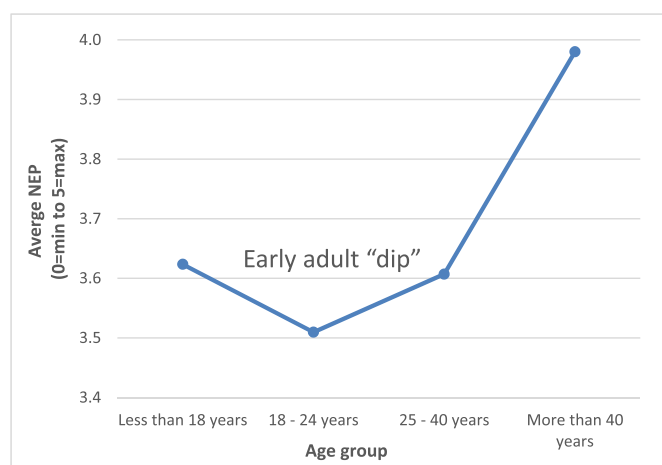
"dip" may reflect the on-going influence of the DSP on undergraduate education and the development of more pro-anthropocentric views. For tertiary educators, it is potentially a time of great influence as emerging adults undergo changes in their worldviews (Perry, 1999) and they obtain the knowledge and skills for their future careers. Providing targeted and differentiated SE could effectively engage young adults during this formative stage and build their competencies.

Table 5 presents Average NEP scores by home region, which varied significantly: Welch adjusted statistic F(7, 79.43) = 26.822, p = .000. Post-hoc comparisons showed students from Anglo-Saxon countries reported significantly higher scores than all other groups except the EU and Latin America. Respondents from the EU also reported significantly higher scores than those from North Asia, South Asia and the Indian Subcontinent.

Findings confirmed results from the earlier pilot study (Sidiropoulos et al., 2013) and elsewhere (Dunlap, 2016; Inglehart and Welzel, 2010; Schwartz, 2007; Soyez, 2012) and reaffirmed the influence of national context and cultural background in shaping students sustainability perspectives, highlighting the importance of adopting a more nuanced and tailored approach to SE.

Table 6 presents Average NEP scores by discipline of study, which exerted a significant effect: Welch adjusted statistic F (4, 168.06) = 26.57, p = .000.

Students in Arts, Science and Education disciplines recorded significantly higher scores than those in Accounting, Business Management & IT or Architecture & Engineering. These findings confirmed previous research of lower scores for Business students (Lang, 2011) and Engineering students (Kuo and Jackson, 2014) compared to other majors. To investigate further, the cross-sectional sample was analysed by individual discipline to investigate any differences in average scores for NEP, ECO and HUMAN orientation. Results showed remarkable consistency within certain disciplines (Education and Arts) reflecting greater homogeneity despite differences in gender and age. Conversely, respondents in Business, in Science and in Architecture & Engineering held more divergent views within their disciplines, with scores influenced by demographic factors of age, gender and home region.

Several explanations can be offered for these observed differences. The course content could be shaping student perceptions over time, or it may indicate a pre-existing bias towards technological solutions and the moral right of humans to manipulate their environment (Teisl et al., 2011). Beliefs are reinforced by the epistemological and ontological assumptions of particular disciplines and lead to divergent conceptualisations of "sustainability" (Christie et al., 2014; Fisher and McAdams, 2015; Sylvestre et al., 2013; Wiek et al., 2011). Indeed, "epistemological silos" have at times, obfuscated the role of values and cognitive aims of

Fig. 5. Mean scores of Average NEP in the pre-test sample by age.

Table 5
Descriptive statistics for Average NEP scores in the pre-test sample by home region.

Average NEP						
Home region	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
					Lower Bound	Upper Bound
Africa, Middle East	32	3.3958	.51777	.09153	3.2092	3.5825
Australia, New Zealand, UK, USA, Canada	524	3.7572	.58773	.02568	3.7068	3.8077
European Union	111	3.6512	.32858	.03119	3.5894	3.7130
Latin America	12	3.6778	.43096	.12441	3.4040	3.9516
North Asia	116	3.2460	.34225	.03178	3.1830	3.3089
South Asia	62	3.3624	.42860	.05443	3.2535	3.4712
Subcontinent	69	3.3930	.33972	.04090	3.3114	3.4746
Other	10	3.5200	.39353	.12444	3.2385	3.8015
Total	**936**	**3.6124**	**.53973**	**.01764**	**3.5778**	**3.6470**

Table 6
Descriptive statistics for Average NEP scores in the pre-test sample by discipline of study.

Average NEP					95% Confidence Interval for Mean	
Discipline of study	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
Accounting, Business Mgmt. & IT	416	3.4196	.50823	.02492	3.3706	3.4685
Architecture & Engineering	192	3.5909	.39486	.02850	3.5347	3.6472
Education	36	3.7463	.37807	.06301	3.6184	3.8742
Science	214	3.8370	.57431	.03926	3.7596	3.9144
Arts	57	3.8515	.50866	.06737	3.7165	3.9864
Total	**915**	**3.5929**	**.52988**	**.01752**	**3.5585**	**3.6273**

knowledge production, whether intentionally or not (Miller et al., 2008). Alternatively, different scores for Average NEP by discipline may simply have reflected students' personality (Lang, 2011) where choice of discipline resonated with students personal values. However, there are limits to the assertion that personal preferences are revealed in free choice, as this is largely a characteristic of liberal democracies and not as prevalent in traditional collectivist societies, where students are more influenced by family priorities (Bomhoff and Gu, 2012). This consideration may have influenced many international students in the sample. Also, longitudinal studies showed that personality accounted for a small part of differences in environmental worldviews or changes in views after SE (Boeve-de Pauw et al., 2011), so discipline and other "cultural" factors remained significant influences. In summary, the relative influence of personality, culture and discipline and their contemporaneous effects remain largely unknown.

Table 7 presents Average NEP scores by level of study, which had a significant effect between groups: Welch adjusted static $F(3, 41.66) = 8.30$, $p = .000$. Post-hoc comparisons show scores for undergraduate students were significantly higher ($p = .00$) than postgraduate students. However, the apparent decline in Average NEP scores with increasing levels of study should be interpreted with caution, given the skewness in the data sample. No significant differences were found within any discipline, suggesting these differences could reflect other factors.

There were significant differences in Average NEP scores between treatment groups: Welch adjusted static $F(1, 963.6) = 30.61$, $p = .000$. Students in the "Intervention" group reported significantly higher scores (M = 3.69, SD = 0.562) than their counterparts in "Control" (M = 3.51, SD = 0.487). This was somewhat surprising because in most disciplines, students in intervention and control groups were enrolled in the same programme of study. Moreover, most Intervention units in Business and in Engineering & Architecture were compulsory units and not always freely chosen by students. To investigate further, a full range of ANOVA one-way tests were conducted for each individual discipline by Group. As expected, there was no difference in Average NEP scores between cohorts in Architecture & Engineering. However, differences were observed between groups in Business and in Science. Within

Science, the strongest influence on scores in the Intervention group was the higher mean scores for respondents in "Sustainability-focussed" units (particularly Average ECO Orientation) compared to other science students. Within the Business discipline, scores in the Control cohort were consistently lower across gender, age, and home region except for students from South Asia, Latin America and the Indian Subcontinent whose scores were higher than the Intervention group. This finding supported the contention that scores for the two cohorts did not always represent students with inherently different environment views/attitudes.

The significance of such variability in sustainability perspectives in the pre-test sample indicated the importance of the personal, situational and educational context in any given learning setting. The importance of context is explored further in Section 5.2, which reports the comparative effects of regular tertiary education and SE.

5.1.2. Personal self-reported behaviours

The list of personal self-reported actions for sustainability and the environment is summarised in Table 8.

Fig. 6 shows the frequency of 10 individual items of self-reported actions. Participants engaged frequently in low commitment actions such as separating waste (recycling), saving energy and water while high commitment actions such as collecting and reusing water, growing food and composting were undertaken less frequently.

Self-reported sustainability behaviour was analysed by each of the 10 personal actions for sustainability and by the sum of all personal actions for sustainability. The influence of demographic and academic factors was also investigated. Whilst both gender and treatment group exerted significant effects on respondents' attitudes and worldviews, neither translated into significant differences in overall behaviour.

Significant effects on overall self-reported sustainability behaviour scores were as follows:

- demographic factors of **age** (n = 946, F = 11.047, df = 3, p = 0.000, eta2 = 0.034) and **home region** (n = 934, F = 11.214, df = 7, p = 0.000, eta2 = 0.078) shown in Fig. 7;

Table 7
Descriptive statistics for Average NEP scores in the pre-test sample by level of study.

Average NEP					95% Confidence Interval for Mean	
Level of Study	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
Tertiary Preparation (TP)	15	3.6844	.82210	.21227	3.2292	4.1397
Undergraduate (UG)	746	3.6453	.55068	.02016	3.6057	3.6849
Postgraduate (PG)	171	3.4513	.43359	.03316	3.3858	3.5167
PhD	19	3.5527	.23686	.05434	3.4385	3.6669
Total	**951**	**3.6092**	**.53679**	**.01741**	**3.5750**	**3.6433**

Table 8
Personal self-reported actions for sustainability and the environment.

Activity	Description
Waste separation	Separate waste and place recyclables (paper, plastics, glass, aluminium, etc.) into recycling bin
Save energy	Save energy by turning off lights and electronic equipment
Grow food	Grow some of your own food
Compost	Compost garden waste and kitchen scraps
Save water	Take shorter showers and/or conserve water by other means
Collect water	Collect and use rainwater
Public transport	Ride your bike or public transport instead of using a car
Nature	Participate in bushwalking or other nature-based outdoor activities
Donate	Donate to social or environmental groups
Volunteer	Volunteer for social or environmental benefit
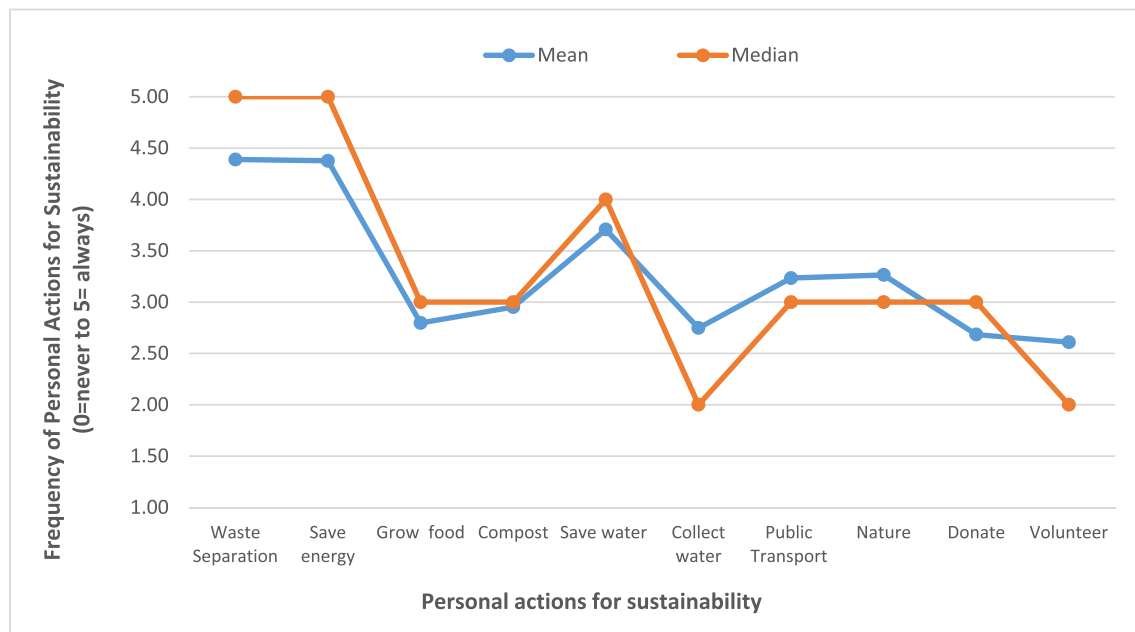
Fig. 6. Frequency of self-reported personal actions for sustainability in the pre-test sample.
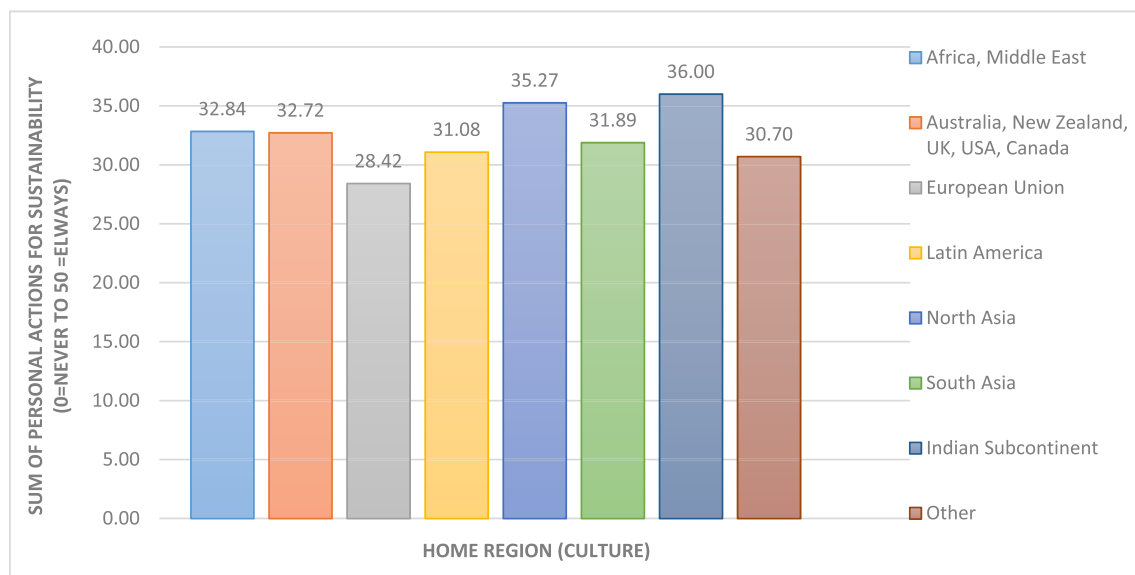
Fig. 7. Overall self-reported sustainability behaviour scores in the pre-test sample by home region.
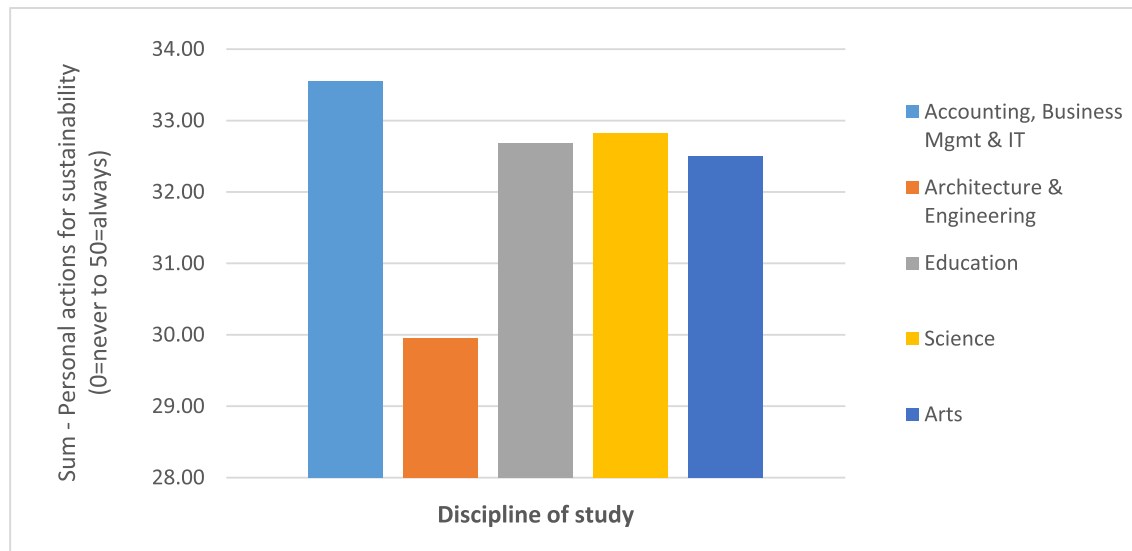
Fig. 8. Overall self-reported sustainability behaviour scores in the pre-test sample by discipline of study.

- situational factors of **country of study** (n = 991, F = 22.457, df = 2, p = 0.000, eta2 = 0.047) and **years in the country of study** (n = 932, F = 7.534, df = 3, p = 0.000, eta2 = 0.024); and
- educational factor of **discipline of study** (n = 940, F = 9.301, df = 7, p = 0.000, eta2 = 0.038) shown in Fig. 8.

Respondents' age influenced their scores for overall self-reported behaviour and most sustainability actions. Only the group aged over 40 years (M = 36.14, SD = 6.681) was significantly different from other age groups: less than 18 years (M = 32.02, SD = 5.615), 18—24 (M = 31.86, SD = 7.132) and 25—40 (M = 32.58, SD = 7.089).

Home region was the most influential factor on overall sustainability behaviour, as reflected in the highest eta2 value of 0.078. Significant differences were found across all individual self-reported actions and were consistent with cultural patterns observed in previous research (Cotton et al., 2016; Vicente-Molina et al., 2013).

Country of study significantly affected scores for overall self-reported behaviour and for most individual items. Post-hoc comparisons indicated respondents in Italy (M = 28.24, SD = 5.634) scored significantly lower than Australia (M = 33.19, SD = 7.005) and Malaysia (M = 32.22, SD = 7.559). This confirmed the pattern for home region and highlights the potential influence of social norms on personal behaviour. Low commitment actions may not be linked to environmental perspectives at all: waste separation and recycling are social norms in Australia according to Roy Morgan Research (2016), while saving water and electricity provide financial benefits.

Discipline of study was found to be significant for overall self-reported behaviour but only between three groups: Architecture & Engineering (M = 29.95, SD = 6.538) was significantly lower than Accounting, Business Management and IT (M = 33.55, SD = 7.284) and Science (M = 32.83, SD = 6.836) groups. The high score for the Accounting, Business Management & IT group could be considered an anomaly given their comparatively low scores for NEP, HWN and importance of sustainability. The apparent disconnection between perspectives and actions towards the environment may reflect moral obligations (Chen, 2016) or possibly a 'social desirability bias' (Milfont, 2009), particularly for the large proportion of North Asian students in the sample (see Fig. 8).

5.1.3. Relationship between attitudes and self-reported behaviour

The relationship between worldviews, attitudes and behaviours was explored using the non-parametric Spearman rho (rank) correlation (Pallant, 2016). Significant correlations were found between attitudes and behaviours as shown in Table 9. The most significant correlations for Overall self-reported behaviour were INS score (9% of total variation), Average Ecocentric orientation (4%) and to a lesser extent, NEP-Limits to Growth. Both INS and Average Ecocentric scores were strongly correlated with high commitment rather than low commitment self-reported actions. No significant correlation was detected between Overall self-reported behaviour and Average NEP, which in turn was weakly correlated with "low commitment" actions.

