



Investigating undergraduate student learning experiences using the good practice learning and teaching for sustainability education (GPLTSE) framework

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ABSTRACT

Sustainability curriculum in higher education is a crucial lever for building capabilities and knowledge for graduates to address the interconnected social, ecological and economic challenges of the 21st century in their professional, and personal lives. A body of theory exists describing elements of good practice learning and teaching for sustainability in higher education which is accompanied by a small range of case studies reporting on sustainability courses and educational initiatives being undertaken in universities around the world. Often, such studies of practice are informed by post-hoc measures of effectiveness, rather than thorough evaluation frameworks informed by theories of good practice sustainability education and educational research methods. This paper aims to explore the lived experience of the theory of good practice learning and teaching for Sustainability Education using a holistic methodological framework. This paper firstly presents the theory of good practice learning and teaching for sustainability and summarises this in the Good Practice Learning and Teaching for Sustainability Education (GPLTSE) framework. This framework is then applied to the learning and teaching practices and student experiences of one undergraduate course in the built environment discipline that seeks to apply best practice educational approaches in course design and delivery. Using qualitative data collected from a mixed-methods case study of the course, along with the GPLTS framework, this paper highlights key factors enabling student engagement and positive learning experiences in this first-year undergraduate course. The findings have implications for pedagogy and also course evaluation approaches that aim to understand learning outcomes.

1. Introduction

In 2015, the 2030 Agenda for Sustainable Development was adopted by more than 150 world leaders. The Agenda includes 17 Sustainable Development Goals which were agreed upon addressing global challenges such climate change, inequality, sustainable communities and environmental conservation (Rieckmann et al., 2017). The systemic and interconnected nature of these challenges requires action by all disciplines and professions. Sustainability curriculum in higher education (HE) is a crucial lever for building capabilities and knowledge for graduates to address these challenges in their professional (Singh and Segatto, 2020), and personal lives. Much literature has been published globally on the inclusion of sustainability into university policy and degree program content. However, there exists less published examples of good practice learning and teaching in sustainability education.

Within the existing literature there are calls for research that explores the best ways to educate for sustainability in the university learning environment (Anderberg et al., 2009; Timmerman and Metcalfe, 2009). Sharpe and Breunig (2009: 310) argue that the 'dearth of concrete description' of course curriculum leaves educators with little guidance in how to teach environmental and sustainability based curriculum. Given that '... a key barrier to the development and implementation of sustainability education is a lack of staff experience/knowledge and resources' (Holdsworth and Thomas, 2012: 46), it is important that research on what is good practice learning and teaching for sustainability is undertaken.

Empirical research specifically on learning and teaching experiences in Sustainability Education (including education for sustainability (Efs), and education for sustainable development (ESD) for the purposes of this paper) is needed because of several distinguishing characteristics of

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Sustainability Education in HE. Sustainability Education has been described 'as a unique educational concept' (Barth and Michelsen, 2013: 106), that 'challenge[s] conventional modes of education and require[s] new methods for integrative learning' (Fortuin and Bush, 2010: 20). Christie et al. (2013: 3) argue that 'sustainability as a concept is epistemologically, ideologically and methodologically unique' because it is interdisciplinary, controversial, subjective and 'requires values judgments'. Part of teaching sustainability involves also proving its relevance and legitimacy as a subject in a course of study.

Implementing Sustainability Education in HE challenges many common practices in HE. Cook et al. (2010) argue that sustainability is a difficult path to take because the actions and effects of sustainability practice are unknown as sustainable development diverges from business as usual. What makes something sustainable is context specific (Christie et al., 2013; Sterling, 2003) and therefore there are no sets of rules or codes of practice that are 'sustainable'. This 'requires teachers to also see themselves as learners, and work with uncertainty and open outcomes' (Martin and Jucker, 2003: 7). The issues that Sustainability Education aims to address are complex and their exact nature and remedies are uncertain, therefore, sustainable development is very much a 'learning process' rather than 'about 'rolling out' a set of pre-determined behaviours' (Vare and Scott, 2007: 192). This means that capabilities for sustainability such as critically reflective practice and problem solving become key to this learning process, rather than merely learning about sustainability. Likewise, educators must also become reflective practitioners in order to teach sustainability (Holdsworth and Thomas, 2015; UNECE, 2012).

The characteristics of sustainability education require pedagogical change through a focus specifically on rethinking learning and teaching practice (Wals and Blewitt, 2010). Pedagogy must be transformed to social constructivist approaches to meet capabilities based learning goals, such as reflective practice (Barth and Michelsen, 2013). Further, the systemic/holistic nature of sustainability challenges academics who work within clearly defined disciplinary boundaries to think in new ways and across other disciplines, this is illustrated by Sibbel (2009: 79), who argues that Sustainability Education 'requires teaching by academics from many disciplines who collaborate to share ideas and make new connections within a flexible and dynamic theoretical base'.

Values judgements must also be made in order to interpret and apply sustainability and therefore 'ESD has to consider the underlying values and support the learner's critical reflection on them' (Barth and Michelsen, 2013: 107). A reflection on values which inform worldviews and decisions is essential to seek out alternatives and navigate the challenges and uncertainties of shifting long-held practices. This approach challenges the assumption that education must remain values neutral with respect to teaching subject matter. However, 'sustainable development has ... been criticized as overly value-based' (Dale and Newman, 2005: 353) and labelled by some as 'indoctrination' (Christie et al., 2013: 3). Teachers in Sustainability Education face the challenge of deciding if and how to 'explicitly state values' given this context.

In summary, Sustainability Education challenges current mindsets and takes a systems approach to understanding the world. This form of education makes explicit the role of values in shaping worldview and practice. It is an educational endeavour that requires pedagogical transformation and learning, and teaching practice based on interdisciplinary collaboration and use of multidisciplinary frameworks.

Despite this, little research exists that evaluates sustainability courses against the theory of good practice sustainability education to show how these challenges are responded to in educational practices. As such, this research sought to understand what good practice learning and teaching approaches for sustainability education look like according to theory and how do these align and translate into practice. To answer this, the research sought to answer the following questions based on mixed methods data collected from a case study course:

- What are the learning and teaching approaches used?

- What are the teaching experiences?
- What are the learning experiences according to the students?
- What are the learning and teaching challenges faced by teacher and students?

This paper presents observational, interview, focus group and survey data collected on the pedagogical approach, intended and perceived learning outcomes, and learning and teaching activities used in a single course taught at a major university in Melbourne, Australia. The theory of good practice learning and teaching for Sustainability Education is presented and used to draw out and frame elements of learning and teaching practice from the case study data.

