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An Overview of Sustainability Content in Higher Education: Applications for University Landscape Architecture Programs

Hye Yeon Park
Utah State University, hyeyeon.park@usu.edu

AN OVERVIEW OF SUSTAINABILITY CONTENT IN HIGHER EDUCATION: APPLICATIONS FOR UNIVERSITY LANDSCAPE ARCHITECTURE PROGRAMS

by

Hye Yeon Park

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Approved:

_____	_____
Carlos V. Licón, Ph.D. Major Professor	Ole Russell Sleipness, Ph.D. Committee Member
_____	_____
Daniella Hirschfeld, Ph.D. Committee Member	Jennifer Givens, Ph.D. Committee Member
_____	_____
David Feldon, Ph.D. Committee Member	D. Richard Cutler, Ph.D. Vice Provost of Graduate Studies

UTAH STATE UNIVERSITY
Logan, Utah

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ABSTRACT

An Overview of Sustainability Content in Higher Education: Applications for University Landscape Architecture Programs

by

Hye Yeon Park, Doctor of Philosophy

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Major Professor: Dr. Carlos V. Licón
Department: Landscape Architecture and Environmental Planning

Since the concept of sustainability emerged in the Brundtland Commission Report in 1987 and Agenda 21 in 1992, higher education institutions have sought to integrate sustainability into university curricula, initiatives, and faculty roles. More than 600 universities around the world currently offer diverse courses focused on sustainability. These institutions are increasingly emphasizing the study of sustainability, considering its environmental, social, and economic aspects and the interrelatedness of these elements. Thus, the application of vital educative tools for integrating theory with practice and achieving sustainable development has produced a new educational paradigm called "Education for Sustainable Development" (ESD). The ESD aims to empower individuals to create a sustainable future by providing a learning education that integrates environmental, social, and economic systems.

ESD in higher education encompasses a wide range of aspects related to higher education, including course content, teaching methodologies, curriculum design, and the roles of faculty members, such as research, teaching, and service. These educative

components, with ESD's holistic and interdisciplinary nature, reflect the need for an integrated approach to achieve sustainable development.

Design and planning education play a crucial role in shaping future decision-makers who will impact society and the environment. In other words, design and planning education approaches help equip future planners and designers to address sustainability's complex and interrelated challenges. Fortunately, a great deal of existing research has expanded the understanding of sustainability in education by developing strategies to teach future planners and designers. However, addressing the complex and interconnected social and environmental issues we face requires more than an understanding of sustainability. Continuous practical application of knowledge and skills is essential for designing and implementing effective solutions. As such, it is crucial that planners and designers continue to integrate and apply their knowledge and skills in practical ways. This ongoing effort is necessary to achieve sustainable development and allow decision-makers to address the multifaceted challenges of sustainability.

Recognizing this continuing need for a practical approach, scholars in the field of design and planning are increasingly aware of the importance of integrating sustainability concepts into their education. ESD in landscape architecture (LA) has received less attention from academia than the design and planning discipline, despite its potential to address complex design challenges and barriers. Therefore, there is a need to prioritize the incorporation of sustainability principles into LA education. Future planners and designers who can make informed decisions and directly influence the environment and society can contribute to a more sustainable future.

This dissertation investigates the nature and extent of ESD integration in LA education. It also examines current ESD approaches used in LA education and looks at the benefits and challenges of integrating ESD into the curriculum, which provides a combination of ESD approaches and LA course content frameworks.

The research method combines quantitative and qualitative research approaches, including surveys, syllabi, and document analysis. Therefore, the findings of this paper will inform LA educators and practitioners on best practices for integrating ESD into LA programs, preparing future professionals to address complex social and environmental challenges.

(175 pages)

PUBLIC ABSTRACT

An Overview of Sustainability Content in Higher Education: Applications for University Landscape Architecture Programs

Hye Yeon Park

Higher education institutions worldwide have recognized the importance of integrating sustainability into their programs, with over 600 universities offering courses focused on sustainable development. This trend has led to the emergence of Education for Sustainable Development (ESD). This multidimensional approach aims to empower individuals to create a sustainable future by integrating environmental, social, and economic systems. In particular, ESD has been implemented in various aspects of higher education, such as course content, teaching methodologies, curriculum design, and faculty roles.

Design and planning education are critical components of shaping future decision-makers who will positively and negatively impact society and the environment. However, despite its potential to tackle complex design challenges, sustainability education in landscape architecture (LA) has received less attention from academia than other design and planning disciplines. As such, there is a need to prioritize integrating ESD into LA education to prepare future professionals for addressing social and environmental challenges.

The objective of this dissertation is to investigate the integration of ESD in LA education and to identify the approaches utilized and the benefits and challenges of integrating ESD into LA programs. The research method combines quantitative and qualitative research approaches, including surveys, syllabi, and document analysis. Therefore, the findings of this paper will inform LA educators and practitioners on best practices for integrating ESD into LA programs, preparing future professionals to address complex social and environmental challenges.

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CHAPER 1

INTRODUCTION

Importance of the Problem

The concept of sustainability has gained widespread recognition and importance since the publication of the Brundtland Commission Report in 1987 and Agenda 21 in 1992, which highlighted the urgent need to address global environmental challenges (UNCED, 1992; WCED, 1987). Sustainability has resultantly become a key issue, not only in academia but also in wider society.

Higher education institutions have taken on an important role in promoting sustainability by providing instruction across various disciplines, implementing innovative teaching methods, and collaborating with students, administrators, international organizations, and local communities (Barlett & Chase, 2004). As a result, more than 600 universities around the world currently offer a variety of sustainability-focused programs (Leal Filho et al., 2015). To establish these programs, higher education institutions have incorporated sustainability into various aspects of university initiatives, programs, and faculty roles, such as research, teaching, and service (Barlett & Chase, 2004; Leal Filho et al., 2015; Von Hauff & Nguyen, 2014). Moreover, universities encourage their students to explore sustainability principles using a multi-dimensional approach that covers environmental, social, and economic dimensions and the interrelationships among these components (Barlett & Chase, 2004; Leal Filho et al., 2015; Lozano, 2008).

Furthermore, UNESCO developed a new educational paradigm named Education for Sustainable Development (ESD), which employs critical educational tools to bridge the gap between theory and practical applications resulting in sustainable development (Barlett & Chase, 2004; Blewitt, 2014; Buckler & Creech, 2014; Kishita et al., 2018). The ESD approach, aimed to "incorporate the theory and practices of sustainable development into education" (Buckler & Creech, 2014), has become a vital consideration at all educational levels (Bedawy, 2014). The ESD approaches prioritize learner-centered, hands-on learning through collaboration, critical thinking, and participation. These approaches are also characterized by their holistic and interdisciplinary nature, as highlighted by various scholars in the field (Backman et al., 2019; Cotterell et al., 2019; Ichinose, 2017; Leal Filho et al., 2018; Lee et al., 2017; Onuki & Mino, 2009; Park et al., 2022; Sterling et al., 2018; Tamura et al., 2018; Wals, 2010). Scholars have observed notable developments in students' learning experiences, including the cultivation of comprehensive thinking (Willamo et al., 2018), a critical understanding of real-world issues (Leal Filho et al., 2018), and in-depth learning (Backman et al., 2019; Howlett et al., 2016). By employing ESD strategies, such as transformative learning, students are empowered to address real-world issues from a holistic perspective (Leal Filho et al., 2018; Trencher et al., 2018).

In addition to the focus on the environmental, social, and economic impacts of human activities, researchers have highlighted the significant influence that planners and designers have on the environment (Sandercock, 1997). It is worth noting that planners' and designers' decisions have long-term consequences that can be either positive or negative (Bolan, 1969; Wheeler, 2004) and thus require careful consideration.