These findings confirmed previous research and may reflect a lack of coherence in the development of students' sustainability orientations across their views/attitudes and self-reported behaviours (Kollmuss and Agyeman, 2010; Lozano, 2008; Sammalisto et al., 2016). Another explanation could be the role of contextual norms and norm-activation, as specified in the VBN model used in this study. Subjective norms are influenced in turn by social norms (Ajzen and Fishbein, 2005) and these may have accounted for some of the differences observed between respondents in different social "cultures" as well as different disciplinary "cultures".

5.2. Longitudinal analysis of matched data

The longitudinal sample (N = 429) was collected from seven institutions in Australia (89%), Italy (9%) and Malaysia (2%). It was similar to the cross-sectional sample in terms of disciplinary composition and distribution, level of study and mode of study, although students in Malaysia were all in intervention courses. Table 10 shows the distribution across discipline groups by treatment group and Table 11 presents demographic characteristics.

Changes in respondents' pre-post scores were investigated by key factors. Statistical tests consisted of parametric tests to compare means including paired-sample and one-way ANOVA t tests (normal data), Welch, Brown-Forsythe (heteroskedastic data), as well as non-parametric tests.

5.2.1. Overall sample

Table 12 presents a comparison of respondents' pre-test and

Table 9
Correlations between sustainability worldviews/attitudes and personal behaviours in pre-test sample.

Spearman rho correlations

	Waste separation	Save energy	Grow food	Compost	Save water	Collect water	Public transport	Nature	Donate	Volunteer	Overall behaviour
INS	.156**	.183**	.170**	.173**	.179**		.143**	.236**	.213**	.231**	**.297****
HWN					.082*			.072*	.095**	.084*	.092**
Average NEP	.092**				.120**		-.125**				
Limits to Growth	.070*		.084**	.108**	.131**	.119**		.101**	.135**	.102**	**.144****
Dominance	.087**	.069*		-.082*			-.093**				
Balance of Nature					.092**						
Constraints					.066*		-.191**		-.117**	-.085**	
Eco-crisis	.109**				.085**		-.071*				
Average Ecocentric[a] orientation	.109**	.098**	.112**	.130**	.168**	.110**		.170**	.157**	.125**	.206**
Average Human[b] orientation				-.102**	.066*		-.193**		-.088**	-.064*	

**Correlation is significant at the 0.01 level (2-tailed). *2 Correlation is significant at the 0.05 level (2-tailed).
[a] Average Ecocentric orientation = mean of odd numbered NEP items.
[b] Average Human orientation = mean of even-numbered NEP items.

Table 10
Discipline of study profile of survey participants in the matched longitudinal sample by group.

Type of group			
	Control	Intervention	Total
Discipline of Study			
Accounting, Business Mgmt. & IT	105	71	176 (43%)
Science	77	47	124 (30%)
Architecture & Engineering	24	42	66 (16%)
Arts	0	25	25 (6%)
Education	17	2	19 (5%)
Total	**223**	**187**	**410**

Table 11
Demographic profile of survey participants in the matched longitudinal sample by group.

Type of group			
	Control	Intervention	Total
Age group			
Less than 18 years	12	4	16 (4%)
18-24 years	75	76	151 (40%)
25 - 40 years	91	69	160 (42%)
More than 40 years	16	37	53 (14%)
Total	**194**	**186**	380
Gender			
Male	63	63	126 (31%)
Female	148	133	281 (69%)
Total	**211**	**196**	407
Home Region - main country of residence			
Australia, NZ, UK, USA, Canada	104	129	233 (62%)
European Union	26	16	42 (11%)
North Asia	27	13	40 (11%)
Subcontinent	16	5	21 (6%)
South Asia	7	14	21 (6%)
Africa, Middle East	5	5	10 (3%)
Latin America	5	2	7 (2%)
Other	1	1	2 (1%)
Total	**191**	**185**	**376**

post-test mean scores for key measures of environmental worldviews and attitudes in the intervention and control cohorts. Results were consistent with cross-sectional analyses with higher initial scores in the intervention cohort. While margins persisted at the end of term, some shifts in direction were also recorded. Scores for AA-Dominance converged lower and the gap in HWN scores narrowed, while those for both AE-constraints and INS widened suggesting some weakening of views in the Control group in the absence of SE. The increase in Cronbach's alpha scores for both cohorts suggested a greater coherence and strengthening of students' worldviews during the term. Overall, student worldviews firmed towards human dominance and exemptions from nature as well as an increased sensitivity to environmental fragility and damage, which confirmed earlier studies (Sidiropoulos et al., 2013; Teisl et al., 2011). A significant and differential rise in the INS score was also observed for the intervention cohort that suggested a greater connectedness to nature after exposure to SE.

5.2.2. Intervention and control cohorts

Key influences on changes in respondents' pre-post mean scores across a range of measures are presented in Table 13, where a tick indicates significant differences between groups.

No significant changes were found within the Control and Intervention cohorts. Also, no significant differences were found between changes in the two cohorts for any *single* measure of worldview, attitude or overall behaviour, with one exception. Exposure to SwPE significantly increased the incidence of a self-reported "Change in perceptions/attitudes to sustainability" compared to respondents in the Control cohort (Mann-Whitney U = 16053, z = −3.77, p = 0.000 (two-tailed). This cognitive shift was significantly correlated with two additional factors: the importance of sustainability in their everyday life, which suggested

an effect of personal motivation/receptivity and the frequency of mentioning sustainability in the course (Fb = 2.601, df = 4, t = 0.037), which suggested an education/pedagogy effect. Thus, SE *did* stimulate cognitive shifts in students' perspectives, albeit not reflected in ANOVA tests for standard quantitative measures/scales.

Outcomes in educational and social research are rarely the result of single causes and there is often confounding and extraneous variation that is not possible to control directly (Tolmie et al., 2011). Given the quasi-experimental nature of the study and the large initial differences between treatment groups (Intervention and Control), a one-way between-groups analysis of covariance (ANCOVA) was conducted using the pre-test score as a covariate to 'control' for the pre-existing differences (Tolmie et al., 2011). Preliminary checks were conducted to ensure that assumptions were not violated regarding normality, linearity, homogeneity of variances, homogeneity of regression slopes and reliable measurement of the covariate (Pallant, 2016). Where assumptions were met, ANCOVA tests were conducted on key NEP measures and overall self-reported behaviour to test for differences between treatment groups. Results are reported in Table 14.

The influence of gender, age, home region and discipline on students' sustainability perspectives is well established in the

Table 12
Comparative mean scores for respondents' pre and post environmental worldviews, by group.

Group	Cronbach's Alpha (Total NEP)	Average NEP	LTG limits	AA dominance	BN balance	AE constraints	Eco-Crisis	INS	HWN
		mean[1] (std deviation)	mean[1] (std deviation)	mean[1] (std deviation) (p value)[2]	mean[1] (std deviation) (p value)[2]	mean[1] (std deviation) (p value)[2]	mean[1] (std deviation) (p value)[2]	mean[1] (std deviation) (p value)[2]	mean[1] (std deviation) (p value)[2]
Pre-test Control	0.766	3.56 (0.519)	3.14 (0.719)	3.72 (0.901)	3.78 (0.668)	3.46 (0.704)	3.69 (0.779)	4.57 (1.446)	2.21 (0.781)
Pre-test Intervention	0.798	3.76**[a] (0.546) (p< .0005)	3.44**[a] (0.854) (p< .0005)	3.91*[a] (0.809) (p = .033)	3.97**[a] (0.705) (p = .007)	3.53 (0.742)	3.97**[a] (0.753) (p< .0005)	4.71 (1.530)	2.31 (0.744)
Post-test Control	0.784	3.54 (0.539)	3.11 (0.741)	3.70 (0.857)	3.76 (0.682)	3.40 (0.726)	3.72 (0.771)	4.47 (1.475)	2.24 (0.796)
Post-test Intervention	0.806	3.78**[b] (0.551) (p< .0005)	3.51**[b] (0.763) (p< .0005)	3.86 (0.846)	3.97**[b] (0.638) (p= .002)	3.57*[b] (0.718) (p= .020)	3.99**[b] (0.749) (p= .001)	4.93**[b] (1.488) p= .003	2.28 (0.761)
Control	*No significant changes in any pre & post-test NEP score*								
Intervention	*No significant changes in any pre & post-test NEP, only for INS*								

1. Scale from 1=Anthropocentric view to 5=Ecocentric view
2. *Significant difference between groups at the *0.05 level, **at the 0.01 level, in (Pre)[a] (Post)[b]
Legend: NEP: New Ecological Paradigm, LTG: Limits to Growth, AA: Anti-Anthropocentrism, BN: Balance of Nature, AE: Anti Exemptionalism, CRISIS: Ecocrisis, and INS: Interconnectedness with Nature Scale.

Table 13
Significant mean differences in respondents' changes in worldviews, attitudes and behaviour for the overall matched sample, by factor.

CHANGE IN SCORES	Group (EfS, Control)	Gender	Age	Home region	Level of Study	Discipline	Country of study	Years in study country
ΔAverage NEP								√*
ΔINS								√**
ΔHWN								√*
ΔNEP- Limits					√**			
ΔNEP- Dominance								√*
ΔNEP- Balance								
ΔNEP- Constraints								
ΔNEP- Ecocrisis								
ΔAverage ECO								
ΔAverage HUMAN								
ΔImp-sus-/programme								
ΔImp-sus-profession						√*		
ΔImp-sus-life								
ΔBehaviour - total		√*						
ΔAttitude/perception	√**		√*				√**	

*Significant at 0.05 level, **Significant at 0.01 level.

literature and recent research has confirmed their importance as mediating factors on the effectiveness of SE. Accordingly, a series of two-way between-groups analysis of covariance (ANCOVA) were conducted for selected NEP measures. A 2 by 2 between-group (Intervention and Control) ANCOVA was conducted for each dependent variable with each factor: gender, age, home region, discipline and level of study. In each test, the dependent variable was the post-test NEP measure with the pre-test NEP score used as a covariate to control for individual differences.

Significant interaction effects were found for several post-NEP scores between Groups (Intervention and Cohort) and gender, discipline and home region. Specifically, males and females

Table 14
ANCOVA one-way results of differences between groups using pre-test scores as covariates.

Post-test measure	Pre-test measure	F value	P value	Partial Eta squared	Group	F value	P value	Partial Eta squared
Average NEP	$\sqrt{}$**	$F(1,354) = 547.985$	<.0005	.61	$\sqrt{}$*	$F(1,354) = 5.417$	.021	.015
NEP- Limits	$\sqrt{}$**	$F(1,356) = 208.558$	<.0005	.371	$\sqrt{}$**	$F(1,356) = 10.13,$	.002	.028
NEP- Dominance	$\sqrt{}$**	$F(1,356) = 400.702$	<.0005	.532	X	$F(1,354) = 1.186$	.277	.003
NEP-Constraints	$\sqrt{}$**	$F(1,355) = 248.530$	<.0005	.414	$\sqrt{}$*	$F(1,355) = 4.938$	.027	.014
NEP-Ecocrisis	$\sqrt{}$**	$F(1,355) = 241.086$	<.0005	.406	X	$F(1,355) = 2.151$	.143	.006
Total Behaviour	$\sqrt{}$**	$F(1,365) = 500.691$	<.0005	.580	X	$F(1,365) = 1.840$	.176	.005

*Significant at 0.05 level, **Significant at 0.01 level.

responded differently in Intervention and Control cohorts for Constraints, $F(1,355) = 4.917$, $p = .027$, eta2 $= 0.014$, and for Average NEP, $F(1,354) = 6.104$, $p = .014$, eta2 $= .017$. The only significant interaction effect between Group and Home region was for the Dominance score, indicating students from different cultures responded differently in the two groups, $F(7,352) = 3.036$, $p = .004$, eta2 $= .060$. Students from different disciplines also responded differently between Intervention and Control cohorts for Limits, $F(3,340) = 4.296$, $p = .005$, eta2 $= .038$. These differential effects between disciplines confirmed previous studies (Felgendreher and Löfgren, 2017; Fisher and McAdams, 2015; Kuo and Jackson, 2014; Warburton, 2003) and showed that student conceptions of and learning for sustainability were strongly influenced by their exposure to particular messages within academic disciplines.

6. Conclusion and recommendations

Thirty years after publication of the Brundtland report espousing Sustainable Development and three years after the end of the DESD, it is pertinent to ask how tertiary education is currently contributing to student learning for sustainability. This paper reported the results of a multi-university study, where a series of "snapshots" were taken of student sustainability views, attitudes and self-reported behaviours at the beginning and end of various terms of study, during 2013—2015. The purpose was to better understand students' existing sustainability orientations and to evaluate the influence of regular education and sustainability education on students learning for sustainability. The sample was drawn from students enrolled in various disciplines, levels of study and locations in Australia, Italy and Malaysia and was typical of the ad hoc approach to sustainability education implemented in many institutions.

Results from cross-sectional analyses showed students initial perceptions/attitudes were characterised by jointly strong ecocentric and anthropocentric orientations that represented "anthropocentric environmentalist" or "utilitarian" views towards sustainability. Significant differences were found between students based on their gender, age, home region ("culture"), discipline and level of study. These differences may pose challenges to tertiary educators in the form of gaps in their understanding and/or their receptivity to more holistic and integrative conceptions of sustainability and SD. The study also found signs of an "early adult dip" where students aged 18—25 years held the strongest anthropocentric views. This could present both a hindrance and an opportunity to create a lasting impact on student learning. Tertiary educators are advised to be cognisant of such variability and accurately gauge their students' perspectives before tailoring suitable pedagogy and learning activities.

The study found student views were not consistently expressed in self-reported actions for sustainability, which were dominated by low commitment actions. Higher commitment actions varied by demographic, educational and situational factors and were linked most strongly to their ecocentric orientation and connection to nature.

Results from longitudinal analyses showed that following tertiary education overall, student perspectives converged towards a more moderate or tempered stance between ecocentric and anthropocentric extremes. Exposure to SE, even during one term, often led to minor shifts in students' sustainability perspectives but the incidence and type of change was mixed. Changes were generally expressed as a closer connection to nature, a heightened awareness and concern about human damage to the environment and constraints/limits to growth but also a stronger belief in human ingenuity to solve problems and to overcome these constraints. Thus, SE reinforced an instrumental view of human-nature relations that may lead to incremental improvements and a gradual reform approach towards pro-sustainability values, behaviours and systems but not a transformation. As expected, students' self-reported behaviour was also generally not affected by exposure to SE in one term.

The outcome of SE was found to be an amalgam of the student's personal context (gender and culture) and their learning situation (discipline and level of study). This represented the complex, multi-layered nature of learning for sustainability in tertiary education that made the learning outcome quite uncertain. Students from different disciplinary and cultural traditions may have been exposed to widely different conceptions of SD and possibly lacked an integrated understanding of how to achieve more holistic sustainable outcomes. Students need to appreciate the role of their discipline and profession in contributing to a transition towards a more sustainable future. Educators can effectively build student knowledge and skills by encouraging students to reflect and discuss their own views compared to others and by adopting educational practices that critically review multiple perspectives and approaches to SD. This study also strongly supports the introduction of generic SD units that complement specific disciplinary approaches and acknowledge and value divergent epistemological perspectives on knowledge and problem solving to build a more holistic and integrative view of SD.

Given the importance of HEIs in shaping and shifting graduate views and capabilities to address and solve sustainability challenges, the results are cause for some concern. Integrating ESD in an ad hoc and largely voluntary manner has produced weak results. Graduates from ad hoc approaches to ESD may lack the values and skills necessary to address acute sustainability challenges or to contribute to significantly more sustainable outcomes, either personally or professionally. This poses a major challenge and necessitates a rethinking from the current ad hoc approach towards a more coherent educational strategy. It is recommended that sustainability education be embedded into every programme (at least ten percent of content and assessment) with the pedagogy tailored to suit the receptivity of students. A structured educational strategy is suggested with repeated exposure to sustainability throughout the programme of study. Sustainability should be woven into each programme to encourage a more critical and creative view of human-nature relations and gradually build student capacity to

envisage and create transition pathways towards transformational change.

This study was subject to several limitations related to the lack of representativeness across intervention and control groups, disciplines and levels of study as well as geographical locations, which limited the generalisability of results. The influence of low response rates, missing values, self-selection bias and small samples sizes also limited the ability to make strong inferences about the impact of SE across a multitude of settings. While it was not possible to generalise results from this study to all HEIs, it did reveal some potentially interesting insights.

The study could be replicated elsewhere to confirm the results and explore generalisability of findings. This type of research could also be extended to other universities ensuring an equivalence of disciplines, levels and modes of study to provide a larger, more balanced sample and allow greater generalisability of results. The apparent "early adult dip" could be investigated further. A complementary line of inquiry into teachers' pedagogies would also provide useful insights to design more effective learning experiences, particularly for young adults and for mixed cohorts of students. Lastly, a mixed/merged research methods approach could provide greater insights into how students experience their learning for sustainability when they report cognitive changes in their views and perspectives resulting from sustainability education, and the main influences on their learning experience.

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Chapter 8: Study Five

8.1 Manuscript (Transformative learning study in sustainability units)

Chapter 9: General Conclusion

9.1 General Discussion (Summary and synthesis of findings)

This section presents a summary and synthesis of the transversal findings across the five studies conducted in this doctoral research project, in which student LfS is situated within the broader context of the contribution of HE to societal transition towards sustainability. The discussion begins with the overall context of broad societal change and the role of HEIs and learning, then shifts to the institutional context of change in the HE sector, and finally concentrates on the influence of the teaching and learning context on changes for individual students. Student LfS is presented in relation to the three research aims guiding this research project.

Transformation of complex systems and the context of SE in HE

Complex systems change with great effort, synergistically and over time. Evidence drawn from the initial literature review study (Study 1) indicates that "strong" sustainability requires transformation of societal structures, which require purposeful and sustained effort on several levels. Studies of transitions from one socio-technical system to another show structural social change to be disruptive, unpredictable, chaotic, and contested (Grin et al., 2010). While certain societal subsystems (socio-technical domains) related to waste, energy and water have adopted incremental or gradual change towards sustainability, conditions don't yet exist to implement mainstream sustainability initiatives across entire societal systems (Loorbach, 2014). Overall, sustainability performance is largely confined to the "pre-development" or initiation phase in most countries around the world. Societal progress towards sustainability in most countries appears to align closely with their overall cultural values (see World Values Map) with Scandinavia and the EU leading the way.

Transitions are often contested and emerge after struggles where incumbent interests, technologies, beliefs, and values (Geels & Schot, 2007) are challenged, resisted, and ultimately reconciled with the new reality. Changes in worldview/mindset are an important aspect of the psychological and sociological shifts required in ST. The speed and direction of transitions is influenced by the role of actors and their agency. The context determines the pathway to sustainability at all levels of human organisation from the entire societal structure to government regulations, the business sector,

individual business organisations, and to HEIs. Learning and education have a central role to play in supporting individual and social change (Sterling, 2014). Sustainability Education and LfS can contribute to societal transformation by raising awareness, building knowledge, prompting behaviour change, and developing the required competencies for individuals to enact their agency for organisational and wider social change. However, achieving sustainability outcomes in both wider societal systems and in individual mindsets through SE are complex endeavours, with shifts/transitions emerging over time from the complex interplay of contextual factors, actions, and agency.