2. Theory of learning and teaching in sustainability education

In order to explore elements of learning and teaching practice in sustainability education, a framework for analysis must first be developed. Based on a review of literature that aims to evaluate subject or course design and delivery, there is little evidence of the use of a theoretical lens to both collect data on sustainability courses or evaluate the practices and learning and teaching experiences and outcomes of the course. According to Huber and Harvey (2013), effective, scholarly evaluation frameworks are important for understanding the wider benefits of learning and teaching innovations in higher education. An important part of evaluation is defining the evaluation criteria at the beginning of the project. This research sought to explore the application of theory in practice and drew on a synthesis of theory of good practice learning and teaching for sustainability in higher education. A literature review was undertaken to explore the learning and teaching approaches advocated in sustainability education, education for sustainability, and education for sustainable development literature, along with some relevant approaches in environmental education literature (as these approaches resembled sustainability education, rather than environmental education only). Dominant themes noted in the literature were summarised for three key components of educational design and delivery, including learning and teaching approaches/pedagogy, learning outcomes and learning and teaching methods. Key themes are summarised in Table 1. These themes then formed the criteria which framed the exploration of the case study in this paper.

This literature is synthesised in the Good Practice Learning and Teaching for Sustainability Education (GPLTSE) framework as shown in Fig. 1 below. On the left of the framework are the underpinning learning processes that are important for sustainability education and include: *transformational learning, capability building and holistic/systemic learning*. The characteristics of these learning and teaching typologies and outcomes are presented in the remaining columns of the GPLTSE Framework. Important to note, there exists no unique relationship between these characteristics and outcomes, rather a number of combinations are possible. Specifically, most of the learning and teaching approaches could be placed in any of the categories, for example according to the literature presented here, reflexive learning is important for transformational learning, capacity building and systemic learning, and a focus on learning processes is important for transformational learning, capacity building and systemic learning, and so on. The learning outcomes advocated in the sustainability education and related literature can result from any of these learning and teaching approaches and methods, for example, reflexive learning can foster capacity for ongoing learning, values reflection and sense of identity and so on, or active and participatory learning could support all of the learning outcomes advocated in the literature reviewed here.

3. Research methods

This study used a qualitative, single case research design as described by Merriam (2014), Stake (1995) and Yin (2003). To avoid making 'claims about teaching practice based only on information gathered

Table 1
Summary of key learning and teaching approaches/pedagogy, learning outcomes and learning and teaching methods.

Component	Theme	Description	Authors
Educational approach/pedagogy	Learner-centred	Founded on social constructivist epistemology, including self-directed learning with the teacher's role as facilitator and learning partner, not the 'expert', and positive student-teacher relationships.	Armstrong and LeHew (2013); Barth and Michelsen (2013); (UNESCO, 2012); Christie et al. (2013)
	Transformational	Deep learning, higher order learning, learning as sustainability and reflexive learning. Role of values in shaping practice is made explicit through learning	Armstrong and LeHew (2013); Cullen et al. (2012); Sterling (2003); Ukpokodu (2009); Barth and Michelsen (2013); Warburton (2003).
	Holistic and systemic	Interdisciplinarity, transdisciplinarity and multidisciplinary approaches and the use of multiple perspectives from differing disciplines and collaborative teaching	Wals and Jickling (2002); UNECE (2012); Armstrong and LeHew (2013); Tilbury et al. (2005)
	Capability building	Enabling and emancipatory capabilities including groups of skills, competencies and attributes beyond the acquisition of information	Fisher (2006); Martin (2005); Sterling (2009); Wals and Jickling (2002); Mochizuki and Fadeeva (2010); Rieckmann et al. (2017)
	Active and participatory	Experiential, participatory and collaborative learning	Barth and Michelsen (2013); Armstrong and LeHew (2013); Wals (2009: 15); Cotton and Winter (2010); Hermann and Bossle (2020)
	Real issues orientation	Mimicking real life through problem or inquiry-based praxis-orientated learning	Cullen et al. (2012); Cotton and Winter (2010); Dale and Newman (2005); Trencher et al. (2018); Hermann and Bossle (2020)
	Learning outcomes	Sustainability literacy	(An umbrella term that can include) understanding of sustainability concepts, how we come to understand sustainability and our responsibilities to the world around us, along with the 'know how' to practise sustainability
Systemic and holistic thinking		Work with complexity, uncertainty and	Sterling (2009); Dale and Newman (2005);

Table 1 (continued)

Component	Theme	Description	Authors
		maintaining a 'big picture' perspective	ARIES and Australian Government and ARIES, (2009); Cohen (2007); Warburton (2003); Sterling and Thomas (2006); Strachan (2009); Morris and Martin (2009); Wiek et al. (2011); Connell et al. (2012); UNECE (2012); Wals and Jickling (2002) Mulligan (2008); Tomkinson (2009); Rieckmann et al. (2017); (Molderez and Ceulemans, 2018)
	Lifelong learning/continuous learning	Capability and motivation for iterative process of learning that allows one to continually adapt to a changing world	Scott and Gough (2010); Morris and Martin (2009)
	Critical thinking	Examine, reflect and challenge existing assumptions	Parker et al. (2004); ARIES and Australian Government and ARIES, (2009); Hurlimann (2009); Jones et al. (2010); UNESCO (2005); Barth and Michelsen (2013); Ukpokodu (2009); Rieckmann et al. (2017)
	Reflexivity	Critical reflection and ongoing learning to facilitate transformation	Mochizuki and Fadeeva (2010); Bawden (2007)
	Interdisciplinary skills	Respond to challenges in a holistic manner drawing on knowledge and skills from many disciplines along with the ability to work with stakeholders	Barth et al. (2007); Cherry (2005); Strachan (2009); Parker (2010); Dale and Newman (2005); Ramage and Shipp (2009); Tilbury (2009); Hermann and Bossle (2020)
	Futures thinking	Analyse and plan for future scenarios and incorporate this into problem solving and decisions i.e. Foresighted or anticipatory thinking	ARIES and Australian Government and ARIES, (2009); Barth et al. (2007); Wiek et al. (2011); Tilbury (2009); Wayman (2009); Rieckmann et al. (2017)
	Awareness of values and ethical behaviour	Ability to reflect on and learn from values including empathy,	Shephard (2008); Cohen (2007); Sterling

(continued on next page)

Table 1 (continued)