Accordingly, design and planning education have already embraced systematic approaches to problem-solving and goal-setting, including environmental protection, urban development, economic activity, and social justice (Khan et al., 2013; Wheeler, 2004). To address the complexities and tradeoffs inherent in planning and design decisions, sustainable development offers a holistic and integrative approach (Vucetich & Nelson, 2010; Waas et al., 2010).

Given the features of ESD approach, these align well with teaching approaches in design and planning disciplines, which emphasize practical and integrative teaching methods. Encompassing holistic and comprehensive features, ESD offers additional educational components that are essential for the development of future planners and designers, such as the ability to develop critical thinking, the ability to clarify their values, and the ability to think systemically (Tilbury, 2011).

By incorporating ESD into their coursework, students can engage in hands-on learning activities that emphasize collaboration, critical thinking, and participation. ESD equips students with necessary tools and skills to approach sustainability challenges in a comprehensive way and help them informed decisions (Bolan, 1969; Sandercock, 1997; Wheeler, 2004), complementing and enhancing traditional design and planning education. Ultimately, students learn how to address the interrelated complexities and tradeoffs inherent in their decision-making process (Corney & Reid, 2007; Vucetich & Nelson, 2010; Waas et al., 2010).

Fortunately, a great deal of research exists that can expand the understanding of sustainability in planning and design education by building strategies to teach future planners and designers (Aktas et al., 2015; Frederick & Pijawka, 2014; Hsieh, 2020;

Martin & Beatley, 1993; Pijawka et al., 2013). In particular, some previous studies emphasized the development and implementation of courses. Frederick and Pijawka (2014) proposing considerations to overcome the challenges, the relationship between sustainability and the subjects, and the introduction of the ESD objectives to support the learning outcomes to design sustainability planning courses. Aktas et al. (2015) suggest the need for better coordination among faculty to offer students adequately prepared courses requiring critical thinking and analysis so that students can engage in meaningful discussions of complex topics. Pijawka et al. (2013) also emphasize the need to determine what and how much to teach in sustainability and at which stage to teach it by offering a four-step framework that integrates sustainability into planning and design courses.

Based on previous studies, the intention of this dissertation agrees that integrating sustainability into design and planning courses can improve the quality of education (Frederick & Pijawka, 2014) and that it has positive impacts in suggesting design solutions to address sustainability issues (Hsieh, 2020). However, there is still a need to determine what and how to teach sustainability and at what different stages, such as undergraduate and graduate programs.

In addition, the continuing complexity of social and environmental issues requires planners and designers to integrate and apply their knowledge and skills in practical ways to resolve the intricate conflicts of property rights, development, and resource use (Campbell, 1996). Recognizing the ongoing need, academics in the fields of design and planning are increasingly aware of the importance of staying informed and adapting to changing circumstances (Hurlimann, 2009; Stauskis & de Vries, 2018; White & Mayo,

2005). Like ESD, landscape architecture (LA) is a multifaceted and interdisciplinary profession (Gazvoda, 2002). The International Federation of Landscape Architects (IFLA) also defines LA as a field that encompasses planning, design, and management in the pursuit of sustainability based on aesthetic and scientific principles (Galan, 2017).

Moreover, literature shows that there have been collaborative efforts between LA education and ESD, which have led to mutual benefits. For instance, LA education has long utilized Charrette, and the interdisciplinary collaboration process is a key feature of an ESD approach (Walker & Seymour, 2008). Furthermore, LA has demonstrated its capacity to solve complex spatial problems, thereby contributing to mitigating environmental, economic, and social impacts (Gazvoda, 2002; Sheppard, 2015; Stauskis & de Vries, 2018).

In short, planning and design disciplines are critical components of achieving sustainable development (Akinci et al., 2016), and ESD approaches in LA have the strong potential to address complex design challenges. However, ESD in LA has not received the same level of attention in academia. Hence, there is a need to prioritize integrating ESD approaches into LA education to equip future professionals with the knowledge and skills needed to achieve sustainability.

Purpose of the Study and Research Questions

The motivation for the current research came from the need for practical implementation of ESD in LA education along with a deeper understanding of how the LA curriculum equips students to become capable, knowledgeable, and responsible practitioners and problem-solvers. Ultimately, it aims to explore ESD approaches to

educating students and the LA curriculum, collect data showing how LA teachers are integrating sustainability into their curriculum, identify gaps in current curriculum, and suggest potential areas for improvement.

This study is mainly concerned with providing insight into how to promote deeper LA student learning of sustainability concepts. In doing so, this dissertation investigates the current state of sustainability education in LA through a systematic review of the existing literature, an online survey, a content analysis of syllabi, and an assignment from a current LA course. The dissertation addresses the following research questions:

1. What ESD approaches can be found in planning and design education, and what issues are faced when applying ESD?
2. How do current LA instructors employ ESD pedagogical approaches and content to teach sustainability, and which learning opportunities or teaching methods have been provided in LA programs?
3. How do students in LA courses reflect sustainability ideas and principles and apply sustainability attributes in their assignments?

Research questions are answered by examining various ESD approaches and their application in LA education. This dissertation aims to provide practical insights into developing appropriate course content by identifying the possibilities and challenges of teaching sustainability in LA education and providing a comprehensive understanding of the current ESD approaches used in the LA field. This will contribute to the literature on ESD and LA education and provide educators with practical recommendations to enhance their teaching practices in promoting sustainability, consistent with the following research objectives:

1. Characterize and identify pedagogical approaches and issues in ESD for planning and design-related education through a review of current literature.
2. Analyze the implementation of ESD content in LA programs in the US using both a faculty survey and syllabi content analysis.
3. Identify and interpret students' awareness and understanding of sustainability in an LA course through content analysis of assignment submissions.

Significance of the study

The current study has two potentially significant impacts. First, it contributes to the literature in planning and design education by identifying relevant ESD content and pedagogical approaches. The study's results also support educators and universities in addressing their programs' limitations and implementing ESD into the programs.

Second, the dissertation's main point followed the core values of accreditation standards of the Landscape Architectural Accreditation Board (LAAB), which urges encompassing sustainability into the knowledge as well as skills and competencies in learning outcomes (LAAB, 2021).

In particular, the core value of the standards met the UN Decade of Education for Sustainable Development report entitled "Shaping the Future We Want" by monitoring and identifying ESD programs (UNESCO, 2014). Against this background, identifying the current status of LAAB standards and ESD content in LA programs contributes to the need to revise and develop LA education.

Definition of the key terms

1) SUSTAINABILITY: In 1804, Georg Ludwig Hartig first defined the concept of sustainability by introducing managed timber harvesting and sustainable forest assessment for the benefit of future generations (Vahrson & Spathelf, 2019). After that, sustainability became more relevant to the human environment (Johnston et al., 2007), and a multidisciplinary, complex topic that overlaps the natural, economic, and social aspects of sustainability (Sverdrup & Stjernquist, 2002). However, for the purposes of this study, sustainability will be defined as an educational concept. Focusing on the concept articulated in the Brundtland Report, "Sustainability requires the enforcement of wider responsibilities for the impacts of decisions. This requires changes in the legal and institutional frameworks that will enforce the common interest" (WCED, 1987).

2) SUSTAINABLE DEVELOPMENT: In 1987, the Brundtland Report defined SD as development that "Meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). This research considers SD to be a concept that integrates the environmental, economic, and social fields (Giddings et al., 2002). Furthermore, as the process for achieving sustainability (Gray, 2010), this study will adopt SD, which provides a holistic approach to addressing the complexities and interrelated aspects of decision-making (Vucetich & Nelson, 2010; Waas et al., 2010).