The tertiary teaching context is strongly influenced by the institutional context of HE and its progress towards societal transitions to sustainability. For HEIs, the context for sustainability in the curriculum and the challenge it presents to the HE sector (Sterling & Witham, 2008) is reflective of the delicate balance of managing the contradictory task of 'reproducing' society by promulgating existing knowledge that perpetuates unsustainability, and "leading" society by co-creating innovative approaches that advance sustainability (Lukman & Glavič, 2007; Sidiropoulos, 2011). Progress towards implementing SE is limited and the sector remains in the "pre-development phase" (in the sustainability transition model by Rotmans & Kemp, 2003) or the "initiation/awakening stage" (in the sustainability maturation curve by Kapitulčinová et al., 2018). As evident in Study 1 (initial literature review study) and in the updated literature review in Chapter 2, SE in HE is still not implemented in a systematic manner but is largely ad hoc, with academics able to choose whether and how to introduce sustainability into their courses (Evans et al., 2017; Holdsworth & Hegarty, 2016; Shephard, 2010; Sinakou et al., 2018).

Four connected empirical studies in this PhD research project investigated LfS and focussed on key elements of the "learning system" (Blake et al., 2013), namely the personal context of the learner, the teaching context (SE compared to regular education) and learning outcomes. This discussion is framed in terms of the three research aims that guided the doctoral research project:

1)   To investigate tertiary students' sustainability perspectives in terms of their views, knowledge, and behaviours prior to a tertiary education intervention;

2)   To investigate the relationship between sustainability education in the tertiary curriculum and students' sustainability perspectives and identify the influences that moderate this relationship; and

3)   To investigate tertiary students' experience of transformative learning in sustainability education and identify the conditions that facilitate this type of learning.

Research aim 1 focussed on the learner context and their positionality regarding sustainability. Personal values were found to be important determinants of sustainability views, knowledge, attitudes, and behaviour. Traditional indigenous cultures have long-held sustainability values, however this has not been the case for other cultures. As evidenced in the initial literature review study, Study 1 (Sidiropoulos, 2011), while cultural values around the world have been moving towards a "sustainability value" as countries progress along their "economic development" route, social attitudes towards environmental/sustainability issues vary considerably between different cultural groups. Tertiary students' sustainability perspectives (views, knowledge, and behaviours) also varied considerably. Prior to a tertiary education intervention, this research found heterogeneity in student dispositions related to their personal context, specifically to demographic (age, gender) and cultural (home region, discipline of study, and acculturation) factors. Heterogeneity in students' environmental and sustainability views and behaviour was evident in Study 2 (pilot study), Study 3 (case study) and Study 4 (multi-university study). Females generally held stronger pro-environmental and sustainability views compared to males, as did older compared to younger students. The findings confirmed previous literature on the influence of gender (Zelezny et al., 2000), culture (Cotton, Shiel, et al., 2016; Ogunbode, 2013; Price et al., 2014; Vicente-Molina et al., 2013), acculturation (Deng et al., 2006) and academic major (Lang, 2011; Shephard et al., 2014; Sherburn & Devlin, 2004) on students' sustainability dispositions.

Research aims 2 and 3 focussed primarily on the influence of SE on learning outcomes in terms of student views, attitudes, knowledge, and behaviours, and particularly the incidence and facilitators of TL. Research findings in Studies 2, 3 and 4 (pilot study, case study and multi-university study respectively) revealed that heterogeneity in personal values influenced how student perceptions regarding holistic sustainability changed after SE. Student dispositions, especially the influence of personal context [demographic (age, gender) and cultural influences in a broad sense (home region,

discipline of study, and acculturation)], affected learner "readiness" or preparedness and their response to challenges and opportunities inherent in SE. Thus, exposure to SE yielded wide variation in results. This finding confirmed previous studies on the influence of gender (Rideout, 2014; Sammalisto et al., 2016), culture (Cotton, Shiel, et al., 2016) and academic major (Harring et al., 2017; Kuo & Jackson, 2014; Sammalisto et al., 2016) on student learning outcomes from SE initiatives.

<u>Internal challenges to implementing SE in HE</u>

Beyond the external challenges faced by tertiary SE educators, internal challenges from students were also evident. These stemmed from variation in students' personal values and conceptions of sustainability, lack of motivation, lack of perceived relevance to their programmes, and resistance to the concept of holistic sustainability per se. In designing SE interventions, tertiary educators faced extra challenges in engaging undergraduate students aged 18-25 years, particularly if SE was offered as an elective rather than as a compulsory course. This finding was supported by evidence in Study 4 (multi-university study) of an early adult dip in the "U shaped" curve for average NEP scores by age, that corresponded to 18-25 years age and in Study 2 (pilot study) of NEP scores by level of study, that corresponded to undergraduate students. For these undergraduate students, it may have proved particularly difficult to "situate" sustainability in their studies, professional development, and personal lives.

One method to "situate" sustainability for students is through assessment, which is critical for learning, particularly formative assessment that supports and motivates learning (Dumont et al., 2010). Therefore, it may be more effective to mandate LfS by embedding SE in the curriculum and assessment of regular courses, a notion supported by evidence in Study 3 (case study) and in the literature (Bradley, 2019; Rose et al., 2015), and/or to mandate LfS through a dedicated stand-alone SE unit, an argument supported by evidence in Study 5 (TL study) and similar findings in the literature (Hegarty et al., 2011; Noy et al., 2017). However, mandating LfS can be a 'double-edged sword' as it can trigger extrinsic motivation for learning in some students and resistance to learning in others.

Resistance to SE was evidenced in both Studies 3 and 5 (case study and TL study), particularly in the latter by students who didn't see the relevance of sustainability to their programme and/or disagreed with it in principle ("I am a happy conservative").

These findings support similar results reported by other researchers in the literature (Bradley, 2019; Burns, 2016; Chaves et al., 2017; Hegarty et al., 2011; Karol & Mackintosh, 2011; Swaim et al., 2014). Another source of resistance was found to be related to the unfamiliar (active learning) pedagogies adopted in SE, as reflected in comments by respondents in Study 5 (TL study) that confirmed other studies in the literature (Recabarren et al., 2015; Watson et al., 2016).

Finally, students did not always connect the concept of holistic sustainability to their study programme as shown in Studies 2-5 (all empirical studies), which supported other findings in the literature (Watson et al., 2016). To establish its relevance, tertiary educators need to embed SE more deeply into regular courses, so it is regarded as integral to their studies and not an optional add-on. Thus, to be more effective, it is argued that SE needs to be mandated and connected to students' perceptions of relevance primarily to their professional education, and to their personal lives.

Learning outcomes from SE in HE

Overall results in Studies 2-5 from the current ad hoc approach to SE in HE were mixed and weak (i.e., limited effect). For example, across Studies 2-4, the pre-post changes in scores for several NEP dimensions ranged from very small to very large and included both positive and negative shifts. This was evidenced by several articles in the materials being presented (Sidiropoulos, 2014, 2018; Sidiropoulos et al., 2013) and by other researchers (Jowett et al., 2013; Shephard et al., 2014; Teisl et al., 2011) Findings in Study 4 (multi-university study) and to a lesser extent Study 2 (pilot study), showed no appreciable difference in the longitudinal pre-post change in average scores for overall measures of attitude and behaviour towards environment/sustainability for students in SE compared to regular education. Indeed, the wide range of score changes within each cohort largely offset each other, which masked overall variability within SE and regular education. Exposure to SE affected several NEP dimensions but the response varied according to the students' personal context (gender, culture, discipline of study). Nonetheless, Study 4 (multi-university study) confirmed that compared to regular education, SE produced differential effects across multiple disciplines, levels of study, universities, and countries. The differential effects of SE were a heightened ecological awareness, a closer connection to nature and self-reported (cognitive) shifts in their perceptions and attitudes towards sustainability. Importantly, both a heightened

ecological awareness and a closer connection to nature are correlated with more committed actions by individuals (Sidiropoulos, 2018) and business leaders.

Holistic sustainability as a challenging concept

The concept of holistic sustainability is arguably a 'threshold concept' that is very challenging for many tertiary students and can produce a range of learning outcomes (Levintova & Mueller, 2015; Sidiropoulos, 2011; Winter, Barton, et al., 2015). As demonstrated in Studies 4 and 5 (multi-university and TL studies), the schema of holistic sustainability is a new and challenging concept for many students who are accustomed to the culture of a mono-disciplinary tradition. The concept of holistic sustainability challenges the traditional mono-disciplinary and reductionist paradigmatic approaches to knowledge and problem solving (Lozano & Peattie, 2011). Results from Studies 2-5 (pilot, case, multi-university, and TL studies) showed that SE produced learning outcomes across the cognitive, affective, and conative domains. Student learning outcomes from SE were dominated by Instrumental Learning (IL) about damage/limits and possible "solutions" and reflected technical learning *about* sustainability (shown in the case study and the TL study, particularly for undergraduate students). Further, evidence from Study 5 (TL study) and the literature (Glisczinski, 2007; Karol & Mackintosh, 2011; Kelly, 2010) indicated that students were not generally inclined to engage in critical thinking and self-reflection about the underlying assumptions and premises of their own beliefs, which typically cause disorientation and discomfort (Mezirow, 1994). Therefore, to support the possibility of transformative sustainability learning, it is argued that educators need to scaffold student capacity for critical thinking and self-reflection, and design learning environments that embed such practices as a natural part of the student learning experience.

Developing sustainability competencies

Student exposure to SE, particularly in interdisciplinary units, also built certain professional skills for sustainability such as enhanced problem-solving ability through systems thinking and complex/wicked problems, the capability for teamwork and collaboration, a better understanding of self and others, and insights on how to influence people to create social change. These effects were evident in Studies 3 and 5 (case study and TL study) and supported findings in the literature on development of student sustainability competencies, particularly in interdisciplinary units (Burns, 2013; Howlett

et al., 2016; Noy et al., 2017). A similar set of factors were found to facilitate sustainability learning in Studies 3-5 (the case study, multi-university study and TL study). These factors were personal support especially from the teacher (and friends and partners), educational activities and the provision of a range of educational resources for students to undertake their own research, and to create solutions/products that situated the learning "to the self".

Motivation is known to play a crucial role in learning as an antecedent, as a moderating variable and as an educational objective (Hansmann, 2010), and these influences were all confirmed in terms of LfS in HE. Results across all empirical studies conducted in this PhD research project confirmed motivation to be a key driver of deep learning. In Studies 2 and 3 (pilot and case studies), the importance of motivation was evident in student comments about caring for the environment and sustainability and their learning outcomes, while Studies 4 and 5 (multi-university and TL studies) showed a close correlation between student scores for "importance of sustainability" and reported LfS.

SE in the context of a total learning system

Repetition and connection had an accretive effect on sustainability learning over time and enabled greater links to aspects of students' lifeworld, as evidenced by results in Studies 3-5 (case study, multi-university study and TL study). Students with repeated exposure to SE throughout their study programme often reported learning outcomes that were deeper and broader in terms of wider system changes, rather than indications of simple technical learning. Respondents in Study 3 (case study) indicated their LfS had progressively built over successive courses in the 12-18 months period after the SE, towards a deeper understanding of sustainability issues and potential approaches. Students in Study 4 (multi-university study) indicated their shifts in thinking about sustainability happened due to accumulated learning throughout their study programme and to links with their work and community activities. Students in Study 5 (TL study) also mentioned their interest in SE was stimulated by previous studies and other life experiences. Further, the reported changes appeared to shift some students beyond individual behavioural change to initiatives for organisational or societal change. This finding confirmed studies in the literature of more sophisticated approaches to sustainability by students with sequential learning (Barrella & Watson, 2016; Miller, 2016). This result may indicate "epistemological stretching" that involves "expanding the ways of knowing that someone respects, understands, and/or engages with" (Harmin

et al., 2017, p. 1490). Thus, a learning sequence that explicitly scaffolds and coordinates sustainability learning across a study programme would create strong synergistic effects. However, even without formal coordination of SE across a study programme, individual educators can assist student learning of complex conceptual material such as holistic sustainability by linking students' disparate knowledge across both time and space to help students create deeper meaning from their experiences (Blake et al., 2013; Istance & Dumont, 2010). Essentially, sustainability has to be considered beyond the limits of each individual unit with educators adopting a total 'learning system'. Such synergy in learning reflects the nature of effective learning, as identified by OECD from a large, coherent body of knowledge. The OECD study identified "horizontal connectedness" as one of seven transversal principles that underpin success in the design of effective learning environments for the 21st century (Dumont et al. (2010). It is argued that "horizontal connectedness" should be promoted "across areas of knowledge and subjects as well as to the community and the wider world" (OECD, 2013, p. 16). In this sense, "horizontal connectedness" effectively links and creates synergies between different areas of knowledge in students' lifeworld (Istance & Dumont, 2010, p. 325). While the OECD learning design principles have mostly been applied to schools (Conner & Sliwka, 2014), researchers have also identified "horizontal connectedness" in HE settings.

The synergistic effect of repetition and connection to students' lifeworld as evidenced in Studies 3-5, confirmed findings in the literature (Barth et al., 2007; Evans et al., 2017; Hiller Connell et al., 2012; Trencher et al., 2018) and supports the notion of the 'ecology of learning' or 'lifelong learning'(Blewitt, 2006; Sterling, 2004c). As suggested by Barth and Michelsen (2012), LfS encompasses all levels of formal education as well as learning opportunities in non-formal and informal education. As demonstrated above, creating connections between SE and meaningful situations would likely enhance student motivation and learning. Barth and Timm (2011) suggest that greater connections to students' lifeworld experience also attracts students who are less familiar with sustainability concepts. These research findings indicate a comprehensive SE approach is required that encompasses the 'ecology of learning' or total "learning system" (Biggs, 1993), which extends from course curricula across the whole campus environment (Chiong et al., 2016; Kember et al., 2017) to learning opportunities beyond (Fung, 2017; Hiser, 2012; Winter & Cotton, 2012).

SE effects on personal behaviour and agency

Improved knowledge and awareness of sustainability did not necessarily translate into behavioural changes as evidenced in results from Studies 3, 4 and 5 that confirmed findings in the literature. The attitude-behaviour gap is a well-known phenomenon that was reflected in the incoherence in student sustainability dispositions. The results lend further support to the argument for adopting a more strategic approach to SE in HE that looks beyond individual behaviour change to address the systemic nature of sustainability challenges. Behavioural outcomes from SE were mostly limited to the personal sphere and were reflected as changes in personal actions towards sustainability, and deeper understanding of self and personal empowerment.

The emergence of wider agency was very limited. Evidence of the emergence of agency was found in Studies 3 and 5 (the case study and TL study) and also reported in the literature (Feriver et al., 2016; Kalsoom & Khanam, 2017). Expressions of wider agency are reflected in the following exemplar student comments:

- *"The most important sustainability skills I learned from this course and subject is the avenues one can take to influence change (with the addition of content knowledge). For example, I am studying to be a teacher, the most important thing to me is to see the world in many lights, create connections between causes and effects and be able to communicate these ideas with others (By understanding how and why I can get to the source of the issue and open the debate and promote action). In the process, I hope to change the minds of others to become more sustainable. This course does well in showing the reasons why people behaviour, the habits they form and how this has led to today's current issues".*
- *"I am also working on a phone app which, if goes to plan assist in connecting environmental movements, business and like-minded individuals together."*

Research findings revealed that agency emerged in an 'ad hoc' fashion as an amalgam of the personal context of students (i.e., their positionality), how they responded to SE, and their unaided ability to connect sustainability learning to events/opportunities elsewhere in their lives. These included connections to other courses in their studies, to on-campus activities (as reported by Dagiliūtė et al., 2018), to other aspects of their lifeworld (i.e., professional and personal lives) (seeWiek et al., 2012; Winter, Cotton, et

al., 2015) and to previous experiences. To enhance TL and agency, it is argued more opportunities are required to synergise learning across the wider "learning system" of students' diverse fields of interest (studies, campus activities, profession/work and personal interests).

<u>Convergence in learning outcomes from SE</u>

Learning outcomes from students' ad hoc SE encounters (Boyle et al., 2015; Evans et al., 2017; Holdsworth & Hegarty, 2016; Perera & Hewege, 2016; Wilson & von der Heidt, 2013) may have been diminished by the countervailing effects of their overall tertiary education experience. The current ad hoc approach to SE in HE led to an overall *convergence* in student worldviews, associated with "weak" sustainability or unsustainability (von der Heidt & Lamberton, 2011, p. 677). After undertaking regular tertiary education in such an environment, student perspectives converged towards a more moderate stance between ecocentric and anthropocentric extremes and is known as "anthropocentric environmentalism" that represents an "integrative eco-humanist" worldview. This view combines ecocentric and anthropocentric concerns and is characterised by a recognition of human damage to nature and the fragility of ecosystems, but also maintains a strong faith in human ingenuity to develop technical solutions to overcome constraints. The trend towards greater "instrumentalism" was evident in Studies 2-4 (pilot study, case study and multi-university study). For example, several students with high initial NEP scores reported a reduction after SE, while many with low initial NEP scores reported a rise, which corroborated findings of mixed effects in research studies conducted in the US (Anderson et al., 2007; Teisl et al., 2011) and in NZ (Harraway et al., 2012; Jowett et al., 2013; Shephard et al., 2014). One explanation for the observed convergence in sustainability views is that students' prior knowledge about sustainability was comparatively more (or less) environmentally focussed and HE facilitated a more 'balanced' perception among the three pillars of sustainability. Indeed, a more 'balanced' sentiment was expressed by respondents in both the multi-university and TL studies and has also been found in the literature (Hegarty et al., 2011; Watson et al., 2016).

Overall, the shift towards an "integrative eco-humanist" view after SE in HE reinforces the tenets of modernity and facilitates a more tempered and incremental change process towards sustainability rather than a transformation. A similar finding was shared by Cotton, Miller, et al. (2016) who reported incremental changes in terms of minor

personal behavioural change rather than an expression of agency and collective action. This instrumental approach relies on "ecological modernisation" (Baker, 2006) and is indicative of technical learning rather than transgressive learning that is required to challenge existing disciplinary, institutional and social structures. It is also indicative of the "problem-solving" perspective that addresses sustainability issues through technological remedies (Loorbach, 2014) and represents the mainstream orthodoxy with limited (i.e., weak) sustainability outcomes (Geels et al., 2015).