Component	Theme	Description	Authors
Learning and teaching methods		compassion, self-motivation and having a sense of identity	and Thomas (2006); Parker et al. (2004); UNESCO (2005); Arbuthnott (2009); Barth et al. (2007); Parker et al. (2004)
	Authentic assessment	Assessment that is meaningful and situated in real life contexts	Armstrong and LeHew (2013); Newton (2008)
	Inquiry based learning	Problem based learning, case studies, research projects, critical incidents and simulations	Tomkinson (2009); Christie et al. (2013); Cotton and Winter (2010); Sprain and Timpson (2012); Barth and Burandt (2010); Trencher et al. (2018); Hermann and Bossle (2020)
	Descriptive and visual conceptual tools	Visually map and represent systemic interconnections, holistic thinking and complex cause and effect i.e. concept mapping, diagrams and models	Warburton (2003); Morris and Martin (2009); Connell et al. (2012)
	Visioning projects	Visualisation of a past, current or future scenarios along with developing plans i.e. Future-focused visioning projects, scenario analysis and back-casting	Connell et al. (2012); Martin (2005); Barth and Burandt (2010)
	Situated learning	Learning outside of classroom in real settings i.e. Place based education, field work and work-based projects	Gebhard (2008); Christie et al. (2013); Tilbury et al. (2005)
	Interactive, perspective sharing activities	Sharing perspectives and gaining an understanding of differences in perspectives i.e. Group discussions, debates, role plays and stimulus activities	Cotton and Winter (2010)
	Reflexive accounts	Reflect on learning and how learning changes as a result of new knowledge	Cotton and Winter (2010)
	Critical reading and writing	Develop arguments or counter discourses by deconstructing arguments and understanding values underpinning them	Cotton and Winter (2010)

about teachers' beliefs without observations of practice' (Kane et al., 2002: 177–178), this research employed mixed methods in order to triangulate data. This research aimed to capture the student perspectives on practices, along with class observation, recognising that 'research that examines only what university teachers say about their practice and does not directly observe what they do is at risk of telling half the story' (Kane et al., 2002: 177). The selection of the course can be described as a

convenience, non-probability purposive sampling technique (Wellington, 2000), as it was selected based on both practicality and access, interest and willingness of teacher, faculty and learners to participate in the research and a focus on sustainability. Yin (2003) argues that the use of multiple sources of evidence (or mixed methods) is an important part of case study research to understand the case as a whole and to provide internal validity through data triangulation. The approach to data triangulation taken in this research does not seek reach consensus regarding a phenomenon i.e. data convergence, given the different perspectives sought, however complementarity between datasets is noted in the findings. As described by Nightingale (2009: 490) 'Complementary triangulation seeks to produce a fuller picture of the research questions by combining information from different methods or different observers'.

The research was undertaken by a researcher who was not involved with the design or delivery of the course, while this paper was written in collaboration with this researcher and the course teacher. Table 2 outlines the research sub questions and corresponding data collection methods used in line with a mixed methods approach.

The participant numbers and methods included:

- One lecture and eight workshops were observed
- 205 students were emailed the end of semester student survey with a response rate of 21.4%
- 10 students attended a 30-min focus group in week 11 of the semester.
- A 1-h interview was undertaken mid-semester with the teacher (course designer, coordinator, lecturer and educator).

For qualitative data, analysis began with initial coding of themes and concepts emerging from the data guided by the research sub-questions. These themes and concepts were counted to determine frequency in line with a general content analysis coding scheme (Franzosi, 2004). Results from the different methods within each case study were compared to triangulate data and differences in themes emerging from student perspectives and teacher perspectives were noted. The case study was analysed based on how the course applied the dominant learning experiences and approaches according of the GPLTSE Framework. Student and teacher perspectives, collected through the interviews, focus groups and surveys, then provided experiential data to explore the effectiveness of the course using the GPLTSE Framework. Data analysis was undertaken by the independent researcher.

4. Findings

4.1. Course description: BUIL1229 Managing for Sustainability

The case study course is a core subject in the first year of three different bachelor programs in the built environment. The course draws on an accounting framework by structuring the course around the 'five capitals' of sustainability (environmental, social, human, manufactured and economic). A key learning objective is for students to 'define and understand the five types of capital (natural, human, social, economic and manufactured)' in relation to sustainability and how they may be applied in professional and personal practice. In addition, the course presents sustainability as contested, requiring students to 'define sustainability and to identify the differences between [their] definition and those of others'. Table 3 provides an overview of the key elements of the case study course.

Students are required to attend one 3-h workshop a week over a 12-week semester. The course is structured into three key themes. The first three weeks focus on foundational theory and concepts relating to sustainability. The foundational activities on worldviews and definitions of sustainability in the early weeks of the course set the context for sustainability as a values-based exploration. Weeks four to ten focus on application, implications and relevance of the five capitals to

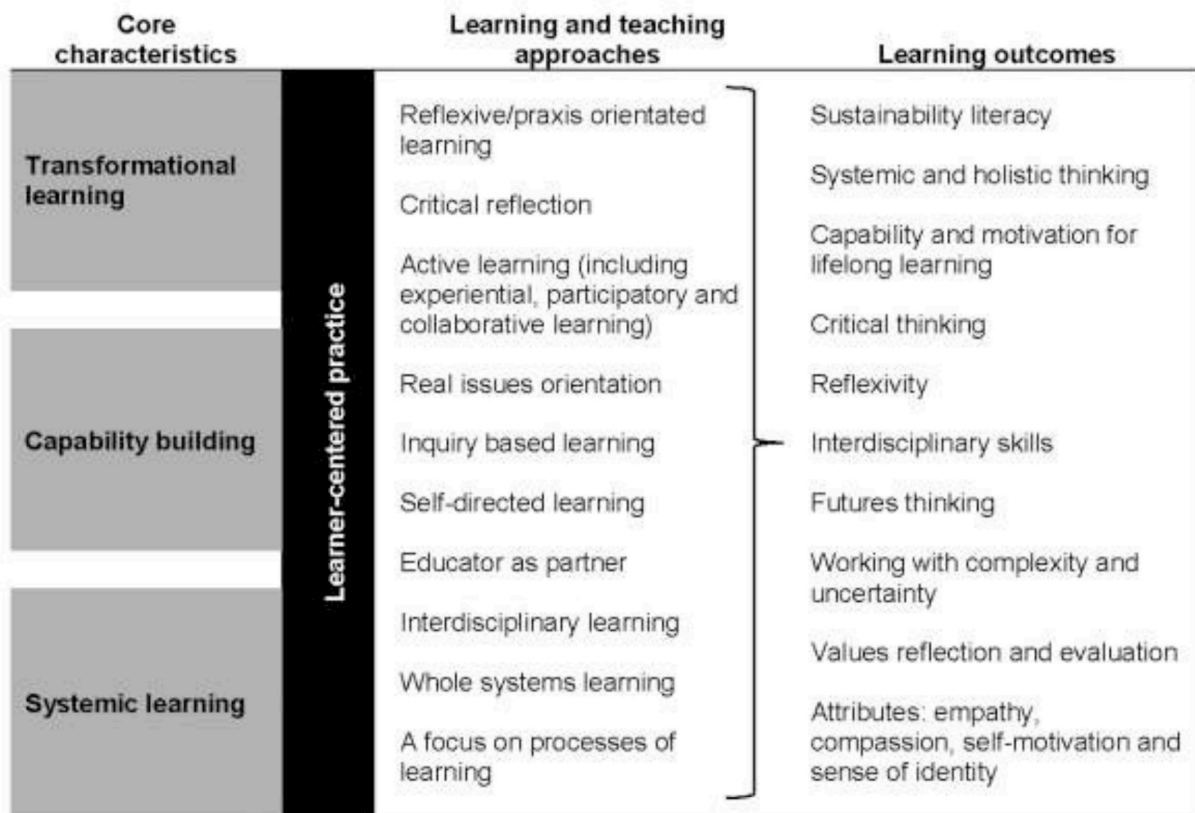


Fig. 1. Theoretical framework of good practice learning and teaching for sustainability education according to the literature.