3) EDUCATION FOR SUSTAINABLE DEVELOPENT (ESD): The United Nations Decade of Education for Sustainable Development stressed the need to "[incorporate] the theory and practices of sustainable development into education" (Buckler & Creech, 2014). This integrated theory and practice led to a new paradigm in education, which led to the creation of ESD (Barlett & Chase, 2004; Blewitt, 2014; Kishita et al., 2018). Teaching and learning about ESD provides a meaningful, real-world focus that helps students to "be aware

of the value of their lives and making schools improve themselves" (Barratt Hacking et al., 2010). The ESD concept adopted for this project follows the ESD for 2030 framework, which emphasizes encouraging learners toward transformative action and structural change by providing skills to guarantee a livelihood (UNESCO, 2019). At the same time, this study follows the main goals of ESD, which are to teach “the subject content,” use “appropriate pedagogies and teaching practices,” and instill sustainability ideas in students to enhance student learning (Sipos et al., 2008).

4) LANDSCAPE ARCHITECTURE (LA): LA allows the practitioner to solve complex interdisciplinary problems (Gazvoda, 2002) by influencing various professions (Stauskis & de Vries, 2018). Since LA combines environment and design, and art and science (IFLA, 2021), an LA education needs to engage diverse fields such as environmental, social, artistic, and planning (Vivas, 2017). In addition to these concepts, this research follows the American Society of Landscape Architects’ definition of landscape architects: "Landscape architecture involves the planning, design, management, and nurturing of the built and natural environments. With their unique skill set, landscape architects work to improve human and environmental health in all communities” (ASLA, 2021).

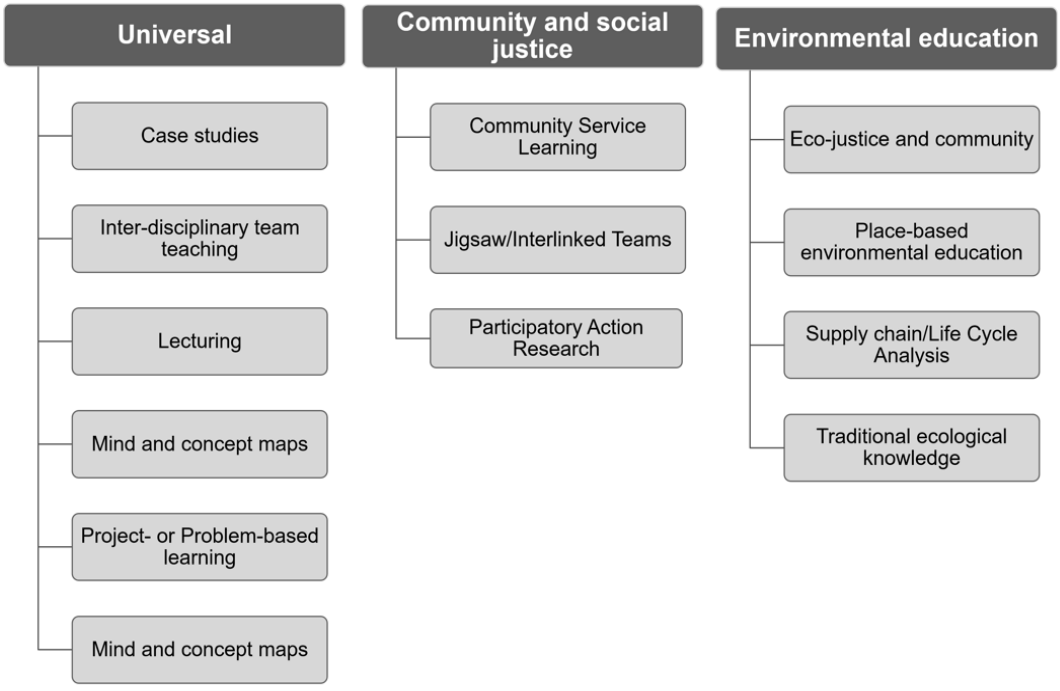
5) ESD PEDAGOGICAL APPROACHES: This study follows the definition of *pedagogy* from the Oxford Dictionary: “The art, occupation, or practice of teaching. Also: the theory or principles of education; a method of teaching based on such a theory.” Pedagogies in ESD highlight student-centered, place-based, or problem- and issue-based learning by asking questions, conducting analysis, practicing critical thinking, and making decisions to stimulate creativity and imagine alternative futures. According to Lozano et al. (2019), there are currently 12 exemplary ESD pedagogical approaches in three categories (see Figure 1): 1) Universal: which is broadly applicable; 2) Community and social justice: for addressing social justice and community building; and 3) Environmental education: for environmental

education practices. Instructors can also develop or choose various pedagogical approaches depending on their educational goals and learning environment and based on the diversity of their students (Lozano et al., 2019).

6) LANDSCAPE ARCHITECTURE ACCREDICATION BOARD (LAAB): The US LAAB has included ESD as a topic in the accreditation of LA programs. LAAB in 2021 encompassed six core values: 1) Environmental Health, Sustainability, Resilience, and Stewardship; 2) Diversity, Equity, and Inclusion; 3) Human and Community Health and Safety; 4) Professional Ethics and Responsibility; 5) Leadership and Innovation; and 6) Application of the Sciences to the Design of Natural and Built Landscapes. This standard evaluates the quality of education in professional programs that lead to a degree in LA by encompassing sustainability into their curricula (LAAB, 2021).

Figure 1

ESD pedagogical approaches in three categories (Lozano et al., 2017)



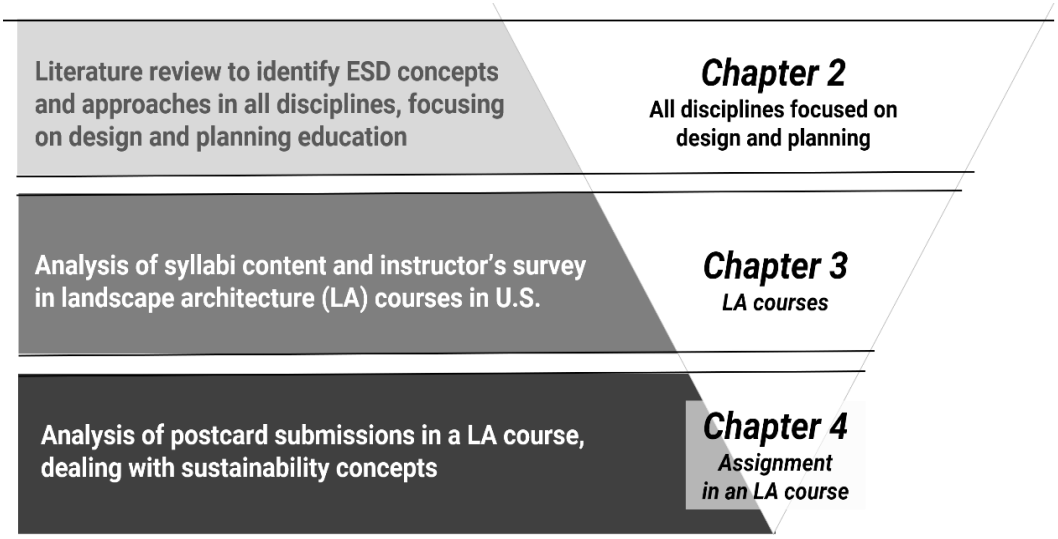
Summary

This dissertation comprises five chapters, including an introduction, three research papers that explore sustainability education in the LA discipline (see Figure 2), and a conclusion. This first chapter—the introduction—outlines the background and importance of ESD and LA education, research gaps, the study's purpose and research questions, definitions of relevant key terms, and the research process and structure.