<u>Maintaining optimism for wider societal change</u>

In raising sustainability issues, tertiary educators are confronted with the delicate task of creating a learning environment that fosters empowerment and hope, instead of hopelessness and despair. Studies 4 and 5 found teaching approaches to SE tended to "problematise" (the hurdles and barriers) not "opportunitise" (the possibilities and gains) potential pathways to sustainability. This may have influenced overall outcomes from Studies 4 and 5 (multi-university and TL studies) that were predominantly focussed on greater levels of personal effort and behaviour. There was also a general view that significant systematic shifts towards sustainability were entirely problematic, very slow and simply "too hard." Some "unintended consequences" of SE revealed in these studies were dispirited and despondent former activists of socio-ecological change, and a generally diminished focus by respondents on transgressing or challenging business, government, and existing institutional structures. After exposure to SE, six students in Studies 4 and 5 (multi-university and TL study) who were previously highly committed, optimistic and confident of implementing sustainability initiatives, reported a diminished sense of optimism and drive, and felt demoralised and "ineffectual" in achieving significant sustainability outcomes. A diminished sense of optimism is indicated in the following exemplar student comments:

- *"The course defiantly opens your eyes even more about how shitty humans can be to the planet. I never realized how much information there was out there already and how many people are already doing something and care! Its empowering but also sad at the same time... Some people have been talking about all this for decades and it feels like we are in the same spot or its even getting worse."*
- *"Perhaps I considered that the damage to the planet was a bit of a moral panic. But after seeing the scientific evidence, i am concerned for the future of the*

planet and our inability to put personal greed aside, unless we reach tipping point- which may be too late."

Few students felt enthused and confident to enact their agency for wider sustainable change. Other researchers also reported "learned helplessness" (Cross, 1998; Landry et al., 2018) and "perceived pessimism" (Cotton, Miller, et al., 2016) in students. Researchers also expressed disappointing findings regarding student sustainability learning and their students' expressed lack of faith in individual and/or collective agency (Cotton, Miller, et al., 2016; Harring et al., 2017; Shephard et al., 2014; Yavetz et al., 2009).

Perhaps such SE outcomes are not entirely unexpected (Howlett et al., 2016; Hursh et al., 2015) given the powerful influence of vested interests in maintaining the status quo of the Dominant Social Paradigm (DSP) in many Western democracies. The essential features of the dominant paradigm of modernity and neo-liberalism are capitalism, free markets, economic growth, and liberal individualism that created and perpetuate unsustainability (Loorbach, 2014). Perhaps students are more daunted by the enormity of the challenge posed by existing global economic structures and entrenched habits of mind in a neoliberal environment, and are cautious of their limited ability either as individuals or collectively to influence wider societal transformation (Gale et al., 2015; Hursh et al., 2015).

The context of free choice learning and agency in ST

These are worrying trends and signify a shortcoming of the current approach to SE in HE, which emphasise free-choice in LfS and action, and present sustainability challenges as being extremely complex/wicked problems with uncertain outcomes in highly contestable environments. In consideration of findings from the current studies and the previous research reviewed, it is argued the reliance and emphasis in SE on individual behaviour change is problematic and faces severe limitations. Instead, educators should also translate general (key) competencies for sustainability towards specific disciplinary competencies to develop student capacity for professional agency and action. Additionally, the evidence reinforces the adoption of a more critical and systemic approach, enlarging the scope of SE to engage with the *process* of societal structural change and the role of individual/collective efforts as well as professional and industry action to enhance ST.

Identifying SE learning outcomes using an augmented LAS instrument

Findings in this research project reaffirmed the highly situated and constructivist nature of LfS and highlight the importance of creating learning environments that recognise individual differences in knowledge, motivation and abilities, and provide opportunities for meaningful engagement (Dumont et al., 2010). In addition to tailoring SE pedagogies for particular student cohorts, tertiary educators may wish to assess student learning outcomes to gauge the effectiveness of their SE initiatives. Findings from Study 5 (TL study) demonstrated the utility of a sustainability-augmented Learning Activities Survey (King, 2009) instrument to detect among the wide range of potential learning outcomes experienced by students (instrumental, communicative, transformative) and to identify the most influential factors affecting each person.

<u>Summary and conclusion</u>

To summarise, SE in HE has the potential to contribute positively to societal sustainability transitions. However, research findings from these four connected empirical studies (conducted across time, countries, universities and disciplines) revealed that the current ad hoc approach yielded learning outcomes that were mixed and weak. Overall, SE led to worldviews that converged towards "integrative eco-humanism". This research also identified a range of beneficial outcomes of SE in HE that included greater personal awareness by students of sustainability issues and their importance (pilot study, case study, multi-university study and TL study), changes in individual behaviour (case study, multi-university study and TL study) and attempts by some to influence others in their personal sphere (case study, multi-university study, and TL study). Implementing SE also created a lever into academic courses to consider sustainability per se and its relationship to their programme and profession (case study, multi-university study and TL study). Finally, SE contributed to a sustainability literate population that was more knowledgeable and amenable to discussion and debate on stronger approaches to sustainability issues beyond changes to individual/personal behaviour, such as taxes and stronger programmes/initiatives by government, industry and NFP sectors (case study, multi-university study and TL study). While these beneficial outcomes can contribute (passively) to sustainability transitions, development of much more agency and professional competence is required to accelerate the transition process.

To conclude, SE in HE needs to be a coordinated, sequential, connected and relevant inclusion that is mandated in all academic programmes to build students' confidence and competence for sustainability. A strategic and systematic effort is required to emphasise the importance of sustainability (to motivate students to undertake the difficult journey of engaging with the challenging concept of holistic sustainability), to ground/anchor their learning experiences by connecting to meaningful/relevant situations in their lifeworld, and to progressively scaffold their sustainability competencies from each learning experience. Adopting a more concerted approach may lead to progressive shifts in student knowledge, points of view (attitudes and opinions) and perspective (worldview and mindset), as well as build the required skills and competence that enable the emergence of their potential agency to hasten the transition to sustainability.

9.2 Research Significance

9.2.1 Contribution to knowledge

Achieving sustainability requires critical theoretical, methodological and paradigmatic shifts in both teaching and learning in HE (Jones, Selby, & Sterling, 2010) that challenge the "firmly established empirical and analytical frameworks (that) are invariably reductionist and mechanistic" (Wals & Blewitt, 2010, p. 57). This research examined the outcomes of SE in the current HE context and has made some important contributions to the field of LfS in HE. Key contributions from each study and from the synthesis of findings are outlined below.

Study One demonstrated the links between individual values and TL for sustainability with changes at the systemic, institutional and sectoral levels and the synergistic effects of sustained efforts over time that are required to create ST. This study connected disparate fields in education and learning, environmental psychology and sustainability transitions to effectively link LfS in HE to transformation of societal systems. Study Two filled a gap by providing insights into the contemporary worldviews, knowledge and attitudes of international tertiary students in Australia and their response to SE in the curriculum. Study Three discussed a teaching praxis of using values to infuse SE into the curriculum of traditional business and economics courses and demonstrated the cumulative and durative effect of repeated exposure to SE over time. Study Four was the first multi-scale survey to investigate the impact of SE on student views, knowledge,

attitudes and behaviour that was conducted across disciplines, levels of study, universities, and countries. The findings in both SE and regular tertiary education revealed a convergence in students' attitudes towards an "integrative eco-humanist" worldview. This mindset favours 'eco-modernism' and represents an incremental approach but does not challenge dominant institutional structures and practices. Importantly, this finding is contrary to expectations by educators and policy makers that SE creates "agents of change". Study Five resulted in a unique survey tool based on the Learning Activities Survey (LAS; King, 2009) that was augmented with context-specific questions to evaluate the incidence of and influences on transformative LfS in HE. Evidence for the use of LAS to investigate transformative LfS in an Australian HE setting is lacking. The findings also highlighted a wide variation in student learning outcomes, types of personal behaviour change and limited agency from exposure to stand-alone SE units.

Knowledge about SE in HE has been contributed in several areas across the five studies. The doctoral research project generated a deeper understanding of significant heterogeneity in student sustainability dispositions and actual learning outcomes from their exposure to the current ad hoc approach to SE in HE, which predominantly focusses on individual change and agency. Significant findings from this research for educational practitioners and policy makers are that current SE in HE efforts are not effective in yielding significant shifts in student mindsets towards an ecological perspective, in stimulating significant change in individual behaviour or in developing professional agency to contribute to the transformations required in societal systems. Instead, student worldviews are converging inexorably towards an "integrative eco-humanist" view, where heightened concern for ecological fragility is balanced by greater confidence in technological solutions. This view is aligned with 'eco-modernism' and incremental changes that are contained within existing societal systems. Many factors drive resistance both to sustainability per se and to TL for sustainability in HE, with students often challenged by epistemological and ideological aspects of LfS.

Learning is a holistic process. This research reinforced that student LfS is enhanced by *repetition* and connection over time, and that deeper TL is *motivated* when sustainability is considered to be important by students and there is *connection* with their lifeworld, i.e., their personal and professional lives. Individual behaviour change

following SE was found to be limited to low commitment actions. A*gency* as a result of SE was rare and emerged when motivation coincided with competence and opportunity, with agency being enacted towards incremental action and system compliance, rather than challenging societal structures and institutional settings.

A further contribution has been to link new knowledge about heterogeneity in student dispositions to their LfS in HE, and any ensuing changes in their sustainability dispositions and behaviour with likely contributions to societal ST. Finally, while most findings reported in this thesis confirm other studies, this multiple-contexts research project has identified that sustainability is a "lifelong learning" process and extends beyond what is gained from individual units in HE. So, SE must be a coordinated, sequential, connected and relevant (preferably mandated) inclusion in all study programmes in order to create the synergy and build momentum for personal transformation that in turn, can contribute to organizational change and societal transitions.

This research project has also made several theoretical contributions to individual constituent theories (VBN, TL and ST) and to the formulation of an overall conceptual framework that guided this study. The first relates to environmental psychology and demonstrates that behaviour is affected iteratively through life experiences and education, which confirms that the sequence in the VBN model is not a straight line but builds and changes over time. HE contributes in a holistic way, and is based on other influences in a person's life including their personal context or situation. The influence of SE in HE is thus 'situated' within the spectrum of 'lifelong learning' that continuously shapes student worldviews, builds their knowledge and competencies and is ultimately expressed in actions that influence the process of ST (or not). The research project supported VBN theory as the findings from Studies 2-5 demonstrated that personal, educational (including SE) and situational factors influenced student worldviews, while Studies 3-5 also demonstrated the influence of these factors on student behaviours and to the expression of their agency for wider social change.

The second contribution was the demonstration of an effective research instrument to evaluate SE in HE; the augmented LAS developed in this research project is context-specific and can effectively identify the extent of and influences on TL for sustainability in an adult setting. The use of an augmented LAS instrument (originally derived from TL theory by King, 2009) in Study 5, demonstrated its potential value to detect among

the wide range of possible outcomes from SE and to identify likely influences (e.g., motivation, repetition, support, resistance, etc.,) and potential outcomes of SE in terms of student competencies, behavior and action for sustainability.

The third theoretical contribution was linking disparate elements from theories in environmental psychology, TL and societal ST and connecting their common elements through the literature and through the research evidence presented. Studies 1,3,4 and 5 confirmed the importance of the common elements of learning, resistance, synergy/connection and action/agency within a broader conceptual framework that connects student learning in HE with individual PEBs and to their competencies and agency to support and advocate for wider societal change. Research findings provided evidence linking student learning outcomes from SE in HE to the development of skills and PEBs that potentially contribute to ST. A further theoretical contribution of the overall conceptual framework is the importance of the individual in ST theory and the reluctance of individuals to challenge structural, institutional and cultural barriers to societal transition to sustainability. The articulation of these different theoretical perspectives into a broad conceptual framework for this research identified the principles and practices of SE in HE that support TL, and the ensuing shifts in student worldviews, knowledge, attitudes and behaviour that contribute to societal ST.

Thus, the theories considered as a single framework adds value to SE by providing a broader scope to consider the wide range of influences on and outcomes of SE endeavours in HE. These outcomes are consistent with those proposed in the UN SDGs, particularly SDG4 that is related to SE and the development of change agents. While the overall framework is useful in its current format, one possible refinement is to conceptualise the three theories (VBN, TL, ST) in a continuous loop with education/learning, attitudes/behaviour and societal change being driven by a person's lived experience.

Knowledge contributions from this research project have been progressively published during the research programme, enabling a faster communication and translation of results to colleagues in the field and to the wider community (Merga, 2015). Findings from each study were also communicated in other fora in Australia and overseas. Studies 1-4 were published as journal articles and the journal manuscript for Study 5 (TL study) is currently under review. All publications in this thesis have been cited at

least once by other authors and as at end August 2019, Paper 3 (case study) was referenced 65 times.

9.2.2 Practical contribution (implications)

Findings from this research are relevant to tertiary educators, policy makers, professional associations and employers who are interested in fostering the development of a workforce and citizenry that is capable of addressing the pressing environmental and sustainability challenges of our time. The purpose of SE is to enhance student capability and empowerment through greater self-efficacy and skill development for whichever field/profession they occupy. The current approach to SE in HE is largely underscored by the dominant ideology of neo-liberalism that focuses on individual responsibility to adopt personal behaviour change, in the mistaken assumption that the totality of human behaviour will somehow create sustainable outcomes. This is mistaken firstly, in the sense that everyone will adopt behaviour changes and secondly, that even if this does not occur, a sufficient number of individuals will enact agency beyond their own personal lives to leverage wider organisational and overall systemic change. As argued in Study 1 (initial literature review study), there is no evidence to indicate such a "tipping point" is nearing in HE, in the business sector or other subsystems, in the physical/legal infrastructure or in wider societal settings. This research has demonstrated that SE is not currently contributing to transformative LfS and there is evidence of limited development of personal, professional, and collective transformative agency to drive ST. So, to accelerate progress towards such a leverage or tipping point, a more interventionist strategy is required and recommended for SE in HE.

To achieve stronger and positive results from SE education, HEIs should endeavour to change from an ad hoc to a strategic approach with consistent incorporation of several key principles: All educators are encouraged to infuse SE into their courses and ensure it is formally coordinated and sequenced across courses in each traditional academic programme (Jones et al., 2010). Implementation of SE should be designed to ensure student LfS in the curriculum is applied to real-life learning contexts and connected to student's lifeworld and to their profession. All students should undertake a generic SE unit, preferably at the start of their programme, to build baseline sustainability knowledge that is subsequently scaffolded and linked across their study programmes. To motivate deeper/TL, HEIs should provide concrete learning opportunities for

students to engage in real-life learning in areas that they themselves identify as important.

Educators and students should adopt a more critical approach to SE in their courses, recognising the fractured perspectives of their own discipline/profession and its influence on wider societal ST. The interpretation of "strong" sustainability (Baker, 2006; Sidiropoulos, 2014; Sidiropoulos, 2011; von der Heidt & Lamberton, 2011) calls attention to political processes and power structures (Springett, 2010) that do not allow sustainability to challenge "the 'rationality' of the capitalist paradigm of production and consumption" (Springett, 2005, p. 149). Thus, a critical perspective is required to reconsider the received wisdom of shifting the burden of adjustment to individual 'green' businesses and consumers and to also closely examine structural changes towards a systematic shift (Akenji, 2014).

Future professionals are likely to be better placed than individuals to influence social, cultural and environmental resource use (Sibbel, 2009). Accordingly, attention should be focussed on developing students' professional competence. However, the ad hoc approach to SE does not support the impression of sustainability as an important professional competency. Rather than adding more content into students' crowded programmes, educators could focus on developing key competencies for sustainability (such as systems thinking, reflexivity, critical thinking, and social action/engagement) in terms of specific disciplinary competencies, which would enhance their students' capacity for professional agency and action. As noted in the Literature Review (Section 2.2, p.16 and Section 2.5, p.25) and as demonstrated from the findings in Studies 4 and 5 (Section 9.2.1), holistic sustainability is a challenging concept for many students who are typically accustomed to a mono-disciplinary perspective. Being confronted with both the complexity of sustainability theories and to their translation to real world "wicked" sustainability problems, can result in "cognitive overload" and a "disorienting dilemma" for students. The instructional design of SE must carefully balance the information presented to learners with the learning activities required of learners to avoid cognitive overload (Paas, Renkl, & Sweller, 2003). Sustainability educators can reduce cognitive overload in students by designing "guided learning" environments that combine direct instruction to help learners initially construct the complex schema of sustainability, and discovery learning to help the subsequent transfer of learning (De Corte, 2010; van Merriënboer, Kester, & Paas, 2006). This approach aligns with the

literature on guided design that balances guided learning (based on external regulation) and discovery learning (based on self-regulation) and that may produce stronger learning outcomes in SE. Indeed, the evidence presented in Studies 3-5 demonstrated the importance of providing a range of educational resources and learning activities that scaffold student LfS from theoretical approaches to practical outcomes. Student indicated their LfS was enhanced by real world case studies, applying theories to real world problems, participating in group work, undertaking research activities and the use of online and digital resources of sustainability challenges and solutions. Guided discovery learning can be fostered by focussing student attention on examples of successful initiatives by agents in niches, as exemplars of potential ST pathways. Subsequent participation in real-world opportunities would enable students to develop their self-efficacy, effective advocacy and interdisciplinary collaboration skills that are required for transformative agency.

As identified by UNESCO (2014b), training is required to develop the capacity of tertiary-level educators and academics to infuse sustainability into traditional academic areas. Resources and incentives should be provided to enhance educators' capacity to embed SE in their courses, to develop their own multidisciplinary fluency and to develop students critical thinking skills. In doing so, educators could reflect on the limits of underlying assumptions in their own disciplines and consider how to create greater linkages with other disciplines (interdisciplinary approaches) to help address sustainability issues and create pathways to more sustainable outcomes. Educators should be encouraged to foster more creative and experiential learning for students in the co-production of knowledge. More committed HEIs could adopt transdisciplinary sustainability approaches to research and teaching through participation in sustainability projects with a range of stakeholders from university, social and civic groups, industry, and government. This approach represents a transgression of disciplinary boundaries and is more in line with the third mission of universities as "Mode 2" institutions that co-create sustainable outcomes with their stakeholders (Nicolaus & Jetzkowitz, 2014; Sedlacek, 2013). Finally, the sustainability- augmented LAS instrument could be a useful tool for tertiary educators to assess the impact of various SE initiatives on student learning outcomes, and to identify the key factors that contribute to cognitive, affective, and conative changes in sustainability dispositions.

Thus, greater links are required across university functional areas (in teaching, research, outreach, campus operations) to synergise learning opportunities in programmes of study, as well as formation of stronger links with external partners (in industry, government, and civic sectors) to enable students to participate in real-life sustainability-infused learning opportunities in their chosen areas of interest.

9.2.3 Implications for research

Implications for research in the field of SE have been identified that relate to research methods, suggested extensions to previous studies and possible new studies. It is noted that mean NEP scores rarely change for students in SE and instead may mask shifts in underlying dimensions of NEP. It is suggested that researchers focus on individual NEP items and underlying dimensions, particularly the main ecocentric (versus anthropocentric) score that is linked to personal and professional behaviour. Alternatively, more sophisticated statistical analysis of NEP can be performed such as multinomial regression (Jowett et al., 2013), factor analysis (Harraway et al., 2012) or multi-dimensional scaling (see Zsóka et al., 2013).