Table 2
Research sub-questions and corresponding data collection methods.

Research sub questions	Sustainability education Literature	Observation	Student surveys	Student focus groups	Semi-structured interview with teacher
What are the learning and teaching approaches used in the case study courses?		✓			✓
How effective are these approaches for learning for sustainability?	What are the teaching experiences in the case study courses?		✓	✓	✓
	What are the learning experiences in the case study courses?		✓	✓	
	What are the learning and teaching challenges faced in the case study courses?		✓	✓	✓
What are good practice learning and teaching approaches for sustainability education according to theory?	✓				

professional practice (including environmental, manufactured, human, social, and economic), and the final two weeks of the course are about professional decision making and organisational change.

Central to the student learning experience is that content, though formative and summative assessment, is grounded in a combination of personal and professional practice. Running throughout the course is an inquiry-based learning assessment task and students are required to apply and evaluate the weekly theory to a professional scenario against the different principles of sustainability.

4.2. Assessment overview and intended learning outcomes

There are three summative assessments in the course; article reviews to build critical analysis skills, an ecological footprint report which requires students to undertake and reflect on their own ecological footprint, and a problem-based learning style group Fisherman’s Bend development report/tender document and map accompanied by an

individual reflection on the project and course.

These assessment tasks and learning and teaching activities were consciously chosen by the educator based on their alignment with intended learning objectives as identified by the educator in their educational design process (Holdsworth and Hegarty, 2016). The formative and summative activities, utilised and identified within the literature as best practice included:

- Future-focused visioning projects (primarily the FBD report)
- Problem based learning (FBD report)
- Case studies (related theory and practice using videos or images)
- Concept mapping of opportunities for industry change
- Working in groups
- Group and class discussions (in almost all activities observed)
- Reflection built into activities within classes
- Critical reading and writing (primarily in the first assessment)

Table 3
Summary of course information.

	Summary of course information
Year level and degree program areas	First year, core/compulsory for three degree programs in the built environment including Construction Management, Project Management and Property Valuation.
Course size	205 students
Duration	12 weeks
Course delivery method	1 h lecture each week and a 2 h workshop each week. The students are spread across four workshops each week with approximately 60 students in each workshop
Learning objectives	<ol style="list-style-type: none"> 1. Define sustainability and to identify the differences between your definition and those of others; 2. Understand and apply key sustainability principles in relation to your disciplinary practice; 3. Define and understand the five types of capital (natural, human, social, economic and manufactured); 4. Recognise, describe and reflect upon your personal and professional practice in relation to sustainability; 5. The development of skills in evaluating current sustainability concepts, theories, methodologies and practices; 6. Reflect critically upon different sustainability concepts, theories and methodologies as they relate; <ul style="list-style-type: none"> • to your ability to make decisions on the basis of a personal and professional interpretation of sustainability; • to your ability to identify good sustainability practice/management; • to your understanding of what constitutes exemplary sustainability leadership and management; 7. Communicate effectively by clearly constructing arguments including presenting and defending positions, and to be able to constructively comment on the work of others; 8. To apply knowledge in problem-based learning exercises; 9. Research and critical analysis skills, including the ability to perform database searches, critically read and revise writing, develop lines of argument supported by appropriate evidence, reference correctly; 10. Skills in participating in discussion groups, and ability to contribute to academic discussions.
Assessment	<ol style="list-style-type: none"> 1. Article reviews (worth 20%) 2. Ecological Footprint Report (worth 20%) 3. Fisherman's Bend Development group report (FBD report) (worth 40%) 4. Fisherman's Bend Development individual reflective narrative (worth 20%)
Relationship of the course to students' experiences of sustainability in other courses in their program	Students come into this course with little knowledge of sustainability beyond their existing awareness (through the media for example). At the time the research was undertaken, this was the only course in the students' degree programs to focus on sustainability although sustainability may have been included as a topic in later courses in the programs. Based on the data collected, students experienced predominately teacher-centred learning and teaching approaches in their degree programs.

Table 4 outlines how the course assessment tasks align with the GPLTSE framework learning outcomes.

This approach to assessment reflects the theory of constructive alignment as advocated by Biggs and Tang (2007). The case study data illustrated that the teacher viewed the development of sustainability aligned capabilities as a key learning outcome of the course and Sustainability Education itself. Capabilities described by the teacher included values reflection, critical reflection and sustainability literacy. High level cognitive learning was also indicated by the teacher through learners' intended analysis and application of theory. For example, the key learning outcomes in the course according to the teacher include:

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

The teacher continued

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

In the context of the learning outcomes advocated in the literature, overall sustainability literacy was developed through the content and activities. This was achieved with the use of case studies and associated activities that illustrated the need for change, and required learners to move through many scenarios to explore rationales for change, approaches to change and implement changes in line with sustainability. Foresighted thinking/anticipatory thinking may have been developed through the focus on future use of development by multiple stakeholders. Futures thinking is implicit in sustainable design in future build projects. To some extent, the capability of dealing with complexity and uncertainty was developed through the scenario and how to build sustainability while meeting current and future stakeholder needs associated with a new development. Evaluating and balancing needs were part of the major assessment and students actively debated how to balance competing needs in their developments in workshop time observed.

In terms of cognitive development, higher level learning was intended in the tasks which required students to go beyond knowledge and comprehension to apply that knowledge in their main assessments. They were also required to analyse the best approach to environmentally sustainable design (ESD) and socially cohesive communities in their development based on the options available. To do so required judgments about the best way to achieve such outcomes in development proposals and justifying their views or values. These activities required a

Table 4
GPLTSE Learning outcomes and the BUIL1229 assessment tasks.

GPLTSE LOs	Task 1	Task 2	Task 3	Task 4
Sustainability literacy		●	●	
Systemic and holistic thinking		●	●	
Capability and motivation for lifelong learning				●
Critical thinking	●	●	●	
Reflexivity			●	●
Interdisciplinary skills			●	
Futures thinking		●		
Working with complexity and uncertainty			●	
Values reflection and evaluation	●			●
Attributes: empathy, compassion, self-motivation and sense of identity		●	●	●

level of synthesis and reasoning skills.