Chapter two is the first research paper, focused on a review of relevant literature, entitled "Teaching sustainability in planning and design education: A systematic review of pedagogical approaches." This paper explores the current status of ESD learning approaches in higher education disciplines, with a specific focus on planning and design disciplines. To achieve this, a systematic review of existing literature was conducted using the Preferred Reporting Items for Systematic reviews and Meta-Analysis for Protocols 2015 (PRISMA-P 2015) guidelines. Moreover, chapter two reviews ESD approaches, course contents, and issues faced while teaching sustainability in all disciplines of higher education to achieve a

Figure 2

The research process for multi paper dissertation



comprehensive understanding of these approaches and courses. This study also identifies teaching methods and establishes a framework for the planning and design discipline.

Chapter three is titled “Implementation of Sustainability Principles in Landscape Architecture: An Examination of Faculty Surveys and Course Syllabi.” It analyzes data from an online survey of LA instructors and a syllabi content analysis to identify the current status of LA education. It also identifies how sustainability is taught by exploring LAAB standards, sustainability themes, barriers, benefits, and teaching methods to find the critical features of ESD in LA courses.

Chapter four is the third paper, entitled “Thematic analysis of student submissions: Sustainability education in LA courses,” which describes a thematic analysis of student submissions in LA courses. It analyzes student reflections on sustainability through the use of an LA course assignment(Cotterell et al., 2019) because a clear conceptualization of sustainability can be a powerful approach in the education field. This study employs a mixed-methods approach to examine both the images and text contained in postcard submissions that were part of undergraduate students’ midterm assignments in an LA course. By using both qualitative and quantitative methods, this study seeks to provide analysis of the students’ perspectives on sustainability.

The final chapter concludes the dissertation by providing a summary of the research and proposing further research avenues based on its findings. Lastly, the dissertation’s theoretical approach is grounded in curriculum theory, which advocates for the need to understand the curriculum and its performance (McCutcheon, 1982). Since curriculum theory aims to identify how educational processes include goals, content, and pedagogy (Wahlström & Sundberg, 2015), this theory is appropriate for this work.

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CHAPTER 2

TEACHING SUSTAINABILITY IN PLANNING AND DESIGN EDUCATION: A SYSTEMATIC REVIEW OF PEDAGOGICAL APPROACHES[1]

Abstract

Sustainable development principles are being increasingly incorporated into university planning and design education. This paper evaluates how university planning and design programs teach sustainability and how these various approaches may influence future planners and designers. This systematic review quantitatively analyzes 5639 empirical research documents published from 2011 to 2020, including peer-reviewed papers and reports related to planning and design disciplines in higher education institutions. Key findings reveal differences in how and if planning and design curricula emphasize sustainability topics, as well as how various teaching approaches or modes correlate with sustainability values. Ultimately, this research offers a comprehensive understanding of how sustainable development approaches and teaching methods can influence the problem-solving approaches of students and emerging professionals when dealing with complex planning and design problems.

[1] [1] Major Author: Hye Yeon Park
Co-Authors: Carlos V. Licon & Ole R. Sleipness
Park, H. Y., Licon, C. V., & Sleipness, O. R. (2022). Teaching sustainability in planning and design education: A systematic review of pedagogical approaches. *Sustainability*, 14(15), 9485.

Keywords: sustainability; education for sustainable development (ESD); curriculum design; higher education; pedagogy; planning and design education

Introduction

Over the last decade, sustainability has emerged as a central theme in higher education institutions (Du et al., 2013; Stein, 2019), along with the belief that education could be a vital aspect of strategy for sustainable development (Yli-Panula et al., 2020). Accordingly, the United Nations decade of education for sustainable development emphasized incorporating theory and practices of sustainable development into education (Buckler & Creech, 2014). These initiatives advance a new paradigm in higher education: education for sustainable development (ESD) (Barlett & Chase, 2004; Bedawy, 2014; Blewitt, 2014; Buckler & Creech, 2014; Kishita et al., 2018).

ESD offers several benefits for schools and individual students, allowing them to engage in critical thinking, explore their values, and adopt a systematic approach (Tilbury, 2011). By providing a meaningful real-world focus, ESD also helps students' awareness of their role in creating a sustainable future (Barratt Hacking et al., 2010).

Above all, students can gain direct sustainability experiences through ESD learning approaches (Buckler & Creech, 2014). These ESD features have helped researchers to recognize it as a vital way to attain sustainability (Kates, 2011; Komiyama & Takeuchi, 2006).

In this paper, we have referenced the concept of ESD from the framework of UNESCO, which emphasizes encouraging learners' transformative action and structural changes by providing people with the skills to guarantee their living (UNESCO, 2019). Additionally, we have accepted the argument in the Report of the World Commission on Environment and Development that "sustainability requires the enforcement of wider responsibilities for the impacts of decisions" (WCED, 1987). Based on this foundation,

we follow the purpose of ESD in nurturing future generations who can make informed decisions and take responsible action to resolve complex problems (S.-Y. Chen & Liu, 2020).

Universities act as significant educational conduits for the resolution of sustainable issues. Their primary roles, including research, teaching, and outreach, support sustainable development and the goals of ESD at the institutional and community levels (Leal Filho et al., 2015). Over 600 universities worldwide have developed diverse educational programs focused on sustainability and sustainable development (Von Hauff & Nguyen, 2014). Notably, a wide array of fields has tried to incorporate ESD into academic areas, such as economics, environment, engineering, and the arts. Along with these trends, planning-related disciplines have increasingly embraced the concept of sustainability, which is also emerging as a new planning stream (Beatley & Manning, 1997).

In the fields of planning and design, including urban planning, regional planning, landscape architecture, and urban design, sustainability is vital to address the development dilemmas of environmental protection, urban development, economic activity, and social expectations (Wheeler, 2004). Design and planning decisions must consider a wide range of activities representing the goals of preservation, development, economic opportunities, social justice, and many others (Khan et al., 2013; Wheeler, 2004).

Given the increasing importance of design and planning-related professions and the long-term environmental effects of their decisions and tasks (Sandercock, 1997), the concept of sustainability into the teaching of planning and design programs should be

integrated (Hurlimann, 2009; Stauskis & de Vries, 2018; White & Mayo, 2005). There is a significant body of research expanding the understanding of sustainability in planning and design education and identifying and selecting strategies to teach future planners and designers (Cincera et al., 2018; Martin & Beatley, 1993).

In order to identify ESD pedagogical approaches in planning and design courses, we conducted a two-step research procedure. First, preliminary background research on publications was performed to understand ESD approaches, experiences, and challenges comprehensively. Second, this paper examines the methods through which educators introduce the concept of sustainability in planning and design teaching (Ahmad et al., 2018). We specifically examine teaching methods, pedagogical approaches, and the benefits and challenges of teaching sustainability.

Background: Preliminary Research

From October 2019 to December 2019, a preliminary publications review examined and synthesized forty publications from the Association for the Advancement of Sustain-ability in Higher Education (AASHE) using systematic review guidelines (Aikens et al., 2016; Onwuegbuzie et al., 2015). The preliminary study results revealed specific elements of educational experiences; for instance, sustainability appears as a specific dedicated course, or a theme in class. We assigned five groupings describing educational elements or dimensions when teaching sustainability: venue, subject, delivery, audience, and outcomes (see Figure 3).