The standard LAS instrument contains items in the TL scale that may not have been interpreted in the manner intended by King, particularly in relation to critical thinking and self-reflection. To overcome this potential shortcoming, it is suggested the LAS be augmented with triangulating questions and/or complemented with qualitative methods to more deeply explore how students experienced TL in their studies.

Future research could combine a pre-post survey using the augmented LAS instrument with qualitative techniques to further explore and explain the findings uncovered in the survey (Creswell, 2012). The pre-post-post survey would include measures to assess shifts in student dispositions and could include the NEP, INS and HWN scales as in Study 4 (multi-university study). According to Perez Salgado, Abbott, and Wilson (2018, p. 168) "survey data alone, even when containing open-ended questions, cannot deliver the dialogue and probing that is essential for a fuller understanding. Thus, a qualitative, discursive approach is required, at least to complement the survey". King (2009) provides pro forma interview guides for various educational contexts, which probe more deeply into aspects of TL as specified in the LAS. Beyond measures of cognitive psychological changes, future research could also explore other processes 'of human knowing: body, emotion, imagination and context and more' (Hart, 2015, p. 28).

The research could investigate the influence of facilitative conditions such as the learning environment or the context for learning, the teacher-learner relationship, the process or structure of learning, the discipline of study and learner characteristics including "transformational readiness" (Griswold, 2007). Questions could also explore student perceptions of their agency to impact sustainability in their personal and professional lives.

This research has generated important findings about types of learning outcomes that result from students completing dedicated SE units. Study 5 (TL study) could be replicated using the augmented LAS in a multi-university setting with larger samples of students drawn from different disciplines, levels of study, universities, and locations in Australia and overseas. This would allow comparison of predictors of TL and outcomes in different contexts.

Focussing on cohorts across year levels in longitudinal studies would provide insights into both the durability of SE learning outcomes over time and how predictors vary as students advance through their studies. Additional measures of previous and concurrent learning for sustainability in formal, non-formal and informal settings, as well as the use of campus resources and activities would provide further insights into how interventions designed to boost motivation and synergies can affect learning outcomes in HE.

This research project demonstrated a progression in personal action where some students moved from individual behaviour change to influencing others in their personal sphere. There may be further progression to professional, organisational agency and wider societal agency. Future research could investigate the impact of repeated exposure to SE over the study programme on student sustainability perceptions (self-identity, self-efficacy), competencies and actions, whether such a progression in action emerges and any influence of discipline. Future research could also include a longitudinal study that follows a cohort beyond graduation to investigate changes in their sustainability dispositions and actions over time.

Finally, a future research study could explore whether 'individualisation" of learning outcomes evidenced in these empirical studies reflect the influence of the content or the context of sustainability. In other words, is there something inherent in the notion of sustainability that elicits an individual response (to content) or does it arise because sustainability is framed within an overarching individual context? The proposed

research could investigate whether results in this doctoral research project manifest the broader context with sustainability positioned as an 'individual issue' and what might change if there was an alternative social imaginary (Hursh et al., 2015), where sustainability is positioned as an imperative, similar to the legal requirement for Occupational Health and Safety. Future research could investigate whether students currently regard sustainability as an 'optional extra' and thus choose to "opt in" (or not) to LfS and to pursue individual actions and agency for sustainability.

9.2.4 Limitations of the current research

Several limitations may have impacted the findings in this research project. Specific limitations have already been outlined in the five publications presented within Chapters 4-8. This section considers broader limitations or methodological issues across the research project that warrant further attention.

The use of self-reported data for measures of worldview, knowledge, attitudes and behaviour face limitations of reliability and validity (Gonyea, 2005), although methods were adopted to triangulate findings using complementary questions in the survey. Self-report surveys in SE research may be hampered by several problems such as careless responses (Meade & Craig, 2012) and several types of bias including social desirability response bias (Fernandes & Randall, 1992), response bias, non-responses and variable responses. The presence of a power imbalance between the researcher and participants may have influenced the perception of an obligation to participate and give the "right" answer, particularly as the issue of sustainability/environment is often positioned as an ethical issue (Fernandes & Randall, 1992) and one that has become increasingly politicised in many countries around the world. Sustainability has become a polarizing topic (Swaim et al., 2014) and therefore sensitive (Fernandes & Randall, 1992) in the Australian discourse. While the research design in all empirical studies attempted to account for social desirability response bias (King & Bruner, 2000) through information and consent forms and by maintaining anonymous responses, the validity of findings across all studies may have been impacted by this issue.

In Stage 1, all research was conducted at one institution however, this was addressed in Stage 2 where multiple universities were included in the study. Data collection in Stage 1 was based on pre-post surveys however, the scope of information collected was limited. No information was sought from students about their prior knowledge of

sustainability and environment and the context of previous learning experiences. To better understand the context of motivation on student learning, subsequent research in Stages 2 and 3 asked additional questions on the importance of sustainability to their studies, to their profession and to their everyday lives.

In Stages 2 and 3, the studies were based on a concurrent mixed method approach (closed and open questions) and was limited by the lack of more in-depth qualitative explorations of student learning experiences. Nevertheless, several open-ended questions were included across dimensions such as knowledge, attitude and behaviour as well as key learnings, and graduate skills, etc., that enabled deeper insights into student learning experiences. Further, all open-ended responses were analysed solely by the researcher without the benefit of another researcher's interpretation, which prevented inter-rater comparability. It is impossible to completely remove the "self" from data collection and analysis, so the researcher's interpretations were likely influenced by the positionality of their lived experiences, beliefs, and perspectives (Johnson, 1997). While the researcher practised reflexivity throughout the research process and interpreted all responses according to relevant theoretical constructs, the coding was inherently subjective and overall reliability may have been improved with investigator triangulation to compare results.

9.3 Conclusion

The purpose of this research was to investigate how current approaches to SE in HE contribute to students' sustainability dispositions and to their competencies and agency towards sustainability. Based on results of four connected empirical studies conducted in this research project, the current ad hoc approach to SE was found to be wanting in several key areas. The wide diversity of views about the notion of sustainability and sustainable development, the role of education, and the free choice nature of teaching and learning for sustainability, has led to a cascade of chasms between the UN goals of education and the emergence of individualised agency for change. Despite expectations that SE would produce change agents, this research indicates that the current approach in HE leads to a convergence of student views towards instrumentalism and incremental change. These views conform rather than challenge or transform current socio-ecological systems and perpetuate the dominant growth/instrumental paradigm, thus contributing to societal systems not progressing beyond the early stages of the necessary sustainability transition.

This research project revealed that learning outcomes of SE interventions are uncertain and emerge as an amalgam of the student's personal context, their learning situation and the quality of the learning environment created by the teaching context and learning activities. Each exposure to SE contributes to a student's learning journey. However, the current findings reinforce that the free-choice approach to SE adopted by educators and students in most Australian universities is too weak and dispersed to build the momentum necessary to leverage TL, and create significant shifts in students beyond incremental and limited personal change.

Nevertheless, grounds for a more optimistic view are also evident. Sustainability education was shown to have the potential to lead to stronger learning outcomes and the emergence of limited agency when students are repeatedly exposed to sustainability in their study programmes, and when there is greater connection to experiences in other aspects of their lifeworld, particularly when there is motivation (personal and/or professional) to enact agency for change. However, it has not been confirmed in this research whether single or multiple exposure to SE leads to wider agency. Educators need to recognise, support and develop opportunities that create synergies in student sustainability learning across time and space. A sustainability enhanced LAS scale was demonstrated as a useful tool to assist educators in their assessment of TL outcomes from their SE endeavours.

This research advances the argument for a more systematic and coordinated approach to SE in HE programmes. This may have implications for the design of tertiary curricula, campus activities and wider engagement projects that foster deeper learning and potentially motivate students' agency to participate more fully and confidently in societal sustainability transitions. The findings of this research revealed the conditions that enhance student learning for sustainability in the current ad hoc environment in HE, paving the way for future research to determine how student learning translates to agency for change in their personal and professional lives.

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Appendix A: Surveys in the multi-university study (Study Four)

Appendix A1: Pre and post surveys for the EfS group

Information

STUDENT SURVEY
Education for Sustainability (EfS) Project,
CQUniversity Terms 1 and 2, 2014
INFORMATION SHEET

Project Overview
CQUniversity is implementing an Education for Sustainability (EfS) Project to further develop our students' skills for sustainability. These skills are becoming increasingly important to meet new government regulations, interest of the business community and changing professional standards for sustainability. This survey is being conducted to find out your knowledge and perspectives about issues of sustainability in general and in relation to your studies.

Participation Procedure
The questionnaire attached has 3 sections and takes 10 minutes to complete. Participation is voluntary and non-participation will not affect your academic standing in any way.

Benefits and Risks
Potential future benefits include more tailored EfS activities at CQUniversity

Confidentiality / Anonymity
All responses are completely anonymous as there is no information that can be used for identification. Data will be securely stored for five (5) years in accordance with the CQU policy.

Outcome / Publication of Results (if applicable)
Feedback from this survey will provide a better understanding of student views, knowledge and perspectives on sustainability and the impact of particular learning activities, allowing us to better tailor our teaching approach in the future. Findings from these surveys may be further aggregated for presentation to conferences or publication in journals in the future.

Right to Withdraw
You have a right to withdraw at any time without penalty.

Feedback
Participants and other interested parties can obtain feedback on aggregated findings on request.

Questions/ Further Information
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Concerns / Complaints
Include this statement:
Please contact Central Queensland University's Office of Research (Tel: 07 4923 2607; E-mail: research-enquiries@cqu.edu.au; Mailing address: Building 32, Central Queensland University, Rockhampton QLD 4702) should there be any concerns about the nature and/or conduct of this research project.

Consent
By clicking on the next button below, you agree to participate in this survey.

Student Survey EfS T1 2014 Stage 1

Section A - Sustainability in your discipline

1. At which university/TAFE/college are you studying?

- ○ CQ University
- ○ Curtin University
- ○ Southern Cross University
- ○ Universiti Tunku Abdul Rahman, Malaysia
- ○ University of Southern Queensland
- ○ Polytechnic University of Bari, Italy
- ○ Victoria University
- ○ TAFE New England
- ○ Deakin University
- ○ Federation University
- ○ Monash University
- ○ Charles Sturt University
- ○ Staff

*2. What is your mode of study?

- ○ On campus with face to face contact with staff members
- ○ Off campus by distance education/Flex

Other (please specify)

In the following questions about your subject/unit, please try to answer from the perspective of your experience in this particular subject/unit. Also, as we are interested in student views and opinions about sustainability and how these may change over time, please be honest and answer freely.

*3. In which individual subject/unit (or course) were you invited to participate in this survey?

*4. Are you a

○ Tertiary Preparation student?

○ Undergraduate student?

○ Postgraduate student?

5. What qualities and skills do you think a graduate from your program [course] and a professional in your chosen field of study is required to have?

6. How would you define 'sustainable development'?

Student Survey EfS T1 2014 Stage 1

One definition of sustainability that you might find useful

"Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations" (United States Environment Protection Authority, 2013).

7. How important is this concept of "sustainability" to:

	Very important	Slightly Important	Don't know	Slightly unimportant	Unimportant
Your program/course?	○	○	○	○	○
Your professsion?	○	○	○	○	○
Your everyday life?	○	○	○	○	○

8. What are the most important "sustainability" skills and knowledge you have already learned?

9. Where did you learn these "sustainability" skills and knowledge?

☐ Other courses/units

☐ Primary/secondary school

☐ Through the media

☐ General awareness

☐ Other (please specify)

*10. What are the most important "sustainability" skills and knowledge you expect to learn during your subject/unit this term?

11. What type of activities are currently being done by your university/TAFE/college, including your particular campus, to create more sustainable outcomes? See definition above.

12. What type of activities do you think should be done by your university/TAFE/college, including your particular campus, to create more sustainable outcomes? See definition above.

Relationship between humans and nature

13. Connectedness to nature.

Please select the figure below that best describes how you see your relationship with the natural environment, that is, how interconnected are you with nature?

○ A   ○ B   ○ C   ○ D   ○ E   ○ F   ○ G

14. Please explain why you selected the figure in the previous question.

15. Hierarchy with nature

Please select the figure below that best describes how you see your relationship with the natural environment, that is, your hierarchy (dominance) compared with nature?

○ A   ○ B   ○ C

16. Please explain why you selected the figure in the previous question.

*17. Personal actions for sustainability

How often do you participate in the following activities? Please tick the relevant column.

	Always	Often	Occassionally	Rarely	Never
Separate waste and place recyclables (paper, plastics, glass, aluminium, etc.) into recycling bin	○	○	○	○	○
Save energy by turning off lights and electronic equipment	○	○	○	○	○
Grow some of your own food	○	○	○	○	○
Compost garden waste and kitchen scraps	○	○	○	○	○
Take shorter showers and/or conserve water by other means	○	○	○	○	○
Collect and use rainwater	○	○	○	○	○
Ride your bike or public transport instead of using a car	○	○	○	○	○
Participate in bushwalking or other nature-based outdoor activities	○	○	○	○	○
Donate to social or environmental groups	○	○	○	○	○
Volunteer for social or environmental benefit	○	○	○	○	○

Other (please specify)

Student Survey EfS T1 2014 Stage 1

Section B - Humans and the environment

*18. Listed below are statements about the relationship between humans and the environment.

For each one, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
We are approaching the limit of the number of people the earth can support.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans have the right to modify the natural environment to suit their needs.	○	○	○	○	○

Additional comments

When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○

Additional comments

Human ingenuity will ensure that we do not make the earth unliveable.	○	○	○	○	○

Additional comments

Humans are severely abusing the environment.	○	○	○	○	○

Additional comments

The earth has plenty of natural resources if we just learn how to develop them.	○	○	○	○	○

Additional comments

Plants and animals have as much right as humans to exist.	○	○	○	○	○

Additional comments

The balance of nature is strong enough to cope with the impacts of modern industrial nations.	○	○	○	○	○

Additional comments

Despite their special abilities humans are still subject to the laws of nature.	○	○	○	○	○

Additional comments

The so-called 'ecological crisis' facing humankind has been greatly exaggerated.	○	○	○	○	○

Additional comments

The earth has very limited room and resources.	○	○	○	○	○

Additional comments

Humans are meant to rule over the rest of nature.	○	○	○	○	○

Additional comments

The balance of nature is very delicate and easily upset.	○	○	○	○	○

Additional comments

Humans will eventually learn enough about how nature works to be able to control it.	○	○	○	○	○

Additional comments

If things continue on their present course we will soon experience a major ecological catastrophe.	○	○	○	○	○

Additional comments

Student Survey EfS T1 2014 Stage 1

Section C – About you

*19. What is your gender?

- ○ Male
- ○ Female

*20. What is your age?

- ○ Less than 18 years
- ○ 18 - 24 years
- ○ 25 - 40 years
- ○ More than 40 years

*21. In which of the following countries/regions have you lived most of your life?

- ○ Australia, New Zealand, UK, USA, Canada
- ○ Subcontinent (India, Pakistan, Nepal, Bangladesh, Sri Lanka)
- ○ North Asia (China, Taiwan, Vietnam, South Korea, Hong Kong, Japan)
- ○ South Asia (Malaysia, Indonesia, The Philippines, Singapore, Thailand)
- ○ Africa, Middle East
- ○ Latin America
- ○ Europe: (please specify below)
- ○ Other (please specify)

*22. How many years did you actually live in that country?

- ○ Less than one year
- ○ 1 to 5 years
- ○ 5 to 10 years
- ○ 10 to 20 years
- ○ More than 20 years

*23. How long have you been living in the country in which you are now studying?

- ○ Less than 1 year
- ○ 1 to 3 years
- ○ 3 to 5 years
- ○ More than 5 years

Student Survey EfS T1 2014 Stage 1

Thank you for completing this questionnaire.

This survey is being conducted over two separate time periods. Thank you for completing this first part of the survey.

An email will be sent at a later date inviting you to complete the second part, which will only take about 5 minutes. Thanks again for participating in this research. Your cooperation is greatly appreciated.

TO COMPLETE THIS STAGE OF THE SURVEY SIMPLY CLOSE YOUR BROWSER WINDOW.

Thank you for completing this questionnaire.

STUDENT SURVEY
Education for Sustainability (EfS) Project,
CQUniversity Terms 1 and 2, 2014
INFORMATION SHEET

Project Overview
CQUniversity is implementing an Education for Sustainability (EfS) Project to further develop our students' skills for sustainability. These skills are becoming increasingly important to meet new government regulations, interest of the business community and changing professional standards for sustainability. This survey is being conducted to find out your knowledge and perspectives about issues of sustainability in general and in relation to your studies.

Participation Procedure
The questionnaire attached has 3 sections and takes 10 minutes to complete. Participation is voluntary and non-participation will not affect your academic standing in any way.

Benefits and Risks
Potential future benefits include more tailored EfS activities at CQUniversity

Confidentiality / Anonymity
All responses are completely anonymous as there is no information that can be used for identification. Data will be securely stored for five (5) years in accordance with the CQU policy.

Outcome / Publication of Results (if applicable)
Feedback from this survey will provide a better understanding of student views, knowledge and perspectives on sustainability and the impact of particular learning activities, allowing us to better tailor our teaching approach in the future. Findings from these surveys may be further aggregated for presentation to conferences or publication in journals in the future.

Right to Withdraw
You have a right to withdraw at any time without penalty.

Feedback
Participants and other interested parties can obtain feedback on aggregated findings on request.

Questions/ Further Information
Liz Sidiropoulos.
Direct Line: +61 (0)3 8662 0577. Facsimile: +61 (0)3 9639 4800
Mobile: +61 402 918 532 Email: l.sidiropoulos@mel.cqu.edu.au

Concerns / Complaints
Include this statement:
Please contact Central Queensland University's Office of Research (Tel: 07 4923 2607; E-mail: research-enquiries@cqu.edu.au; Mailing address: Building 32, Central Queensland University, Rockhampton QLD 4702) should there be any concerns about the nature and/or conduct of this research project.

Consent
By clicking on the next button below, you agree to participate in this survey.

Stage 2 of Survey

Thank you for coming back to complete Stage 2. This should only take you around 5 minutes to complete.

*1. At which university/TAFE/college are you studying?

○ CQ University

○ Curtin University

○ Southern Cross University

○ Universiti Tunku Abdul Rahman, Malaysia

○ University of Southern Queensland

○ Polytechnic University of Bari, Italy

○ Victoria University

○ TAFE New England

○ Deakin University

○ Federation University

○ Monash University

○ Charles Sturt University

○ Staff

*2. What is your mode of study?

○ On campus with face to face contact with staff members

○ Off campus by distance education/Flex

3. In which individual subject/unit/course were you invited to participate in this survey?

*4. Are you a

○ Tertiary Preparation student?

○ Undergraduate student?

○ Postgraduate student?

5. What qualities and skills do you think a graduate from your program [course] and a professional in your chosen field of study is required to have?