The role of values was made explicit with the teacher modelling the way their values shaped how the teacher understood sustainability regularly based on observation. Affective learning was aimed to occur through this values reflection and making value judgments in projects specifically through the problem-based learning project. Students are asked to make values judgments when applying sustainability concepts in their problem-based learning activity and reflect on why they made the choices they did.

4.3. Educational approach taken to achieve intended learning outcomes

Based on interview and observational results, Managing for Sustainability is a learner-centred course that features many of the learning and teaching approaches and some activities advocated in the GPLTSE Framework. This section will explore these key characteristics based on the observation and interview results.

4.3.1. Learner-centred

Learner-centred learning and capacity building was a key characteristic observed as underpinning the development and delivery of this course. This aligned to the teacher's pedagogy articulated as:

Sustainability, education and good teaching and learning has to be about understanding the context upon which students come to the classroom ... and then to ensure that the material that you present to those students allows them to challenge and explore their assumptions.

Part of the learner-centred approach is described by the teacher as '... giving the students a point of entry' in the learning and teaching activities for students. To put this learning and teaching approach into practice educators must:

... understand the topics as [they] relate to [the students'] own personal identity and professional context ...

And:

L&T strategies need to enable students to: think through the systemic implications of short term and long-term impacts, reflect on their [students'] understanding of the ways in which their values have been brought to that particular problem and then relate that awareness back to themselves and also other stakeholder groups.

The teacher also commented that:

... it was important for me to make sure that the material – its structured and the topics - reflected the cohort and were presented it in a way that provided them with a point of entry that made sense.

From the reflections provided above it is clear that the course is situated in a learner-centred pedagogy as students are encouraged to bring their own views and values to make sense of the content and assessments as they understand them. However, based on observations, students are guided by the teacher through ongoing feedback, and therefore learning is not wholly self-directed, which is advocated in the literature.

4.3.2. Holistic, systemic and interdisciplinary

Students were given several multi or interdisciplinary learning experiences throughout the 12 weeks of the course. This was possible due to the interdisciplinary composition of the workshops and assessment groups, and the multidisciplinary collaborative nature of the major assessment piece. Additionally, guest lecturers with different perspectives also helped to bring in a multidisciplinary and multi-value lens on the content areas. The use of media such as videos allowed students to understand sustainability from multiple perspectives. These practices also ensured that the teacher was not the only source of knowledge and catered to different learning needs. The teacher commented that the

variety of learning and teaching methods brought different voices to the weekly issues and ensured students saw the relevancy of the content and associated skills:

... I use media to illustrate different assumptions, assumptions that I can't cover effectively because I don't have that lived value ... to give the material legitimacy so it's coming from a respected, legitimate source like the Building Council of Australia.

4.3.3. Transformative

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

4.3.4. Real issues orientation

The course and associated activities consistently linked theory to future practice using assessments and activities observed. Assessments and case studies were intended to provide real-life context for students and the problem-based learning intended to situate learning in professional and personal contexts. According to the teacher, 'even though you are in a classroom, you have to give them a context, because sustainability is nothing without context ...'. Learning and teaching activities must allow students to explore complexity and link problems with practice, '... learning and teaching strategies that present problems, that get them to explore complexity as it relates to the scenario or situation ... to think about the theory as it relates to the practice'. The teaching methods intend to provide context of the material and assessments for students so that students can understand the links and how they connect personally and professionally with sustainability therefore supporting praxis-orientated learning linking theory and experience. The teacher commented that the students 'respond to case studies that show them their responsibilities.' This 'real issues' orientation also provided students with opportunities to better experience facets of practice that they may not have experienced yet.

Table 5 summarises how the key learning and teaching activities within the course align with the GPLTSE framework learning and teaching approaches.

4.3.5. Pedagogical implications

The above approaches were embedded within three pedagogical qualities that the data indicated were key in providing learners with a meaningful and engaging learning experience. These included the explicit and honest reflection on values within the course, the positive student-teacher relationship and the reflective practice of the teacher.

4.4.5.1. *Role of values.* As seen in the previous qualitative comments, the teacher throughout the interview stressed the role of values and the need for students and teachers to reflect on these. Observational data also identified that the concept of values and their influence on shaping understandings was emphasised in workshops. The role of values in learning and teaching was made explicit to students by the teacher through their observed openness about how their own values shaped

Table 5
GPLTSE Learning & Teaching approaches and the BUIL1229 learning activities.

GPLTSE L&T approaches	Lectures	Workshops	Task 1	Task 2	Task 3	Task 4
Reflexive/praxis orientated learning		●		○	●	●
Critical reflection			●	●		●
Active learning (including experiential, participatory and collaborative learning)		●		●	●	
Real issues orientation	●			●	●	
Inquiry based learning					●	
Self-directed learning					○	
Educator as partner		●			●	
Interdisciplinary learning	●				●	
Whole systems learning	●				○	
A focus on processes of learning		●			●	●

Legend: ○ Somewhat indicated by data ● Indicated by data.

their understanding of the content and their approach to issues when delivering content and guiding class discussion.

4.4.5.2. Positive student-teacher relationship. The role of the teacher was observed to be like ‘educator as partner’. The teacher explicitly stated they did not have all the answers, and therefore, this positioned them as part of the learning community with the students. A trusting relationship appeared to be built between students and teacher through much positive and nurturing support from the teacher in terms of feedback and assistance. According to the teacher:

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

There appeared to be a relaxed and friendly relationship built between the teacher and students. The teacher felt that a trusting relationship was fundamental to addressing the learning and teaching challenges associated with Sustainability Education and problem-based learning activities. The level of engagement from the teacher with the students and their learning needs is also key to a positive learning experience for the students. ‘Part of the learning process is creating an environment where [students] trust you so that when you do ask them to

Table 6
Activities and experiences cited by students who completed the survey as facilitating a deep learning experience.

Activities	Respondent comments
Videos	“Definitely the day [the teacher] shown us the video of the people who live in such unacceptable environment. That moment really struck me ... and made me realise how important this is”. “Seeing the videos which showed sustainability in practice”.
Class discussions promoted by reflective/scenario based activities/question	“Watching videos was also great as it provides alternative viewpoints on topics”. “Group brainstorming allowed you to expand your thinking on issues”. “Having group discussions and listing peoples values on the board helped to gain a snap shot of the groups current overall standing”.
Guest speakers	“[The guest speakers] put the concepts [of sustainability] in practice”.
Assessments (ecological footprint and FBD reports)	“[The feedback from planning students] outlined things to consider which I never thought of”. “[The ecological footprint report] taught me how everyday routines can negatively impact society. Once doing that, everything in managing sustainability kind of “clicked”.

take a risk they are willing to do so’. Expressing passion for course content was also important for engaging students in the learning according to the teacher:

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

4.4.5.3. Reflective teaching practice. The teacher commented that reflective and reflexive teaching practice underpin their learning and teaching approach so therefore learning and teaching is viewed as an ongoing reflexive process:

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

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

The student perspective on these learning and teaching approaches.