(1) **Venue** refers to where learning is happening. Venue can include the whole institution committed to teaching sustainability through programs, vision statements, or

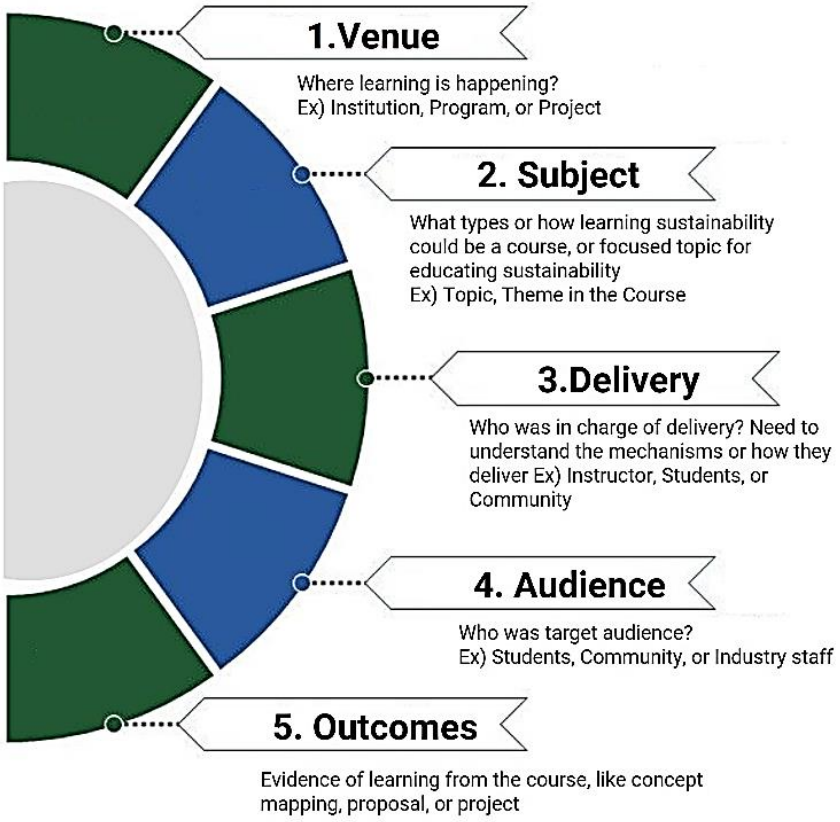
practice. More focused teaching approaches include programs, courses, projects, workshops, or field trips.

(2) **Subject** describes the specific learning topic, theme, or course.

(3) **Delivery** is the messenger in charge of teaching sustainability, which could include not only course instructors, but also students, peer tutors, external community members, etc. (4) **Audience** describes the targeted learners. It can include students, the community at large, or a specific sector or industry, but in most cases, students are the target audience. (5) **Outcomes** identify and gather evidence of learning. Learning outcomes include tangible products, such as a project, and intangible outcomes, such as

Figure 3

Five dimensions of sustainability educational experiences



design thinking, collaboration skills, or even environmental awareness.

This literature review also identified 22 educational approaches. These approaches describe the pedagogical strategies implemented to enable learning. Among these strategies are collaborative learning, experiential learning, interdisciplinary studies, etc. The three dominant strategies implemented are interdisciplinary approaches (n = 7), transdisciplinary studies (n = 5), and competency-based approaches (n = 4). Table 1 combines these strategies with the educational elements or dimensions within which learning took place.

Table 1

Teaching approaches and dimensions in sustainability education

Rank	ESD Approaches in HE	Venue	Subject	Delivery	Audience	Outcome	Type of Disciplines
1	Interdisciplinary (n = 7)	2	7	6	6	4	Sustainability science (Tamura et al., 2018), construction management/art and design (Li et al., 2018), social science (Howlett et al., 2016), general (Altbach & Knight, 2007; Mulder, 2014), sustainable development and management (van Dam-Mieras et al., 2008), combination of humanities, natural sciences, and social sciences (Steiner & Posch, 2006)
2	Transdisciplinary (n = 5)	2	4	2	2	2	Sustainability science (Komiyama & Takeuchi, 2006), education, ecology, environmental science, chemistry, economics and business, political science, psychology, etc.(Cincera et al., 2018), sustainability science (Tamura et al., 2018), combination of humanities, natural sciences, and social sciences (Steiner & Posch, 2006), Social sciences and humanities perspectives (Tejedor et al., 2018)
3	Competencies (n = 4)	2	4	2	3	3	General (Altbach & Knight, 2007; Mulder, 2014), sustainable

							development and management (van Dam-Mieras et al., 2008), accounting and administration (Piza et al., 2018)
4	Transformative learning (n = 3)	x	3	3	2	2	General (Leal Filho et al., 2018), general centering on a specific postgraduate program, economics, renewable energy, the development of affordable housing workspace, and local food production and processing (Sterling et al., 2018), management (Brunnquell & Brunstein, 2018)
5	Experiential learning (n = 2)	2	2	2	2	2	General (Backman et al., 2019), sustainable environmental Management (Kricsfalusy et al., 2018)
6	Service learning (n = 2)	2	2	2	2	2	education, ecology, environmental science, chemistry, economics and business, political science, psychology, etc. (Cincera et al., 2018), sustainable environmental management (Kricsfalusy et al., 2018)
7	Self-regulated learning (n = 2)	1	2	2	2	1	Construction management/art and design (Li et al., 2018), combination of humanities, natural sciences, and social sciences (Steiner & Posch, 2006)
8	Project-based learning (n = 2)	1	2	1	2	2	Construction management/art and design (Li et al., 2018), urban planning (Korobar & Siljanoska, 2016)
9	Critical thinking/reflection (n = 2)	x	2	2	2	2	Social science (Howlett et al., 2016), management (Brunnquell & Brunstein, 2018)
10	Collaborative (n = 2)	x	2	2	x	1	General (Li et al., 2018), sustainability science (Tamura et al., 2018)
11	Problem and project-based learning (n = 1)	1	1	1	1	1	Sustainable environmental management (Kricsfalusy et al., 2018)
12	Cross cultural (n = 1)	1	1	1	1	1	Construction management/art and design (Li et al., 2018)
13	Learning landscape (n = 1)	1	1	1	1	1	General (Backman et al., 2019)
14	Human-centered design (n = 1)	1	1	1	1	1	Construction management/art and design (Li et al., 2018)
15	Generalism, holism, and holarchism (n = 1)	1	1	1	1	x	Environmental science and policy (Willamo et al., 2018)
16	Comprehensive (n = 1)	1	1	1	1	x	Environmental science and policy (Willamo et al., 2018)

17	Interculturality (n = 1)	x	1	1	1	1	Sustainable development and management (van Dam-Mieras et al., 2008)
18	Reflective thinking (n = 1)	x	1	1	1	1	Social science (Howlett et al., 2016)
19	Problem-based learning (n = 1)	x	1	x	1	1	Urban planning (Korobar & Siljanoska, 2016)
20	Case based learning (n = 1)	x	1	x	1	1	Urban planning (Korobar & Siljanoska, 2016)
21	Holistic approach (n = 1)	x	1	1	1	x	General centering on a specific postgraduate program, economics, renewable energy, the development of affordable housing workspace, and local food production and processing (Sterling et al., 2018)
22	Transversality strategy (integrative approach) (n = 1)	1	1	x	x	1	Accounting and administration (Piza et al., 2018)
Sum of frequency of different dimensions		19	42	33	34	30	

This study found that in many cases, teaching sustainability implemented more than one approach. For instance, the transformative learning approach, which emphasizes students' critical skills, such as asking questions, finding reliable information, and critical thinking, was used along with a collaborative approach. This mix of strategies helps students address real-world issues from a holistic perspective (Leal Filho et al., 2018; Trencher et al., 2018). Another notable result is that ESD approaches are frequently used in the "subject" dimension (n = 42). The "venue" dimension (n = 19) was the least preferred environment where sustainability teaching took place.

This preliminary review also documented the main outcomes resulting from these teaching efforts, including the development of comprehensive thinking (Willamo et al., 2018), critical understanding of real-world issues (Leal Filho et al., 2018), and in-depth learning (Backman et al., 2019; Howlett et al., 2016). In addition, the re-view documented 23 challenges faced when teaching sustainability. The main challenges are

the needed time and effort and the lack of sustainability awareness as the two most frequent and critical problems with existing educational barriers. Some cases faced community collaborating challenges, miscommunication among different fields, misunderstandings of sustainability, financial burdens, insufficient funding, etc. (Agirreazkuenaga, 2019; Leal Filho et al., 2018; Trencher et al., 2018).