6. How would you define 'sustainable development'?

7. How important is sustainability for

	Very important	Slightly important	Don't know	Slightly unimportant	Unimportant
Your program?	○	○	○	○	○
Your profession?	○	○	○	○	○
Your everyday life?	○	○	○	○	○

*8. What are the most important "sustainability" skills and knowledge you actually learned during your subject/unit this term?

*9. Which of the following statements best describes how your perceptions and attitudes to sustainability have changed during this term?

○   My previous attitudes and perceptions have not changed at all

○   My previous attitudes and perceptions have changed towards sustainability

○   My previous attitudes and perceptions have changed away from sustainability

Further comments

10. What topic or activity on sustainability influenced you the most?

11. Why did this topic or activity change your opinions?

12. What type of activities are currently being done by your university, including your particular campus, to create more sustainable outcomes?

13. What type of activities do you think should be done by your university, including your particular campus, to create more sustainable outcomes?

Relationship between humans and nature

*14. Connectedness to nature

Please select the picture below that best describes how you see your relationship with the natural environment, that is, how interconnected are you with nature?

○ A   ○ B   ○ C   ○ D   ○ E   ○ F   ○ G
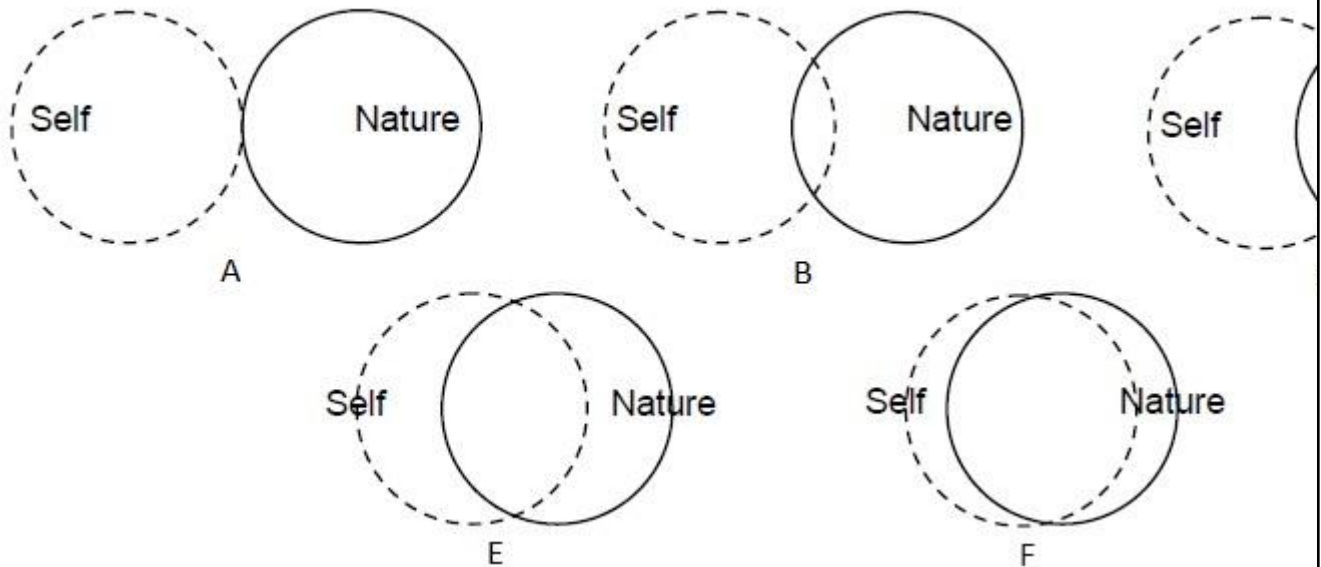
15. Please explain why you selected the figure in the previous question.

*16. Hierarchy with nature

Please select the figure below that best describes how you see your relationship with the natural environment, that is, your hierarchy (dominance) compared with nature?

○ A

○ B

○ C

17. Please explain why you selected the figure in the previous question.

*18. Personal actions for sustainability

How often do you participate in the following activities? Please tick the relevant column.

	Always	Often	Occassionally	Rarely	Never
Separate waste and place recyclables (paper, plastics, glass, aluminium, etc.) into recycling bin	○	○	○	○	○
Save energy by turning off lights and electronic equipment	○	○	○	○	○
Grow some of your own food	○	○	○	○	○
Compost garden waste and kitchen scraps	○	○	○	○	○
Take shorter showers and/or conserve water by other means	○	○	○	○	○
Collect and use rainwater	○	○	○	○	○
Ride your bike or public transport instead of using a car	○	○	○	○	○
Participate in bushwalking or other nature-based outdoor activities	○	○	○	○	○
Donate to social or environmental groups	○	○	○	○	○
Volunteer for social or environmental benefit	○	○	○	○	○

Other (please specify)

Section B - Humans and the Environment

*19. Listed below are statements about the relationship between humans and the environment.

For each one, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
We are approaching the limit of the number of people the earth can support.	○	○	○	○	○

Additional comments

Humans have the right to modify the natural environment to suit their needs.	○	○	○	○	○

Additional comments

When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○

Additional comments

Human ingenuity will ensure that we do not make the earth unliveable.	○	○	○	○	○

Additional comments

Humans are severely abusing the environment.	○	○	○	○	○

Additional comments

The earth has plenty of natural resources if we just learn how to develop them.	○	○	○	○	○

Additional comments

Plants and animals have as much right as humans to exist.	○	○	○	○	○

Additional comments

The balance of nature is strong enough to cope with the impacts of modern industrial nations.

Additional comments

Despite their special abilities humans are still subject to the laws of nature.

Additional comments

The so-called 'ecological crisis' facing humankind has been greatly exaggerated.

Additional comments

The earth is like a spaceship with very limited room and resources.

Additional comments

Humans are meant to rule over the rest of nature.

Additional comments

The balance of nature is very delicate and easily upset.

Additional comments

Humans will eventually learn enough about how nature works to be able to control it.

Additional comments

If things continue on their present course we will soon experience a major ecological catastrophe.

Additional comments

Section C – About you

*20. What is your gender?

○ Male

○ Female

*21. What is your age?

○ Less than 18 years

○ 18 - 24 years

○ 25 - 40 years

○ More than 40 years

*22. In which of the following countries/regions have you lived most of your life?

○ Australia, New Zealand, UK, USA, Canada

○ Subcontinent (India, Pakistan, Nepal, Bangladesh, Sri Lanka)

○ North Asia (China, Taiwan, Vietnam, South Korea, Hong Kong, Japan)

○ South Asia (Malaysia, Indonesia, The Philippines, Singapore, Thailand)

○ Africa, Middle East

○ Latin America

○ Europe: (please specify below)

○ Other (please specify)

*23. How many years did you actually live in that country?

○ Less than one year

○ 1 to 5 years

○ 5 to 10 years

○ 10 to 20 years

○ More than 20 years

*24. How long have you been living in the country in which you are now studying?

○ Less than 1 year

○ 1 to 3 years

○ 3 to 5 years

○ More than 5 years

Thank you for completing both parts of this survey. Your participation is greatly appreciated.
Click on the "Done" button to submit your survey. Thanks.

Congratulations, you will now be in the draw to win a Gold Class double cinema ticket. Good luck!

Appendix A2: Pre and post surveys for the Control group

Information

STUDENT SURVEY
Education for Sustainability (EfS) Project,
CQUniversity Terms 1 and 2, 2014
INFORMATION SHEET

Project Overview
CQUniversity is implementing an Education for Sustainability (EfS) Project to further develop our students' skills for sustainability. These skills are becoming increasingly important to meet new government regulations, interest of the business community and changing professional standards for sustainability. This survey is being conducted to find out your knowledge and perspectives about issues of sustainability in general and in relation to your studies.

Participation Procedure
The questionnaire attached has 3 sections and takes 10 minutes to complete. Participation is voluntary and non-participation will not affect your academic standing in any way.

Benefits and Risks
Potential future benefits include more tailored EfS activities at CQUniversity

Confidentiality / Anonymity
All responses are completely anonymous as there is no information that can be used for identification. Data will be securely stored for five (5) years in accordance with the CQU policy.

Outcome / Publication of Results (if applicable)
Feedback from this survey will provide a better understanding of student views, knowledge and perspectives on sustainability and the impact of particular learning activities, allowing us to better tailor our teaching approach in the future. Findings from these surveys may be further aggregated for presentation to conferences or publication in journals in the future.

Right to Withdraw
You have a right to withdraw at any time without penalty.

Feedback
Participants and other interested parties can obtain feedback on aggregated findings on request.

Questions/ Further Information
Liz Sidiropoulos.
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Concerns / Complaints
Include this statement:
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Consent
By clicking on the next button below, you agree to participate in this survey.

Student Survey Control T1 2014 Stage 1

Section A - Sustainability in your discipline

1. At which university/TAFE/college are you studying?

☐ CQ University

☐ Curtin University

☐ Southern Cross University

☐ Universiti Tunku Abdul Rahman, Malaysia

☐ University of Southern Queensland

☐ Polytechnic University of Bari, Italy

☐ Victoria University

☐ TAFE New England

☐ Deakin University

☐ Federation University

☐ Monash University

☐ Charles Sturt University

☐ Staff

*2. What is your mode of study?

○ On campus with face to face contact with staff members

○ Off campus by distance education/Flex

Other (please specify)

[ ]

In the following questions about your subject/unit, please answer from the perspective of your experience in this particular subject/unit. Also, as we are interested in student views and opinions about sustainability and how these may change over time, please be honest and answer freely.

*3. In which individual subject/unit/course were you invited to participate in this survey?

*4. Are you a

- ○ Tertiary Preparation student?
- ○ Undergraduate student?
- ○ Postgraduate student?

5. What qualities and skills do you think a graduate from your program [course] and a professional in your chosen field of study is required to have?

6. How would you define 'sustainable development'?

One definition of sustainability that you might find useful.

"Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations" (United States Environment Protection Authority, 2013).

7. How important is this concept of "sustainability" to:

	Very important	Slightly Important	Don't know	Slightly unimportant	Unimportant
Your program/course?	○	○	○	○	○
Your professsion?	○	○	○	○	○
Your everyday life?	○	○	○	○	○

8. What are the most important "sustainability" skills and knowledge you have already learned?

9. Where did you learn these "sustainability" skills and knowledge?

☐ Other courses/units

☐ Primary/secondary school

☐ Through the media

☐ General awareness

☐ Other (please specify)

10. What type of activities are currently being done by your university/TAFE/college, including your particular campus, to create more sustainable outcomes (see definition above).

11. What type of activities do you think should be done by your university/TAFE/college, including your particular campus, to create more sustainable outcomes?

Relationship between humans and nature

12. Connectedness to nature.

Please select the figure below that best describes how you see your relationship with the natural environment, that is, how interconnected are you with nature?

  ○ A   ○ B   ○ C   ○ D   ○ E   ○ F   ○ G
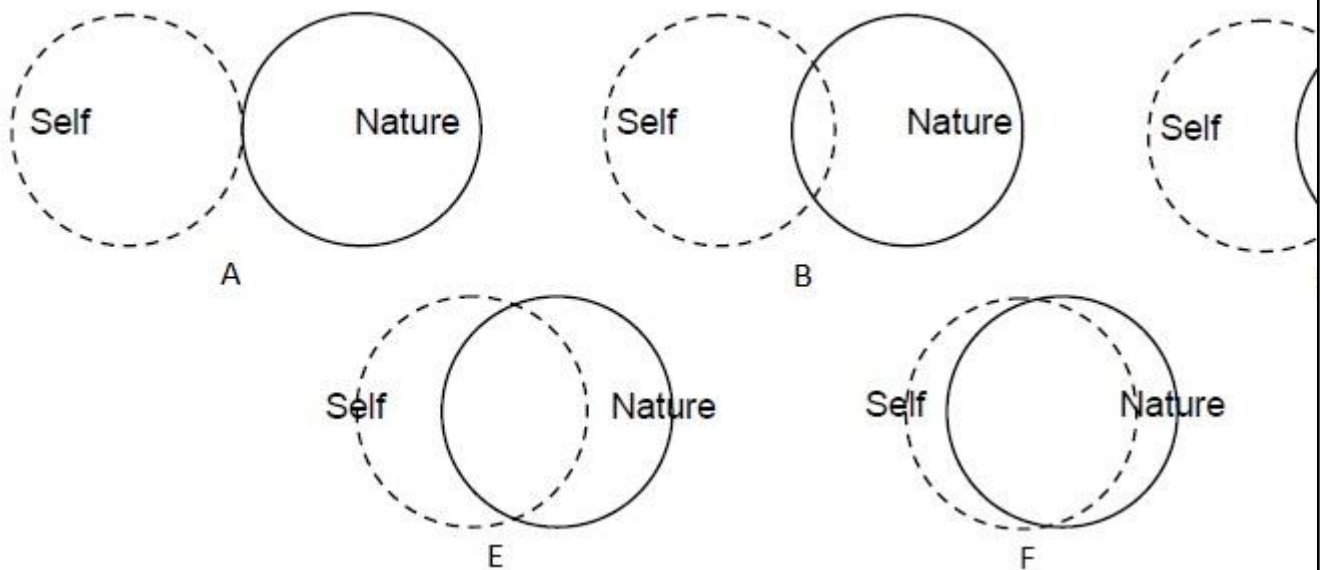
13. Please explain why you selected the figure in the previous question.

14. Hierarchy with nature

Please select the figure below that best describes how you see your relationship with the natural environment, that is, your hierarchy (dominance) compared with nature?

  ○ A   ○ B   ○ C

15. Please explain why you selected the figure in the previous question.

*16. Personal actions for sustainability

How often do you participate in the following activities? Please tick the relevant column.

	Always	Often	Occasionally	Rarely	Never
Separate waste and place recyclables (paper, plastics, glass, aluminium, etc.) into recycling bin	○	○	○	○	○
Save energy by turning off lights and electronic equipment	○	○	○	○	○
Grow some of your own food	○	○	○	○	○
Compost garden waste and kitchen scraps	○	○	○	○	○
Take shorter showers and/or conserve water by other means	○	○	○	○	○
Collect and use rainwater	○	○	○	○	○
Ride your bike or public transport instead of using a car	○	○	○	○	○
Participate in bushwalking or other nature-based outdoor activities	○	○	○	○	○
Donate to social or environmental groups	○	○	○	○	○
Volunteer for social or environmental benefit	○	○	○	○	○

Other (please specify)

Section B - Humans and the environment

*17. Listed below are statements about the relationship between humans and the environment.

For each one, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
We are approaching the limit of the number of people the earth can support.	○	○	○	○	○

Other (please specify)

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans have the right to modify the natural environment to suit their needs.	○	○	○	○	○

Other (please specify)

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○

Other (please specify)

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Human ingenuity will ensure that we do not make the earth unliveable.	○	○	○	○	○

Other (please specify)

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans are severely abusing the environment.	○	○	○	○	○

Other (please specify)

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The earth has plenty of natural resources if we just learn how to develop them.	○	○	○	○	○

Other (please specify)

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Plants and animals have as much right as humans to exist.	○	○	○	○	○

Other (please specify)

The balance of nature is strong enough to cope with the impacts of modern industrial nations.

Other (please specify)

Despite their special abilities humans are still subject to the laws of nature.

Other (please specify)

The so-called 'ecological crisis' facing humankind has been greatly exaggerated.

Other (please specify)

The earth has very limited room and resources.

Other (please specify)

Humans are meant to rule over the rest of nature.

Other (please specify)

The balance of nature is very delicate and easily upset.

Other (please specify)

Humans will eventually learn enough about how nature works to be able to control it.

Other (please specify)

If things continue on their present course we will soon experience a major ecological catastrophe.

Other (please specify)

Section C – About you

*18. What is your gender?

○ Male

○ Female

*19. What is your age?

○ Less than 18 years

○ 18 - 24 years

○ 25 - 40 years

○ More than 40 years

*20. In which country have you lived most of your life?

○ Australia, New Zealand, UK, USA, Canada

○ Subcontinent (India, Pakistan, Nepal, Bangladesh, Sri Lanka)

○ North Asia (China, Taiwan, Vietnam, South Korea, Hong Kong, Japan)

○ South Asia (Malaysia, Indonesia, The Philippines, Singapore, Thailand)

○ Africa, Middle East

○ Latin America

○ Europe (please specify below)

○ Other (please specify)

*21. How many years did you actually live in that country?

○ Less than one year

○ 1 to 5 years

○ 5 to 10 years

○ 10 to 20 years

○ More than 20 years

*22. How long have you been living in the country in which you are now studying?

○ Less than 1 year

○ 1 to 3 years

○ 3 to 5 years

○ More than 5 years

Student Survey Control T1 2014 Stage 1

Thank you for completing this questionnaire.

This survey is being conducted over two separate time periods. Thank you for completing this first part of the survey.

An email will be sent at a later date inviting you to complete the second part, which will only take about 5 minutes. Thanks again for participating in this research. Your cooperation is greatly appreciated.

TO COMPLETE THIS STAGE OF THE SURVEY SIMPLY CLOSE YOUR BROWSER WINDOW.

Information

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CQUniversity Terms 1 and 2, 2014
INFORMATION SHEET

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Confidentiality / Anonymity
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Outcome / Publication of Results (if applicable)
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Right to Withdraw
You have a right to withdraw at any time without penalty.

Feedback
Participants and other interested parties can obtain feedback on aggregated findings on request.

Questions/ Further Information
Liz Sidiropoulos.
Direct Line: +61 (0)3 8662 0577. Facsimile: +61 (0)3 9639 4800
Mobile: +61 402 918 532 Email: l.sidiropoulos@mel.cqu.edu.au

Concerns / Complaints
Include this statement:
Please contact Central Queensland University's Office of Research (Tel: 07 4923 2607; E-mail: research-enquiries@cqu.edu.au; Mailing address: Building 32, Central Queensland University, Rockhampton QLD 4702) should there be any concerns about the nature and/or conduct of this research project.

Consent
By clicking on the next button below, you agree to participate in this survey.

Student Survey Control T1 2014 Stage 2

Stage 2 of Survey

Thank you for coming back to complete Stage 2. This should only take you around 5 minutes to complete.

Student Survey Control T1 2014 Stage 2

1. At which university/TAFE/college are you studying?

○ CQ University

○ Curtin University

○ Southern Cross University

○ Universiti Tunku Abdul Rahman, Malaysia

○ University of Southern Queensland

○ Polytechnic University of Bari, Italy

○ Victoria University

○ TAFE New England

○ Deakin University

○ Federation University

○ Monash University

○ Charles Sturt University

○ Staff

2. What is your mode of study?

○ On campus with face to face contact with staff members

○ Off campus by distance education/Flex

*3. In which individual subject/unit/course were you invited to participate in this survey?

*4. Are you a

○ Tertiary Preparation student?

○ Undergraduate student?

○ Postgraduate student?

5. What qualities and skills do you think a graduate from your program [course] and a professional in your chosen field of study is required to have?