The learning and teaching activities that students felt were important for their learning about sustainability, in the course, were those that they believed helped them see the application of theory, see different perspectives and motivated them to make changes or think over/analyse concepts. Reasons provided for these learning and teaching approaches included: visualising the application of theory, experiences different perspectives and these led to a motivation to make changes to current practice or simply reflect on their current understanding of the topics presented. As such, it can be argued that the kinds of thinking the teacher intended and associated learning and teaching methods developed have assisted the students to learn and, in some cases, transform their thinking and even practice. The activities and experiences cited by the students as facilitating a deep learning experience are shown in [Table 6](#).

Eight survey respondents felt that learning about ‘the sustainability capitals’ was an engaging part of the course. One respondent felt that learning about the five capitals ‘showed how complex solving the environment crisis can be as its interlinked with all the other capitals.’ Activities that respondents found engaging were mixed. Within the survey, less respondents commented on the learner-centred activities. Three students found the problem based FBD report engaging and some students commented on the activities that allowed them to apply knowledge or relate back to personal contexts, however overall there

was no clear trend in responses. For example:

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

Focus group participants felt that although the FBD report was large, there was value in it due to the way it was designed, and this included the visual (map) component. The combination of descriptive and visual tasks allowed for the needs of different learners to be met. Participants liked the 'real life' aspect of the assessment which supports theory of good practice Sustainability Education. The teacher also found that students engaged most with the FBD report:

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

Activities that triggered a conscious change in thinking or present a 'light bulb' moment included; learning about of sustainability facts, understanding the relationship between the five capital of sustainability or the application of sustainability theory to practice such as the ecological footprint report. These results indicate some alignment between what students felt helped their learning for sustainability and what is advocated in the GPLTSE framework. Problem based learning (in the form of FBD report) and case studies (described by participants mostly as related to the videos) were mentioned, with videos being one of the most common responses for helping learning about sustainability and showing relevance and application of sustainability in professional practice. Group discussions were also mentioned as important for learning and specifically for seeing different views.

To some extent student participants mostly focused on activities which support learning about sustainability and its applications rather than those activities that develop skills or capabilities for sustainability such as the processes in the problem-based learning FBD report or article analysis for example. Information, facts or content generally helped student participants change their thinking or present a rationale for change while assessments were good for applying theory for some participants. Videos and guest speakers presented different views and helped participants see professional applications. The combination of delivering facts and information about sustainability through engaging mediums such as videos and guest speakers was important for learning about sustainability and its applications in practice. Applying theory in assessments and developing skills for sustainability were less mentioned. However, what this indicates is that both learning *about* sustainability and learning *for* sustainability (capabilities for professional application of theory and change), are important learning for students, which is in line with the GPLTSE framework. Based on the interview and observational data, the approach taken by the teacher is what the teacher feels best supported learning for sustainability. This approach is in line with theory which advocated the majority of the practices undertaken in the course.

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

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

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

The teaching style was described in four responses that commented on the teacher's passion and enthusiasm for the material and subject helping their engagement and also the teacher's knowledge and presentation style. For example, 'the tutorials because [the teacher] was passionate about [their] material and made it engaging'. The focus group participants were also positive about the teaching approach. Based on participants' feedback, the students found the student-teacher relationship to be positive and supportive of their learning:

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

The teacher was also said to be open to student ideas and gave the participants space in the course to make their own meaning in their understandings and application of sustainability according to focus group participants. For example, '[The teacher] encourages you to come up with your definition of every concept. The teacher stresses that the teacher wants you to come up with your own' and, 'As long as you can justify your answers, [The teacher] is very open to people giving different answers and respects them as well.' Focus group participants also felt that student opinions were not judged by the teacher: '[the teacher] always states that [they are] open to opinion. You need to develop your own definitions ...' The student research participants felt that the learner-centred approach in this regard was important and these factors made for a very positive student-teacher relationship and learning experience.

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

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

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

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

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

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

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

Based on the focus group results, the course did have a big impact on participants' understanding and perceived relevance of sustainability. The language used by students to describe their change in thinking as a result of the subject shows that they feel they have a broader outlook on their profession and sustainability as a result of the course. Two-thirds of survey respondents felt their thinking had changed as a result of the course,¹ however again this related to 'awareness', 'understanding' and 'realisation', rather than transformation of the way they think, suggesting comprehension of sustainability and related concepts.

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

- It has definitely brought a lot of new ways of thinking. Especially eco footprint and how high my footprint was and it was something I never thought about before. But it certainly makes you look at the world differently and think of the future ...
- Before this [course] I had this perception that sustainability is just being green, but after this course I have an idea that sustainability encompasses social capital and human capital and many other capitals than just being green. So it has widened my perspectives.

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

Only one survey respondent mentioned an activity about values in all

¹ It is important to note that some respondents had previously stated that they already understood sustainability and felt it was relevant before beginning the course.

the data collected from the surveys. The absence of qualitative comments from respondents about values or values-based activities is interesting given the explicit mention of values throughout the course activities and assessments (based on observation and teacher interview data).

4.3.7. Perceived skills development

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

Academic skills	Writing (5) Communication (4) Article analysis (4) Research (2) Teamwork (2) Reading (1) Referencing (1)
Knowledge	Sustainability (4) Environment (3) Environmentally Sustainable Design (2) Social & community sustainability (2) Regulations (2) Economics (1) Town planning (1) Awareness of issues (1) Sustainable technology (1)

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

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

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

Table 7
GPLTSE Learning outcomes and learner participant's perceived learning outcomes.

GPLTSE LOs	Learner participant's perceived learning outcomes
Sustainability literacy	●
Systemic and holistic thinking	○
Capability and motivation for lifelong learning	x
Critical thinking	○
Reflexivity	x
Interdisciplinary skills	○
Futures thinking	x
Working with complexity and uncertainty	x
Values reflection and evaluation	x
Attributes: empathy, compassion, self-motivation and sense of identity	x

Legend: x Not indicated ○ Somewhat indicated by data ● Indicated by data.

such as writing skills were mentioned by some participants. This again may indicate a difficulty in reflecting on skills or unawareness of sustainability specific skills that the course aims to foster. The challenges of measuring learning outcomes in the context of sustainability is reflected in Table 7 that shows learner participant's perceived learning outcomes against those in the GPLTSE framework. The table reflects the limitations of this research method in evaluating learning outcomes, a point that is further discussed in section 5.2.