Based on the findings of the preliminary review, this study aims to narrow the scope and answer the following questions with respect to the disciplines of planning and de-sign:

1) What educational approaches are being implemented in planning and design education?
2) What teaching methods are applied in these programs?
3) What are the benefits and challenges faced in teaching sustainability in planning and design?

Methodology

The study applied the preferred reporting items for systematic reviews and meta-analysis for protocols 2015 (PRISMA-P 2015). This research method facilitates the development and reporting of systematic review protocols to reduce arbitrary decision-making (Moher et al., 2015). This study also compared ESD learning approaches in design and planning education with pedagogical approaches from the preliminary study described in the preceding sections. The objectives of this study are:

1. to explore and characterize current ESD approaches in design and planning;
2. to identify teaching modes in use and in combination with ESD pedagogical approaches;
3. to identify issues and experiences in teaching sustainability; and
4. to compare identified challenges with the results of the preliminary research.

Search Strategy

Data was collected from three different publication clearinghouses: AASHE, which offers quality resources related to sustainability curricula; the Education Resources Information Center (ERIC), which supports education research and information; and SCOPUS, a comprehensive high-quality scholarly database. The study limited the scope of the publications to those written in English and that were published from 2011 to 2020. The data screening and selection procedure followed the PRISMA-P 2015 guidelines suggested in Shamseer et al. (2015) and McInnes et al. (2018). The review procedure includes identification, screening, eligibility, and inclusion stages. We followed the

inclusion/exclusion method used by McInnes et al. (2018). Table 2 shows the inclusion and exclusion criteria used in this selection process.

Table 2

Inclusion and exclusion criteria of PRISMA-P 2015.

	Inclusion Criteria	Exclusion Criteria
1	Empirical research (survey or case study)	Nonempirical research (policy, theory, or methods)
2	Conducted in higher education	Not conducted in higher education
3	Managing course or program contents	Not discussed regarding the course or program contents
4	Applicable to design or planning-related education	Not applicable to design or planning education
5	Written in English	Written in other language types of English

Data Collection and Analysis

After using the inclusion and exclusion criteria, this study applied different combinations of terms for collecting samples as listed in Table 3. Since data from AASHE includes sustainability by organizational definition we used a different set of keywords focusing on “environment” and “education.” The resulting selection included 753 citation records in publications on research and higher education curricula. The data from ERIC covers education, and thus the keywords “environmental” and “sustainability” were used, with specific criteria, such as” peer-reviewed”, “journal article”, and “higher education”. The results presented 660 items. For the SCOPUS search, we applied keywords, such as “environmental” and “sustainability” and “education” with “curriculum” or “course” and “university” or “college” or “higher education”.

Table 3

The data collection process

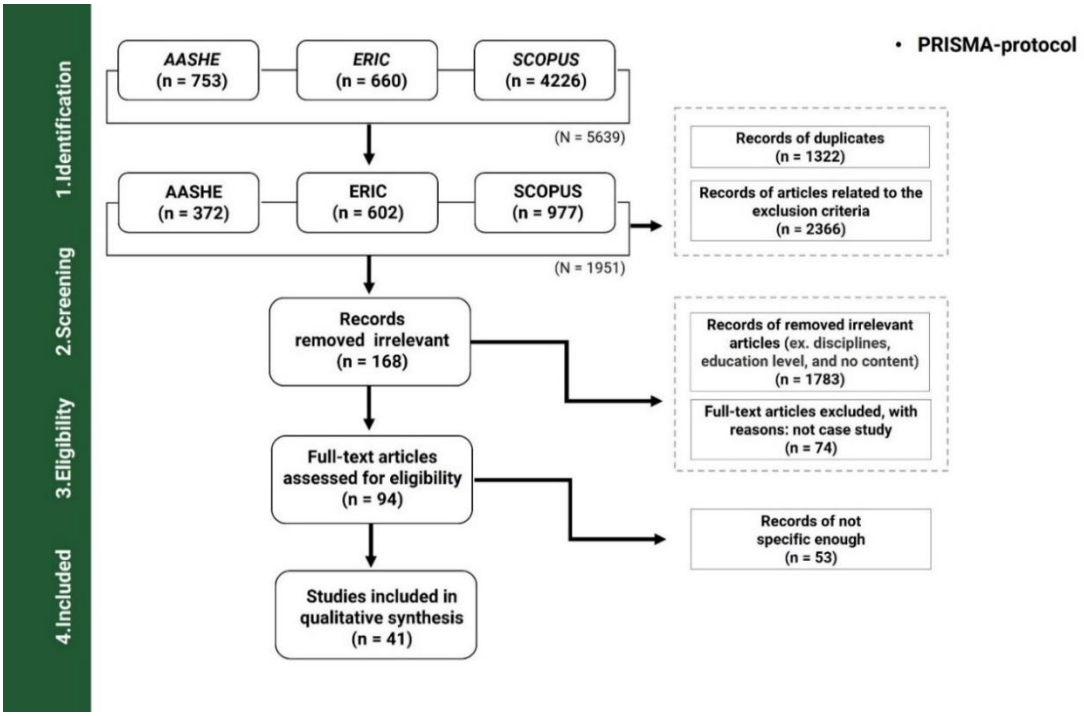
Database	Applied Inclusion Criteria	Result
AASHE (n = 753)	• Content-type: case studies and publications, sustainability topic: curriculum and research • Year posted: 2011–2020 • Applying related to disciplines (architecture, behavior sciences, design, education, environmental studies, social sciences, arts, sustainability studies, urban, community, and regional planning)	• Environment + Education: 103 • Environment + Educational: 104 • Environmental + Education: 164 • Environmental + Educational: 163 • Environment + Environmental + Education + Educational: 80 • Environmental AND Sustainability AND Education: 139
ERIC (n = 660)	• Full text available on ERIC • Year posted: 2011–2020 • Applying: higher education level	• Environment AND Sustainability AND (Design OR Planning): 49 • Environment AND Sustainable AND (Design OR Planning): 51 • Environmental AND Sustainability AND (Design OR Planning): 35 • Environmental AND Sustainable AND (Design OR Planning): 31 • (Environment OR Environmental) AND (Sustainability OR Sustainable) AND (Design OR Planning): 110
SCOPUS (n = 4226)	• Search within article title, abstract, and keyword, open access • Year posted: 2011–2020 • Applying related to disciplines (social sciences, environmental science, earth and planetary sciences, agricultural and biological sciences, and arts and humanities) and final publication stage	• Environment AND Sustainability AND Education AND Design OR Planning: 250 • Environment AND Sustainability AND Educational AND Design OR Planning: 86 • Environment AND Sustainable AND Education AND Design OR Planning: 408 • Environment AND Sustainable AND Educational AND Design OR Planning: 154 • Environmental AND Sustainability AND Education AND Design OR Planning: 334 • Environmental AND Sustainability AND Educational AND Design OR Planning: 108 • Environmental AND Sustainable AND Education AND Design OR Planning: 489 • Environmental AND Sustainable AND Educational AND Design OR Planning: 180 • Environment OR Environmental AND Sustainability OR Sustainable AND Education OR Educational AND Design OR Planning: 973

- Environmental AND Sustainability AND Education: 1245

As shown in Figure 4, the identification stage produced a total of 5639 hits. After the identification stage, we removed duplicates and applied exclusion criteria, removing articles written in languages other than English, or those not focused on higher education. This step reduced the set to 1951 items. Further filters eliminated items not related to the disciplines of planning and design. The selection emphasis was on course content, with few additional papers covering case studies or institutional changes (Alkaher & Avissar, 2018; Cavas et al., 2014; Hugé et al., 2016). At this point, 94 publications survived the cut. Finally, we selected 41 papers for the systematic review that were closely related to planning and design-related education. The focus on searching for empirical or case

Figure 4

The procedure of PRISMA-protocol



study-based research regarding sustainability teaching methods and approaches resulted in the elimination of some nonempirical research and some specific reports with reliability issues. However, the selected samples were sufficient for the analysis in the study.