6. How would you define 'sustainable development'?

7. How important is sustainability to:

	Very important	Slightly Important	Don't know	Slightly unimportant	Unimportant
Your program/course?	○	○	○	○	○
Your professsion?	○	○	○	○	○
Your everyday life?	○	○	○	○	○

*8. How often during this course has your teacher/tutor/lecturer referred to some aspect of sustainability or the environment?

○ Very often

○ Often

○ Sometimes

○ Rarely

○ Never

*9. How often in other courses/units have your teachers/tutors/lecturers referred to some aspect of sustainability or the environment?

○ Very Often

○ Often

○ Sometimes

○ Rarely

○ Never

Please specify the course

*10. Which of the following statements best describes how your perceptions and attitudes to sustainability have changed during this term?

○ My previous attitudes and perceptions have not changed at all

○ My previous attitudes and perceptions have changed towards sustainability

○ My previous attitudes and perceptions have changed away from sustainability

Further comments

11. What type of activities are currently being done by your university, including your particular campus, to create more sustainable outcomes?
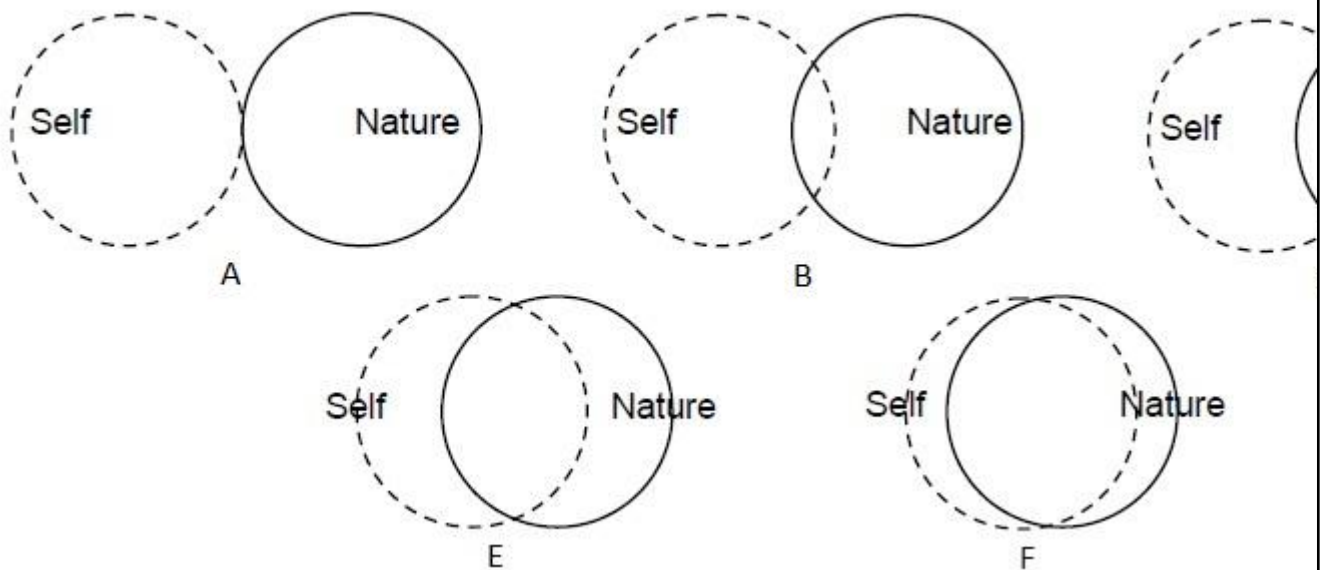
12. What type of activities do you think should be done by your university, including your particular campus, to create more sustainable outcomes?

Relationship between humans and nature

13. Connectedness to nature.

Please select the figure below that best describes how you see your relationship with the natural environment, that is, how interconnected are you with nature?

   A   B   C   D   E   F   G

14. Please explain why you selected the figure in the previous question.

15. Hierarchy with nature

Please select the figure below that best describes how you see your relationship with the natural environment, that is, your hierarchy (dominance) compared with nature?

   A   B   C

16. Please explain why you selected the figure in the previous question.

*17. Personal actions for sustainability

How often do you participate in the following activities? Please tick the relevant column.

	Always	Often	Occasionally	Rarely	Never
Separate waste and place recyclables (paper, plastics, glass, aluminium, etc.) into recycling bin	○	○	○	○	○
Save energy by turning off lights and electronic equipment	○	○	○	○	○
Grow some of your own food	○	○	○	○	○
Compost garden waste and kitchen scraps	○	○	○	○	○
Take shorter showers and/or conserve water by other means	○	○	○	○	○
Collect and use rainwater	○	○	○	○	○
Ride your bike or public transport instead of using a car	○	○	○	○	○
Participate in bushwalking or other nature-based outdoor activities	○	○	○	○	○
Donate to social or environmental groups	○	○	○	○	○
Volunteer for social or environmental benefit	○	○	○	○	○

Other (please specify)

Student Survey Control T1 2014 Stage 2

Section B - Humans and the environment

*18. Listed below are statements about the relationship between humans and the environment.

For each one, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
We are approaching the limit of the number of people the earth can support.	○	○	○	○	○

Additional comments

Humans have the right to modify the natural environment to suit their needs.	○	○	○	○	○

Additional comments

When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○

Additional comments

Human ingenuity will ensure that we do not make the earth unliveable.	○	○	○	○	○

Additional comments

Humans are severely abusing the environment.	○	○	○	○	○

Additional comments

The earth has plenty of natural resources if we just learn how to develop them.	○	○	○	○	○

Additional comments

Plants and animals have as much right as humans to exist.	○	○	○	○	○

Additional comments

The balance of nature is strong enough to cope with the impacts of modern industrial nations.

Additional comments

Despite their special abilities humans are still subject to the laws of nature.

Additional comments

The so-called 'ecological crisis' facing humankind has been greatly exaggerated.

Additional comments

The earth is like a spaceship with very limited room and resources.

Additional comments

Humans are meant to rule over the rest of nature.

Additional comments

The balance of nature is very delicate and easily upset.

Additional comments

Humans will eventually learn enough about how nature works to be able to control it.

Additional comments

If things continue on their present course we will soon experience a major ecological catastrophe.

Additional comments

Section C – About you

*19. What is your gender?

○ Male

○ Female

*20. What is your age?

○ Less than 18 years

○ 18 - 24 years

○ 25 - 40 years

○ More than 40 years

*21. In which country have you lived most of your life?

○ Australia, New Zealand, UK, USA, Canada

○ Subcontinent (India, Pakistan, Nepal, Bangladesh, Sri Lanka)

○ North Asia (China, Taiwan, Vietnam, South Korea, Hong Kong, Japan)

○ South Asia (Malaysia, Indonesia, The Philippines, Singapore, Thailand)

○ Africa, Middle East

○ Latin America

○ Europe (please specify below)

○ Other (please specify)

*22. How many years did you actually live in that country?

○ Less than one year

○ 1 to 5 years

○ 5 to 10 years

○ 10 to 20 years

○ More than 20 years

*23. How long have you been living in the country in which you are now studying?

○ Less than 1 year

○ 1 to 3 years

○ 3 to 5 years

○ More than 5 years

Student Survey Control T1 2014 Stage 2

Thank you.

Thank you for completing both parts of this survey. Your participation is greatly appreciated.
Click on the "Done" button to submit your survey. Thanks.

Congratulations, you will now be in the draw to win a Gold Class double cinema ticket. Good luck!

Appendix B: Modified Learning Activities Survey (Study Five)

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate
You are invited to participate in a research project entitled "The contribution of tertiary sustainability education to student knowledge, views, attitudes and behaviour towards sustainability". This project is being conducted by a student researcher Elizabeth Sidiropoulos as part of a PhD study at Victoria University under the supervision of Professor Nicola Yelland from College of Education.

Project explanation
Victoria University is collaborating with La Trobe University in a research project to better understand *how tertiary students develop skills for sustainability.* These skills are becoming increasingly important to meet international policy developments, new government regulations, emerging interest of the business community and changing professional standards for sustainability. This survey is being conducted to find out your knowledge and perspectives about issues of sustainability in general and in relation to your studies.

What will I be asked to do?
Welcome back! This questionnaire relates to the second stage, has 3 sections and takes 10 minutes to complete. Participation is voluntary and non-participation will not affect your academic standing in any way. You can withdraw at any time.

What will I gain from participating?
Personal benefits may include greater insights into your own sustainability perspectives as well as your learning in this course. Potential future benefits include more tailored sustainability education activities at the tertiary level and specifically at your university. All respondents who complete both stages will be able to enter a draw to win a Gold Class Double Cinema Pass. Those who also complete a subsequent mini-interview will be entered into a prize drawing for an iPad Mini 2.

How will the information I give be used?
Feedback in this survey will provide a better understanding of student views, knowledge and perspectives on sustainability and the influence of particular learning activities, allowing a more tailored teaching approach in the future. Findings from these surveys may be further aggregated for presentation to conferences or publication in journals in the future. All responses are completely anonymous as there is no information that can be used for identification. Data will be securely stored for five (5) years in accordance with the Victoria University policy.

What are the potential risks of participating in this project?
There are no known risks associated with participating in this research project.

How will this project be conducted?
LTU students enrolled in BUS2SUS are invited to participate in an online survey conducted over

two time periods to better understand their sustainability dispositions and how these may be influenced by tertiary studies.

Who is conducting the study?
VU and LTU are collaborating in this study.

Chief Investigator: Professor Nicola Yelland, email Nicola.Yelland@vu.edu.au
Student Researcher: Elizabeth Sidiropoulos, email elizabeth.sidiropoulos@live.vu.edu.au or mobile 0402 918 532.

Any queries about your participation in this project may be directed to the Chief Investigator listed above.

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

Consent
By clicking on the next button below, you agree to participate in this survey.

Stage 2 of Survey

Thank you for coming back to complete Stage 2. This should only take you around 5-10 minutes to complete.

1. In Stage 1 of the survey, all respondents were asked to provide a password or unique identifier to assist us to track participants responses anonymously over time. This consisted of your year of birth and initials of your name (e.g., 1991ES).

Please insert your password/unique identifier from Stage 1 of the survey, in the box below.

2. Did you provide a password/unique identifier in Q1?

◯ Yes

◯ No

SECTION A - About you and your study

* 3. What is your gender?

◯ Male

◯ Female

* 4. What is your age?

◯ Less than 18 years

◯ 18 - 24 years

◯ 25 - 40 years

◯ More than 40 years

* 5. In which of the following countries/regions have you lived most of your life?

◯ Australia, New Zealand, UK, USA, Canada

◯ Subcontinent (India, Pakistan, Nepal, Bangladesh, Sri Lanka)

◯ North Asia (China, Taiwan, Vietnam, South Korea, Hong Kong, Japan)

◯ South Asia (Malaysia, Indonesia, The Philippines, Singapore, Thailand)

◯ Africa, Middle East (please specify below)

◯ Latin America (please specify below)

◯ Europe: (please specify below)

◯ Other (please specify)

[   ]

* 6. How many years did you actually live in that country?

◯ 1 to 5 years

◯ 5 to 10 years

◯ 10 to 20 years

◯ More than 20 years

* 7. How long have you been living in Australia?

○ Less than 1 year

○ 1 to 3 years

○ 3 to 5 years

○ 5 to 10 years

○ All your life

* 8. What is your current major:

○ Allied Health

○ Business

○ IT / Computer Science

○ English

○ General Arts

○ Nursing

○ Science/Engineering

○ Social Sciences (Education, Psychology, Sociology)

○ Other (please specify)

[   ]

* 9. What is the highest level of your prior education?

○ High school

○ Certificate IV

○ Diploma

○ Bachelors degree

○ Masters degree

○ Doctorate

○ Other (please specify)

[   ]

* 10. How many semesters have you been enrolled in your program at this university?

[   ]

The following questions relate to the specific subject/unit of BUS2SUS in which you are enrolled. Please answer from the perspective of your experience in this particular subject/unit. Also, as we are interested in student views and opinions about sustainability and how these may changed over time, *please be honest and answer freely.*

11. What qualities and skills do you think are required for a graduate from your program [course] and a professional in your chosen field of study?

* 12. What is your understanding of the term 'sustainability'?

* 13. What is your understanding of the term 'sustainable development'?

Sustainability skills and knowledge

PLEASE READ THE FOLLOWING DEFINITION OF SUSTAINABILITY

Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations"
(United States Environment Protection Authority, 2013).

* 14. Considering the definition of sustainability above, how important is sustainability for:

	Unimportant	Slighty unimportant	Don't know	Slightly important	Very important
Your program/course?	◯	◯	◯	◯	◯
Your profession?	◯	◯	◯	◯	◯
Your everyday life?	◯	◯	◯	◯	◯

* 15. Considering the definition of sustainability above,**what are the most important "sustainability" skills and knowledge you actually learned during your subject/unit** BUS2SUS this term?

Learning Activities (adapted from King, 2009)
These questions relate specifically to your experiences as adult learners. We believe that important things happen when adults learn new things. Only with your help can we learn more about this.

* 16. Thinking back over your educational experiences in this particular subject/unit, select any of the following statements that may apply.

☐ I had an experience that caused me to question the way I normally act.

☐ I had an experience that caused me to question my ideas about social roles. (Examples of social roles include how a graduate or professional should act.)

☐ As I questioned my ideas, I realised I no longer agreed with my previous beliefs or role expectations.

☐ As I questioned my ideas, I realised I still agreed with my beliefs or role expectations.

☐ I realised that other people also questioned their beliefs.

☐ I thought about acting in a different way from my usual beliefs and roles.

☐ As I questioned my ideas, I felt uncomfortable with traditional social expectations.

☐ I tried out new roles so that I would become more comfortable or confident in them.

☐ I tried to figure out a way to adopt these new ways of acting.

☐ I gathered the information I needed to adopt these new ways of acting.

☐ I began to think about the reactions and feedback from my new behaviour.

☐ I took action and adopted these new ways of acting.

☐ I do not identify with any of the statements above.

* 17. Since you have been taking this subject/unit, do you believe you have experienced a time when you realised that your values, beliefs, opinions or expectations had changed?

○ Yes

○ No

18. Briefly describe what happened.

19. A person's values, beliefs, opinions or expectations can change due to a wide variety of situations and events. Which of the following influenced your change? (select all that apply)

Was it a person who influenced the change?

○ Yes

○ No

20. If "Yes" to Q 23, was it . . . (select all that apply)

○ Another student's support

○ Your classmates' support

○ Your advisor's support

○ A challenge from your teacher

○ Your teacher's support

○ Other (please specify)

21. What role did your tutor in this subject/unit BUS2SUS have on the development/change in your views, attitudes, behaviour and skills for sustainability during the semester?

22. Was it part of a class assignment that influenced the change?

○ Yes

○ No

23. If "Yes" to Q25, was it . . . (select all that apply)

- ☐ Class/group projects
- ☐ Writing about your concerns
- ☐ Personal journal
- ☐ Non-traditional structure of the course
- ☐ Internship or co-op
- ☐ Deep, concentrated thought
- ☐ Personal learning assessment (PLA)
- ☐ Verbally discussing your concerns
- ☐ Term papers/essays
- ☐ Self-evaluation in a course
- ☐ Class activity/exercise
- ☐ Lab experiences
- ☐ Personal reflection
- ☐ Assigned readings
- ☐ Online resources
- ☐ Other (please specify)

24. Was it a significant change in your (personal) life that influenced the change?

- ○ Yes
- ○ No

25. If "Yes" to Q27, was it.... (select all that apply)

- ○ Marriage
- ○ Birth/adoption of a child
- ○ Moving
- ○ Divorce/separation
- ○ Death of a loved one
- ○ Change of job
- ○ Loss of job
- ○ Retirement

* 26. Thinking back over this course, which of the following statements best describes how your perceptions and attitudes to sustainability (as defined above) have changed during this term?

   ( ) My previous attitudes and perceptions have not changed at all

   ( ) My previous attitudes and perceptions have changed towards sustainability and the environment

   ( ) My previous attitudes and perceptions have changed away from sustainability and the environment

Further comments

27. What topic or activity on sustainability and the environment in this course influenced you the most?

28. Why did this topic or activity in this course change your opinions?

* 29. Would you characterise yourself as one who usually thinks back over previous decisions or past behaviour?

   ( ) Yes

   ( ) No

* 30. Would you say that you frequently reflect upon the meaning of your studies for yourself, personally?

   ( ) Yes

   ( ) No

* 31. Given your learning in this subject/unit BUS2SUS, do you feel more capable to identify and address challenges and opportunities related to the environment and sustainability?

   ( ) Yes

   ( ) No

* 32. Given your experience in this subject/unit BUS2SUS, do you think you will be more actively advocating for the environment and sustainability?

   ( ) Yes

   ( ) No

33. Thinking back over your entire programme of study, which of the following have been part of your overall educational experience at this university.. (select all that apply)

- [ ] Class/group projects
- [ ] Writing about your concerns
- [ ] Personal journal
- [ ] Non-traditional structure of the course
- [ ] Internship or co-op
- [ ] Deep, concentrated thought
- [ ] Personal learning assessment (PLA)
- [ ] Verbally discussing your concerns
- [ ] Term papers/essays
- [ ] Self-evaluation in a course
- [ ] Class activity/exercise
- [ ] Lab experiences
- [ ] Personal reflection
- [ ] Assigned readings
- [ ] Online resources
- [ ] Other (please specify)

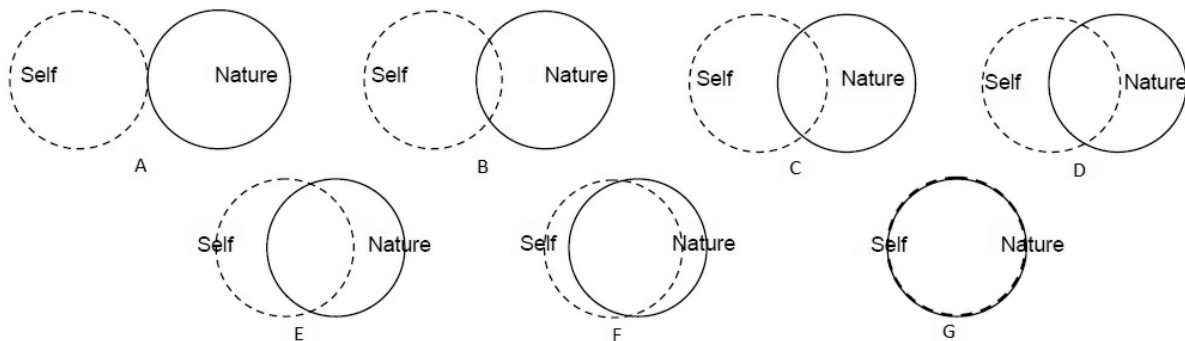34. Did any major life events occur while you were taking other subjects/units at this university?

- ( ) Yes
- ( ) No

SECTION B: Relationship between humans and nature

* 35. Connectedness to nature
Please select the picture below that best describes how you see your relationship with the natural environment, that is, how interconnected are you with nature?