Just over half of survey respondents felt confident in applying sustainability in their future professional practice which links to the above results regarding little mention of skills related specifically to sustainability. Results show that research participants see relevance and how sustainability applies to their profession, yet feel less confident applying sustainability in their future professional practice.

4.3.8. Perceived relevance and value of the course

In terms of relevance and value of the course, a majority of survey respondents felt the course was relevant to their profession and there was consensus among the focus group that the course was relevant and valuable. The relevance of sustainability both personally and professionally increased over the course with 100% of respondents feeling that sustainability was relevant professionally and 84.6% feeling that it was relevant personally after the course, 66.7% of survey respondents felt their thinking had changed as a result of the course including new 'awareness', 'understanding', 'realisation' and widened perspectives.

Learning and teaching challenges described by teacher and student participants.

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

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

High levels of teacher engagement with students according to the teacher help address this resistance and created a safe learning environment. This shows that for the teacher, despite the challenges they faced in delivering the course, the concept of fostering a positive educator-learner relationship as advocated in the theory of good practice Sustainability Education is important for addressing these challenges. Taking this teaching approach however is something that the teacher also found to be challenging:

Doing assessment in class that requires skill development it is exhausting—emotionally exhausting, physically exhausting. Putting yourself out there and trying to educate in areas that you know they fundamentally disagree with like environmental concepts can be exhausting ... large classes using student-centred models nearly kills me.

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

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

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

- *The project was too big when we have other subjects to do [other student's agreed]. [the teacher] does give us lots of class time to do it all but designing a whole new suburb is a big task and I think a lot of people didn't know when to stop. How much detail to go into.*
- *[FBD report is] probably more of a 2nd or 3rd year task ...*

One survey respondent commented that 'Understanding the scope of [the FBD report]: Mapping the site was just such a big task that it took a long time just to work out how we were going to go about it'. Other participants felt that there was enough support for the task to make it a valuable learning experience. The structure of the course, specifically workshops, and the 'interactive' and 'supportive' teaching approach seemed integral to the positive learning process and based on focus group feedback, useful for overcoming challenges associated with the problem-based learning process. This supports the theory of good practice Sustainability Education and the need for a positive student-teacher relationship as advocated in the theory.

Based on observations, the highly supportive teaching approach in response to the learning and teaching challenges described by the teacher and student participants does mean that although the course features predominantly learner-centred activities, students need a lot of support in undertaking tasks, particularly the FBD report, in order to have a positive learning experience and to not reject activities or the assessments due to size and perceived complexity in the first year of a degree program. Therefore the student learning is not wholly self-directed in the problem-based learning assessment as advocated for good practice by Barth and Burandt (2010). Finding a middle-ground where students are supported enough to feel confident to make decisions and engage in the problem-based learning appears to be what the teacher is aiming for in their approach.

5. Discussion

5.1. Implications for good practice learning and teaching in sustainability education

This case study is an example of a Sustainability Education course that uses most of the practices advocated in the literature on good practice learning and teaching for Sustainability Education. What is interesting about this case study for the purposes of this research is that it has a very large cohort of students (205) with one academic delivering workshops and lectures in a learner-centred manner. This example shows how good practice theory can be implemented in a large first year foundational course. This example situates sustainability in the professional context in every aspect of the course and aims to build capability through learner-centred activities. Assessment is embedded in the course activities and all content is linked with assessments so that there is a high level of integration between knowledge, capabilities, and application in professional context and therefore relevance of learning for students to their degree program with useful learning outcomes. This is a good example of constructive alignment as advocated by Biggs and Tang (2007). The use of many varied learning and teaching activities is also note-worthy. The high student satisfaction with learning and understanding of sustainability in the professional context affirms the learners perceived value of the course. This case study also shows that learner-centred Sustainability Education can be delivered in large early degree cohorts with positive learning experiences and perceived learning outcomes from the learners. Underpinning the overall effectiveness of the course, the lived experience of theory reveals the complexity of designing and delivering a learner-centred sustainability course, in a traditionally non-environmental discipline, and fostering

transformative learning experiences that build capability and values reflection.

Using Blumberg's (2009) theory of learner-centred teaching, *Managing for Sustainability* was inherently a learner-centred course. The course presented the students with rationales for their learning of content, to solve real problems, learn about discipline specific methodologies, and use inquiry-based thinking used in the discipline. Based on the use of content in the course through application, students took ownership of content through interpretation and exploration rather than 'acquiring knowledge'. The data indicates that the learner centred approach was essential in the positive learning experiences of students in the course. Furthermore, the learning was enhanced by a positive student-teacher relationship with the teacher seen as partner in learning journey based on the student data. This was facilitated by the teachers own reflective and reflexive teaching practice. The teacher provided support, guidance and feedback and facilitated interactive activities and assessments in workshops where students learned from peers and made sense of the content. Having a supportive and positive teacher-learner relationship seemed the most important for student participants' positive learning experiences. Student data showed a very strong preference for the positive, supportive and friendly relationship that was established with the teacher. These students commented that the teacher was like a friend and therefore felt comfortable seeking help and expressing their views. This links back to the theory of good practice sustainability which also advocated for positive student-teacher relationships (UNECE, 2012).

The responsibility for learning, as understood by Blumberg (2009) in the context of learner-centred learning, was predominantly in the hands of students; however, it was observed that the learning was not wholly self-directed as a lot of guidance and support from the teacher through activities was required. The teacher played a very supportive role providing guidance on how assessment tasks could be completed, leading students at times through the problem-based learning process and other assessment activities like article analysis. The amount of support that is provided to students, particularly those in first year courses is an important consideration. This supports others' findings on self-directed learning in Sustainability Education (Hegarty et al., 2011). The teacher felt that students needed a certain level of support, so self-directed learning is not just a matter of sending students out to undertake their own research independent of the teacher's input or support. Students really valued teacher support in their learning process. So while the literature advocates self-directed learning in Sustainability Education (Barth and Burandt, 2010; Cotton and Winter 2010; Fortuin and Bush, 2010), care must be taken to understand what this involves in the context of learner-centred practice to ensure enough support is provided for students initially to feel comfortable and confident with undertaking complex tasks associated with the likes of problem-based learning, especially when engaging with the complex concepts of sustainability for the first time.

Of critical importance is the balance of power between the learner and the teacher (Blumberg, 2009). A teacher must encourage learners to explore aspects of the content independently and encourage alternative views. Students were provided the space to explore and determine course content through their assessment tasks; they were able to develop their own creative responses to building, planning and design challenges through applying their own evidenced understandings of sustainability. Through research and group discussions, students took content in their own directions in their assessments. Following on from this, students were able to express alternative views with their responses based on their own understandings and evidence to support these understandings. In this way, assignments were open-ended and allowed for more than one answer.