Results

After analyzing 5639 publications, this study selected a total sample of 41 articles looking at higher education institutions with planning or design programs in 37 countries, with the greatest number of institutions found in the United States (39.0%), followed by Southern Europe (14.6%) and Asia (14.6%). Western Europe, the UK, and Australia each comprised less than 10 percent of the sample analyzed. The selected articles were published in 20 journals covering sustainability (SUS), education (EDU), environment (ENV), ecology (ECO), and design (DES). Table 4 shows that the education category covers most journals (n = 19).

Table 4

Category of reviewed journals.

Category	**Journals**
Sustainability	Sustainability (6) Current Opinion in Environmental Sustainability (1) Michigan Journal of Sustainability (1)
Environment	Journal of Cleaner Production (4) Journal of Future Studies (2) Journal of Green Building (1)
Environmental Sciences	Journal of Integrative Environmental Sciences (1) Journal of Environmental Studies and Sciences (1)
Ecology	Habitat International (1) GAIA-Ecological Perspectives for Science and Society (1)
Higher Education	International Journal of Sustainability in Higher Education (5) Higher Education Pedagogies (2) Journal of Problem-Based Learning in Higher Education (2)
Education/Pedagogies	International Journal of Teaching and Learning in Higher Education (1) Scandinavian Journal of Educational Research (1)
Environmental education	Environmental Education Research (4)

Natural resource education	Journal of Natural Resources and Life Sciences Education (1)
	Solar Energy (1)
Biology education	Journal of Biological Education (2)
Design	The Design Journal (1)

ESD Approaches in Planning and Design Education

To identify ESD approaches when teaching sustainability in design and planning education, we examined the teaching methods used, as well as the benefits and challenges described in the revised articles. Compared to the preliminary research results, the findings after the PRISMA protocol showed 24 ESD learning approaches with specific purposes for design and planning education (see Table 5). In many cases, the pedagogical strategies implemented consist of a combination of approaches. For instance, some cases combine action-oriented with transformative approaches (Maruna et al., 2018), while in other examples, courses combine problem-based and project-based learning approaches to provide students with practical experiences in community service projects (Kricsfalusy et al., 2018; Wiek et al., 2014). The following descriptions offer some examples of eight innovative ESD learning approaches that are not found in the preliminary research stage.

Experimental Studio (Green Design Studio)

The experimental studio includes teaching sustainable green methods of design and construction through design projects and living lab experiments. This learning approach requires students to design given extreme wind conditions and conduct a workshop in a living lab situation to experiment with and test environmental solutions, such as energy efficiency (Dabaieh et al., 2017)].

The Burn Model of Sustainability Pedagogy

The burn model "integrates ecological design, systemic and interdisciplinary learning, multiple perspectives, an active and engaged learning process, and attention to place-based learning" (Burns et al., 2018). It focuses on applying sustainability pedagogy from diverse perspectives with practical suggestions for teaching sustainability. Teaching modes include large or small group discussions, meeting guest speakers, field trips, and journal writing (Burns et al., 2018).

A Three-Fold Framework of Activities on the Environment

This approach aims to "promote multiple learning outcomes to enable students (of any age) to participate in various learning experiences." The three-fold framework focuses on education for the environment and in/from the environment, including basic knowledge, investigation, environmental concerns, values, and attitudes. Specifically, it involves lectures, fieldwork, investigations, data analysis, class presentations, discussions on human impact on the environment, ethical issues and questions, etc. (Mintz & Tal, 2018).

Learning Networks

Learning networks pursue "bottom-up approaches as well as self-organization, while the organizational, educational, and technological components are activated to encourage self-directed learning processes jointly" (Dlouhá et al., 2013).

Table 5

24 ESD approaches in planning and design education courses.

	24 ESD Approaches in Planning and Design Courses	
1	Action-oriented (n = 7)	Action competence and transformative learning, action research, action-oriented transformative pedagogical approach, active learning constructivist approach, active learning (n = 3)
2	Interdisciplinary (n = 6)	Interdisciplinary and crosscultural setting, interdisciplinary approach, interdisciplinary education, interdisciplinary (urban planning education in post-social transitional countries (UPEPSTCs)), interdisciplinary (multidisciplinary) (n = 2)
3	Problem-based learning (n = 6)	Problem- and project-based learning (PPBL), problem-based learning (n = 3), problem solving approach (n = 2)
4	Project-based learning (n = 5)	Project-based learning (PBL) and service learning (SL), project-based learning (PBL) (n = 4)
5	Experiential learning (n = 4)	Experience-based learning, experiential learning (n = 3)
6	Place-based learning (n = 4)	Place-based learning, Place-based education (PBE) and experiential learning, Place-based education (n = 2)
7	Participatory action research (n = 3)	Participatory (sustainable architectural design studios (SADS), participatory action research (n = 2)
8	Service learning (n = 3)	service learning approach (n = 3)
9	Transformative (n = 3)	Transformative learning (n = 3)
10	Crosscultural (n = 2)	Multicultural education, crosscultural collaboration
11	Collaborative (n = 2)	Collaborative learning, Collaborative action research
12	Integrative (n = 2)	Integrative approach (n = 2)
13	Case-based learning	Case method teaching
14	Competency-based	Competency-based approach
15	Experimental studio	Experimental green design studio
16	Future-oriented	Future-oriented learning
17	Holistic approach	Holistic and human rights-oriented approach
18	Learning network	Learning network approach
19	Performance-oriented	Performance-oriented architecture
20	Self-regulated	Self-regulated learning
21	Solution-oriented	Solution-oriented sustainability learning (SOSL)
22	The burn model	Burn model sustainability pedagogy
23	Three-fold framework	A ‘three-fold’ framework of activities on the environment (self-reported outcome)
24	Transdisciplinary	Transdisciplinary approach

It emphasizes open communication and supports “the transition of the educational system that would be difficult to accomplish within traditional organizational frame-works” (Dlouhá et al., 2013). Teaching includes essays, discussion forums, writing research proposals and group presentations, collaboration with regional players, and a virtual seminar (Dlouhá et al., 2013).

Future-Oriented Learning

Future-oriented learning pursues "the experimental-innovative game-based futures curriculum design" and aims to "participate, facilitate, collaborate, and play with students in the classroom world, like less lecture, more play" (K.-H. Chen & Hoffman, 2017). This approach emphasizes a game's strength in spatial planning and understanding sustainability. Players or learners can "interact with artifacts, test ideas, attempt their strategies, and adapt to changing conditions as the game progresses to fulfill their goals" (K.-H. Chen & Hoffman, 2017). The teaching method consists mainly of the contents of the games, such as exploring images of the future, collaborative activities, mapping the future, graphical visualization of direct and indirect results according to future development, making headline news, and having debates (K.-H. Chen & Hoffman, 2017).

Performance-Oriented Learning

The performance-oriented approach emphasizes "an interdisciplinary approach to establishing adequate starting positions for tackling compound sustainability problems through design" (Hensel et al., 2020). It connects design thinking and systems thinking to address a broad scope of actors and stakeholders and also pursues expanding the remit far beyond human-centric design. Teaching content includes interviews with locals and visitors, collaboration with stakeholders and students, field trips, and analysis (Hensel et al., 2020).