○ A ○ B ○ C ○ D ○ E ○ F ○ G

36. Please explain why you selected the figure in the previous question.

* 37. Listed below are statements about the relationship between humans and the environment.
For each one, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
We are approaching the limit of the number of people the earth can support.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans have the right to modify the natural environment to suit their needs.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Human ingenuity will ensure that we do not make the earth unliveable.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans are severely abusing the environment.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The earth has plenty of natural resources if we just learn how to develop them.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Plants and animals have as much right as humans to exist.	○	○	○	○	○

Additional comments

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	○	○	○	○	○

Additional comments

* 38. For each statement below, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Despite their special abilities humans are still subject to the laws of nature.	○	○	○	○	○

Additional comments

[ ]

The so-called 'ecological crisis' facing humankind has been greatly exaggerated.	○	○	○	○	○

Additional comments

[ ]

The earth is like a spaceship with very limited room and resources.	○	○	○	○	○

Additional comments

[ ]

Humans are meant to rule over the rest of nature.	○	○	○	○	○

Additional comments

[ ]

The balance of nature is very delicate and easily upset.	○	○	○	○	○

Additional comments

[ ]

Humans will eventually learn enough about how nature works to be able to control it.	○	○	○	○	○

Additional comments

[ ]

If things continue on their present course we will soon experience a major ecological catastrophe.	○	○	○	○	○

Additional comments

[ ]

SECTION C - Actions for the environment / sustainability

* 39. How often do you (or your household) participate in the following activities? Please tick the relevant column.

	Always	Often	Occassionally	Rarely	Never
Separate waste and place recyclables (paper, plastics, glass, aluminium, etc.) into recycling bin	◯	◯	◯	◯	◯
Save energy by turning off lights and electronic equipment	◯	◯	◯	◯	◯
Grow some of your own food	◯	◯	◯	◯	◯
Compost garden waste and kitchen scraps	◯	◯	◯	◯	◯
Take shorter showers and/or conserve water by other means	◯	◯	◯	◯	◯
Collect and use rainwater	◯	◯	◯	◯	◯
Ride your bike, walk or take public transport instead of using a car	◯	◯	◯	◯	◯
Participate in bushwalking or other nature-based outdoor activities	◯	◯	◯	◯	◯
Donate to social or environmental groups	◯	◯	◯	◯	◯
Volunteer for social or environmental benefit	◯	◯	◯	◯	◯
Posted or shared something on social media regarding the environment or sustainability?	◯	◯	◯	◯	◯

Other (please specify)

* 40. During the next 12 months, do you intend to..... (please tick the relevant column)

	Yes	No
Contribute time or money to an environmental or wildlife conservation group?	○	○
Start buying a product because you think it protects the environment?	○	○
Contact a government agency to get information about the environment?	○	○
Read a conservation or environmental magazine?	○	○
Watch a television special on the environment?	○	○
Vote for or against a political candidate because of his or her position on the environment?	○	○
Recycle newspapers, glass, or other items on a regular basis?	○	○

Other (please specify)

Thank you very much for completing both parts of this survey. Your participation is greatly appreciated.

41. If you'd like to enter the draw to win a Gold Class double cinema ticket, please provide your private email address. Good luck!

42. This next part of the research is MOST important.

All survey participants are invited to take part in a 20-30 minute follow-up interview to discuss your learning experience in this subject/unit BUS2SUS. If you are willing to be contacted by the researcher again, please provide your phone number or private email below.

By participating in an interview you could assist your own learning and also enter a prize draw to win an iPad Mini 2! Many thanks in advance for your contribution!

Click on the "Done" button to submit your survey.

Thank you very much!. All the very best for your studies!

INFORMATION TO PARTICIPANTS INVOLVED IN RESEARCH

You are invited to participate
You are invited to participate in a research project entitled "The contribution of tertiary sustainability education to student knowledge, views, attitudes and behaviour towards sustainability". This project is being conducted by a student researcher Elizabeth Sidiropoulos as part of a PhD study at Victoria University under the supervision of Professor Nicola Yelland from College of Education.

Project explanation
Victoria University is collaborating with University of Southern Queensland in a research project to better understand how tertiary students develop skills for sustainability. These skills are becoming increasingly important to meet international policy developments, new government regulations, emerging interest of the business community and changing professional standards for sustainability. This survey is being conducted to find out your knowledge and perspectives about issues of sustainability in general and in relation to your studies.

What will I be asked to do?
Welcome back! This questionnaire relates to the second stage, has 3 sections and takes 10 minutes to complete. Participation is voluntary and non-participation will not affect your academic standing in any way. You can withdraw at any time.

What will I gain from participating?
Personal benefits may include greater insights into your own sustainability perspectives as well as your learning in this course. Potential future benefits include more tailored sustainability education activities at the tertiary level and specifically at your university. All respondents who complete both stages will be able to enter a draw to win a Gold Class Double Cinema Pass. Those who also complete a subsequent interview will be entered into a prize drawing for an iPad Mini 2.

How will the information I give be used?
Feedback in this survey will provide a better understanding of student views, knowledge and perspectives on sustainability and the influence of particular learning activities, allowing a more tailored teaching approach in the future. Findings from these surveys may be further aggregated for presentation to conferences or publication in journals in the future. All responses are completely anonymous as there is no information that can be used for identification. Data will be securely stored for five (5) years in accordance with the Victoria University policy.

What are the potential risks of participating in this project?
There are no known risks associated with participating in this research project.

How will this project be conducted?
USQ students enrolled in REN1201 and REN8101 are invited to participate in an online survey

conducted over two time periods to better understand their sustainability dispositions and how these may be influenced by tertiary studies.

Who is conducting the study?
VU and USQ are collaborating in this study.

Chief Investigator: Professor Nicola Yelland, email Nicola.Yelland@vu.edu.au
Student Researcher: Elizabeth Sidiropoulos, email elizabeth.sidiropoulos@live.vu.edu.au or mobile 0402 918 532.

Any queries about your participation in this project may be directed to the Chief Investigator listed above.

If you have any queries or complaints about the way you have been treated, you may contact the Ethics Secretary, Victoria University Human Research Ethics Committee, Office for Research, Victoria University, PO Box 14428, Melbourne, VIC, 8001, email researchethics@vu.edu.au or phone (03) 9919 4781 or 4461.

Consent
By clicking on the next button below, you agree to participate in this survey.

Stage 2 of Survey

Thank you for coming back to complete Stage 2. This should only take you around 5-10 minutes to complete.

1. In Stage 1 of the survey, all respondents were asked to provide a secret password to assist us to track participants responses anonymously over time.

Please insert your secret password from Stage 1 of the survey, in the box below.

2. Did you provide a password in Q1?

○ Yes

○ No

SECTION A - About you and your study

* 3. What is your gender?

◯ Male

◯ Female

* 4. What is your age?

◯ Less than 18 years

◯ 18 - 24 years

◯ 25 - 40 years

◯ More than 40 years

* 5. In which of the following countries/regions have you lived most of your life?

◯ Australia, New Zealand, UK, USA, Canada

◯ Subcontinent (India, Pakistan, Nepal, Bangladesh, Sri Lanka)

◯ North Asia (China, Taiwan, Vietnam, South Korea, Hong Kong, Japan)

◯ South Asia (Malaysia, Indonesia, The Philippines, Singapore, Thailand)

◯ Africa, Middle East (please specify below)

◯ Latin America (please specify below)

◯ Europe: (please specify below)

◯ Other (please specify)

[   ]

* 6. How many years did you actually live in that country?

◯ 1 to 5 years

◯ 5 to 10 years

◯ 10 to 20 years

◯ More than 20 years

* 7. How long have you been living in Australia?

○ Less than 1 year

○ 1 to 3 years

○ 3 to 5 years

○ 5 to 10 years

○ All your life

* 8. At which university are you studying?

○ USQ - University of Southern Queensland

○ CQU - CQ University

○ MQU - Maquarie University

○ LTU - LaTrobe University

○ VU - Victoria University

○ Staff

* 9. What is your mode of study?

○ On campus with face to face contact with staff members

○ Off campus by distance education/Flex

○ Mixed mode, both on campus and by distance/flex

* 10. Are you a?

○ Undergraduate student

○ Postgraduate student

* 11. What is your current major:

○ Allied Health

○ Business

○ IT / Computer Science

○ English

○ General Arts

○ Nursing

○ Science/Engineering

○ Social Sciences (Education, Psychology, Sociology)

○ Other (please specify)

[   ]

* 12. What is the highest level of your prior education?

○ High school

○ Certificate IV

○ Diploma

○ Bachelors degree

○ Masters degree

○ Doctorate

○ Other (please specify)

[   ]

* 13. How many semesters have you been enrolled in your program at this university?

[   ]

The following questions relate to the subject/unit specified in the email invitation sent to you. Please answer from the perspective of your experience in this particular subject/unit. Also, as we are interested in student views and opinions about sustainability and how these may change over time, please be honest and answer freely.

* 14. In which of the following individual subject/unit/course were you invited in the email to participate in this survey?

( ) REN1201

( ) REN8101

15. What qualities and skills do you think are required for a graduate from your program [course] and a professional in your chosen field of study?

[ ]

* 16. What is your understanding of the term 'sustainability'?

[ ]

* 17. What is your understanding of the term 'sustainable development'?

[ ]

Sustainability skills and knowledge

PLEASE READ THE FOLLOWING DEFINITION OF SUSTAINABILITY

Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations"
(United States Environment Protection Authority, 2013).

* 18. Considering the definition of sustainability above, how important is sustainability for:

	Unimportant	Slighty unimportant	Don't know	Slightly important	Very important
Your program/course?	○	○	○	○	○
Your profession?	○	○	○	○	○
Your everyday life?	○	○	○	○	○

* 19. Considering the definition of sustainability above, **what are the most important "sustainability" skills and knowledge you actually learned during your subject/unit** this term?

Learning Activities (adapted from King, 2009)
These questions relate specifically to your experiences as adult learners. We believe that important things happen when adults learn new things. Only with your help can we learn more about this.

* 20. Thinking back over your educational experiences in this particular course, select any of the following statements that may apply.

☐ I had an experience that caused me to question the way I normally act.

☐ I had an experience that caused me to question my ideas about social roles. (Examples of social roles include how a graduate or professional should act.)

☐ As I questioned my ideas, I realised I no longer agreed with my previous beliefs or role expectations.

☐ As I questioned my ideas, I realised I still agreed with my beliefs or role expectations.

☐ I realised that other people also questioned their beliefs.

☐ I thought about acting in a different way from my usual beliefs and roles.

☐ As I questioned my ideas, I felt uncomfortable with traditional social expectations.

☐ I tried out new roles so that I would become more comfortable or confident in them.

☐ I tried to figure out a way to adopt these new ways of acting.

☐ I gathered the information I needed to adopt these new ways of acting.

☐ I began to think about the reactions and feedback from my new behaviour.

☐ I took action and adopted these new ways of acting.

☐ I do not identify with any of the statements above.

* 21. Since you have been taking this course, do you believe you have experienced a time when you realised that your values, beliefs, opinions or expectations had changed?

○ Yes

○ No

22. Briefly describe what happened.

23. A person's values, beliefs, opinions or expectations can change due to a wide variety of situations and events. Which of the following influenced your change? (select all that apply)

Was it a person who influenced the change?

○ Yes

○ No

24. If "Yes" to Q 23, was it . . . (select all that apply)

○ Another student's support

○ Your classmates' support

○ Your advisor's support

○ A challenge from your teacher

○ Your teacher's support

○ Other (please specify)

25. Was it part of a class assignment that influenced the change?

○ Yes

○ No

26. If "Yes" to Q25, was it . . . (select all that apply)

☐ Class/group projects

☐ Writing about your concerns

☐ Personal journal

☐ Non-traditional structure of the course

☐ Internship or co-op

☐ Deep, concentrated thought

☐ Personal learning assessment (PLA)

☐ Verbally discussing your concerns

☐ Term papers/essays

☐ Self-evaluation in a course

☐ Class activity/exercise

☐ Lab experiences

☐ Personal reflection

☐ Assigned readings

☐ Online resources

☐ Other (please specify)

[   ]

27. Was it a significant change in your (personal) life that influenced the change?

○ Yes

○ No

28. If "Yes" to Q27, was it.... (select all that apply)

○ Marriage

○ Birth/adoption of a child

○ Moving

○ Divorce/separation

○ Death of a loved one

○ Change of job

○ Loss of job

○ Retirement

* 29. Thinking back over this course, which of the following statements best describes how your perceptions and attitudes to sustainability (as defined above) have changed during this term?

○ My previous attitudes and perceptions have not changed at all

○ My previous attitudes and perceptions have changed towards sustainability and the environment

○ My previous attitudes and perceptions have changed away from sustainability and the environment

Further comments

30. What topic or activity on sustainability and the environment in this course influenced you the most?

31. Why did this topic or activity in this course change your opinions?

* 32. Would you characterise yourself as one who usually thinks back over previous decisions or past behaviour?

○ Yes

○ No

* 33. Would you say that you frequently reflect upon the meaning of your studies for yourself, personally?

○ Yes

○ No

* 34. Given your learning in this course, do you feel more capable to identify and address challenges and opportunities related to the environment and sustainability?

○ Yes

○ No

* 35. Given your experience in this course, do you think you will be more actively advocating for the environment and sustainability?

○ Yes

○ No

36. Thinking back over your entire programme of study, which of the following have been part of your overall educational experience at this university.. (select all that apply)

- ☐ Class/group projects
- ☐ Writing about your concerns
- ☐ Personal journal
- ☐ Non-traditional structure of the course
- ☐ Internship or co-op
- ☐ Deep, concentrated thought
- ☐ Personal learning assessment (PLA)
- ☐ Verbally discussing your concerns
- ☐ Term papers/essays
- ☐ Self-evaluation in a course
- ☐ Class activity/exercise
- ☐ Lab experiences
- ☐ Personal reflection
- ☐ Assigned readings
- ☐ Online resources
- ☐ Other (please specify)

37. Did any major life events occur while you were taking other courses at this university?
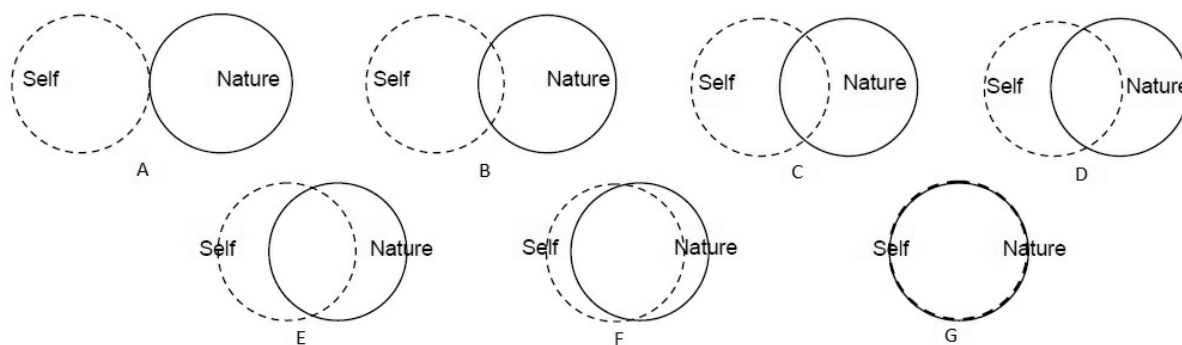
- ○ Yes
- ○ No

SECTION B: Relationship between humans and nature

* 38. Connectedness to nature
Please select the picture below that best describes how you see your relationship with the natural environment, that is, how interconnected are you with nature?

○ A ○ B ○ C ○ D ○ E ○ F ○ G

39. Please explain why you selected the figure in the previous question.

* 40. Listed below are statements about the relationship between humans and the environment. For each one, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
We are approaching the limit of the number of people the earth can support.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans have the right to modify the natural environment to suit their needs.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
When humans interfere with nature it often produces disastrous consequences.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Human ingenuity will ensure that we do not make the earth unliveable.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans are severely abusing the environment.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The earth has plenty of natural resources if we just learn how to develop them.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Plants and animals have as much right as humans to exist.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The balance of nature is strong enough to cope with the impacts of modern industrial nations.	○	○	○	○	○

Additional comments

[ ]

* 41. For each statement below, please indicate whether you Strongly Agree, Mildly Agree, are Unsure, Mildly Disagree, or Strongly Disagree.

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Despite their special abilities humans are still subject to the laws of nature.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The so-called 'ecological crisis' facing humankind has been greatly exaggerated.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The earth is like a spaceship with very limited room and resources.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans are meant to rule over the rest of nature.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
The balance of nature is very delicate and easily upset.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
Humans will eventually learn enough about how nature works to be able to control it.	○	○	○	○	○

Additional comments

[ ]

	Strongly Agree	Mildly Agree	Unsure	Mildly Disagree	Strongly Disagree
If things continue on their present course we will soon experience a major ecological catastrophe.	○	○	○	○	○

Additional comments

[ ]

SECTION C - Actions for the environment / sustainability

* 42. How often do you (or your household) participate in the following activities? Please tick the relevant column.

	Always	Often	Occassionally	Rarely	Never
Separate waste and place recyclables (paper, plastics, glass, aluminium, etc.) into recycling bin	○	○	○	○	○
Save energy by turning off lights and electronic equipment	○	○	○	○	○
Grow some of your own food	○	○	○	○	○
Compost garden waste and kitchen scraps	○	○	○	○	○
Take shorter showers and/or conserve water by other means	○	○	○	○	○
Collect and use rainwater	○	○	○	○	○
Ride your bike, walk or take public transport instead of using a car	○	○	○	○	○
Participate in bushwalking or other nature-based outdoor activities	○	○	○	○	○
Donate to social or environmental groups	○	○	○	○	○
Volunteer for social or environmental benefit	○	○	○	○	○
Posted or shared something on social media regarding the environment or sustainability?	○	○	○	○	○

Other (please specify)

* 43. During the next 12 months, do you intend to..... (please tick the relevant column)

	Yes	No
Contribute time or money to an environmental or wildlife conservation group?	○	○
Start buying a product because you think it protects the environment?	○	○
Contact a government agency to get information about the environment?	○	○
Read a conservation or environmental magazine?	○	○
Watch a television special on the environment?	○	○
Vote for or against a political candidate because of his or her position on the environment?	○	○
Recycle newspapers, glass, or other items on a regular basis?	○	○

Other (please specify)

Thank you very much for completing both parts of this survey. Your participation is greatly appreciated.

44. If you'd like to enter the draw to win a Gold Class double cinema ticket, please provide your private email address. Good luck!

45. This next part of the research is MOST important.

All survey participants are invited to take part in a 20-30 minute follow-up interview to discuss your learning experience in this course. If you are willing to be contacted by the researcher again, please provide your phone number or private email below.

By participating in an interview you could assist your own learning and also enter a prize draw to win an iPad Mini 2! Many thanks in advance for your contribution!

Click on the "Done" button to submit your survey.

Thank you very much!. All the very best for your studies!