Dale and Newman (2005: 357) argue that 'sustainable development is not a theoretical pursuit, but by its nature is rooted in praxis.' Sustainability content was situated wholly in professional contexts and had a 'real issues orientation', that is, sustainability was always linked to real

professional problems and examples. This research indicates that situating content in professional contexts was important for learner engagement and demonstrating relevance of sustainability for learners, rather than discussing sustainability as an abstract theory. Situating sustainability in personal contexts (for example the Ecological Footprint assessment where learners reflected on personal impacts of consumption) was also undertaken. The majority of student participants felt that sustainability was relevant to their future profession and degree program and important to learn about. Therefore, this indicates that situating sustainability in professional practice is important for demonstrating relevance of sustainability and fostering learner engagement.

The implications of this study are that applying the GPLTSE elements in educational design and delivery in lived practice is complex and dependent on a number of pedagogical elements that are essential in Sustainability Education for an engaging and positive learning experience. These pedagogical implications are explored further in (Sandri and Holdsworth, Under review). Furthermore, while this study endeavoured to follow a rigorous and holistic methodological framework to explore the lived experience of Sustainability Education in practice, evaluation of course approaches and effectiveness is similarly complex and timely, especially evaluating the learning outcomes generated in Sustainability Education.

5.2. Implications for evaluation of learning experiences in sustainability education

Deep learning in Sustainability Education means that learners are not being taught what to think, but developing 'the dispositions necessary to act successfully in different contexts' (Barth and Michelsen, 2013: 111). From this research it is difficult to determine if students experienced a transformation or 'metamorphosis' (Armstrong and LeHew, 2013: 4) of their beliefs. Learning *about* sustainability was certainly indicated by student participants. Generally, responses related to learning or changes in thinking did not indicate *how* students understand sustainability, with students mostly talking about 'sustainability' rather than delving into the concept's meaning for them. Further research is needed to delve deeper into learning outcomes before conclusions can be drawn on the depth of learning and transformation that occurred.

This research found that while collecting data on activities that support capabilities development is relatively straightforward, measuring capabilities for sustainability as a learning outcome is a challenging task. While this research did not set out to measure actual learning outcomes, as it was beyond the scope, it did attempt to collect data on perceived learner confidence in applying sustainability, perceived skills developed and perceived confidence in specific capabilities for sustainability. Students were asked about the skills they felt they developed. The notable trend across all student participants was that they seemed more comfortable articulating what they had learned *about*, rather than the skills they felt they had developed. Similarly, there seems to be a challenge for learners reflecting on their learning outcomes, beyond understanding and awareness of sustainability, associated measures, and how these relate to professional practice.

A noteworthy observation about researching students' perceived learning outcomes is the high levels of confidence students expressed in regard to applying a number of capabilities for sustainability. One of the research methods used involved a survey of student's perceived confidence in applying a number of capabilities for sustainability found in the literature. Students were asked to rate their perceived level of confidence at the beginning and the end of the courses. The data collected showed that students were very confident in all of the capabilities for sustainability (including skills such as complex problem solving, stakeholder engagement, systems thinking and so on) at the beginning of the first semester, first year undergraduate course and remained so at the end of the semester. This brings into question the use of self-assessed capability or competency survey tools, which are a dominant

assessment approach taken according to the literature (Sandri et al., 2018).

Another issue in evaluation of learner's experiences is the use of voluntary quantitative tools such as surveys in small student populations. Low survey response rates can limit the generalisability of survey findings, which is why holistic data collection methods including triangulation with qualitative data is so important in this context. Other methods which may assist in enhancing the measurement of learning outcomes could include longitudinal research to understand how students have applied their sustainability learning in other subjects/courses or to use quasi-experimental studies to compare the learning experiences and outcomes of different learner cohorts, for example those that have completed the course compared with those that have not. Even with these methods, the challenge remains for how to measure deep learning and capability outcomes. This type of learning may need to be assessed beyond the course in the context of professional practice (Holdsworth et al., 2019).

Overall, the findings provide insight into the learning experiences and practices of those involved in the case study course which is important for informing teaching and learning practice for sustainability education. Furthermore however, these findings also highlight the challenges of research design for the evaluation of learning outcomes and how important consideration of valid data collection methods are in order to attain rigour of research methodology when researching learning processes and outcomes in sustainability education. Despite the researchers best efforts to design such a methodology, there are limitations in gaining a deep and valid understanding of actual learning outcomes in the context of sustainability education as highlighted in Table 7.

In the context of data triangulation, the data from all methods produced complementary findings. Data triangulation allowed the different perspectives from the teacher and students to be captured along with researcher observation. Despite the different perspectives captured, all four methods used in this case study provided data that was consistent regarding the learning and teaching activities, student-teacher relationships and pedagogical approach within the course. The key differences in data were with regards to the observation of skills developed during classes and those reported by the student participants and the emphasis on values reflection by the teacher and observed by the researcher and the limited discussion of this aspect of the course by student participants in the survey and focus group. The data triangulation however did not set out to validate the methods used through data convergence, but to 'enrich the analysis' (Nightingale, 2009: 490), therefore, these differences are indications of different perspectives and even perhaps different awareness of learning between the teacher, researcher and student participants which enrich the dataset. Overall, the complementarity and convergence of the findings from each data source does serve to validate the methods used.

6. Conclusion

This study aimed to explore what good practice learning and teaching for Sustainability Education looks like in practice. To do this, the study develops a theoretical framework based on a synthesis of good practice learning and teaching for sustainability theory. The synthesis is summarised in the GPLTSE framework. The study then formed a methodological framework to explore the GPLTSE in practice, shedding light on both the complexity of implementing good practice learning and teaching and also evaluating the effectiveness from the student and theory perspective. The study found that the case study course, Managing for Sustainability featured many of the characteristics of GPLTSE. The findings from the data provide an example of the lived experiences of many of the key elements of learning and teaching according to the GPLTSE framework. The results show that, with an effective pedagogy, students can have positive and meaningful learning experiences in a sustainability course that is transformative and values based that

challenges existing norms and asks students to engage in systems thinking and complexity in responding to real life case studies. In addition to the characteristics found in the literature, the lived experience of these characteristics from the teacher and students' perspectives sheds light on those practices which can enhance the delivery and learning experiences in the course. The findings have implications for pedagogy and also course evaluation approaches that aim to understand learning outcomes.

CRediT authorship contribution statement

Sarah Holdsworth: Resources, Formal analysis, Writing - original draft, Writing - review & editing. **Orana Sandri:** Conceptualization, Methodology, Investigation, Formal analysis, Writing - original draft, Writing - review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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