Solution-Oriented Learning

The solution-oriented learning approach consists of "competencies-based and experiential learning, which allows students to learn while transforming" (Wiek & Kay, 2015). This approach aims to change passive learning to active, transformative, participatory, and project-based learning. It offers students the opportunity to learn about informed sustainability problems and build the capability to solve them. During the course, instructors offer students an overview of sustainability problems, involving collaborations with experts and stakeholders, field trips, making products, such as plans, policies, reports, and webpages, developing scenarios and visualizations of urban futures, boot camps, small group exercises, and incorporating external facilitators (Wiek & Kay, 2015).

Participatory Action Research (PAR)

PAR approach is a design studio with participatory and social features. It pursues more practical knowledge to complement theoretical knowledge by integrating real sustainability issues into design projects. The course content in PAR involves small group projects and discussions, field trips, presentations, workshops with experts, critical design approaches, concept mapping, and reflective journals (K.-H. Chen, 2019; Grover et al., 2019; Mohamed & Elias-Ozkan, 2019).

ESD Approaches with Methods

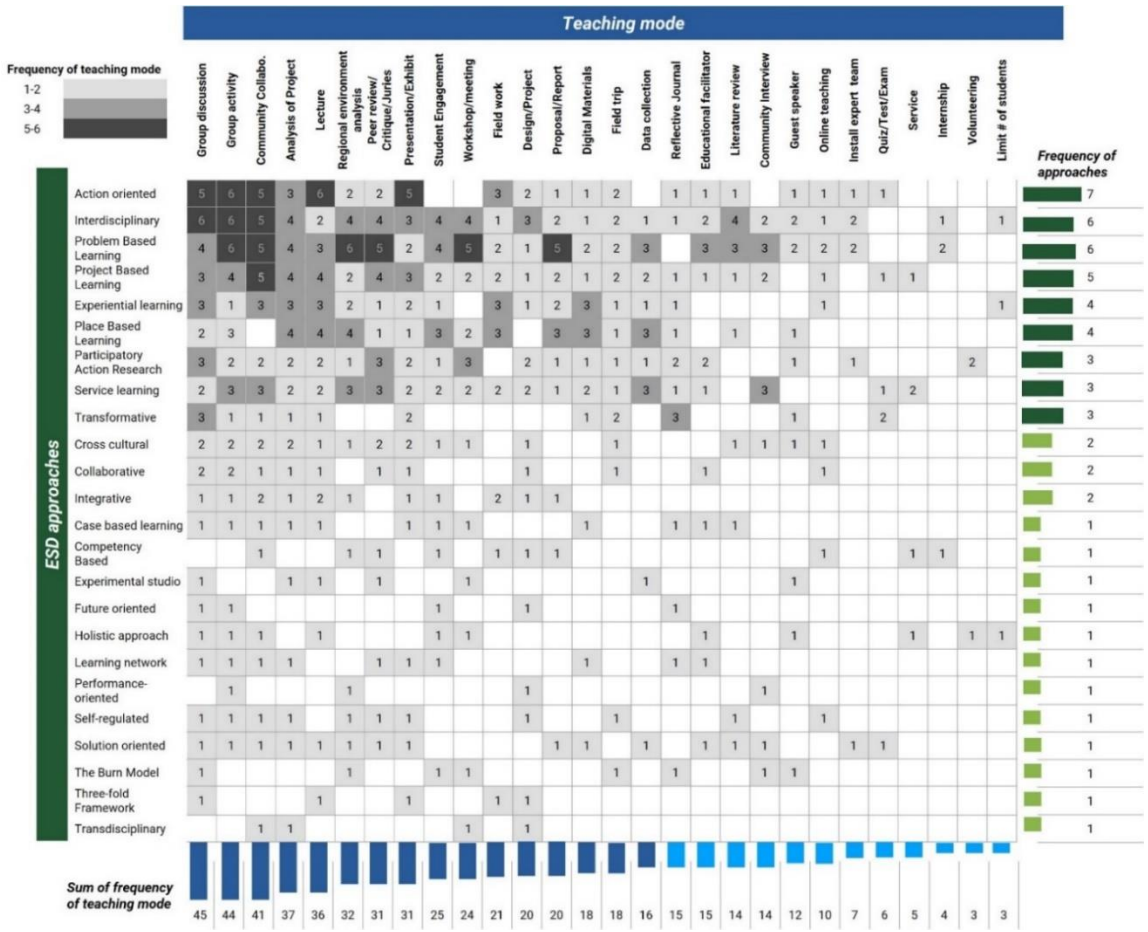
One of the study's objectives is to understand how different teaching methods or modes support different ESD pedagogical approaches. This combination of tactics

(teaching modes) with strategies (approaches) offers a valuable framework to articulate and integrate different ways to teach sustainability in design and planning education.

Figure 5 shows the frequency of use of each teaching mode for each of the 24 approaches identified. The top five pedagogical approaches recognized in design and planning education are teaching through action-oriented approaches (n = 7), interdisciplinary approaches (n = 6), problem-based learning (n = 6), project-based learning (n = 5), and experiential learning (n = 4). Overall, pedagogical approaches seem

Figure 5

The framework of ESD approaches and teaching modes or methods in planning and design courses.



to be more focused in teaching sustainability through practice and learning-by-doing activities (K.-H. Chen, 2019; Grover et al., 2019; Mohamed & Elias-Ozkan, 2019).

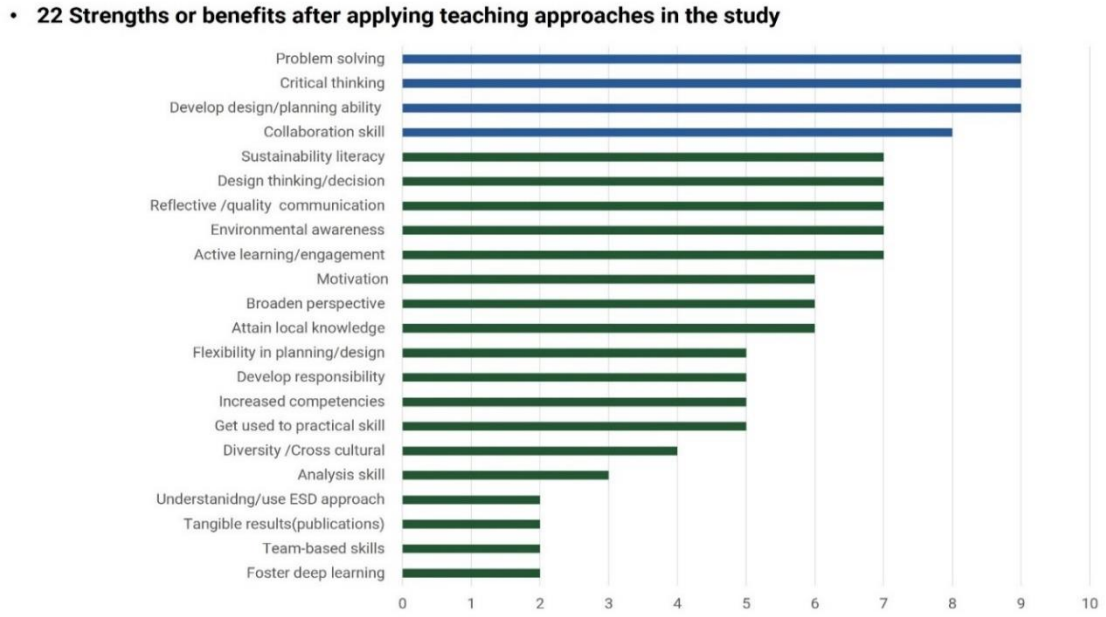
These practice and experiential strategies rely on group projects, collaboration with local communities, NGOs, industries, and other institutions, and sharing through group presentations (Aktas et al., 2015; S.-Y. Chen & Liu, 2020; Dlouhá et al., 2013; Eppinga et al., 2019; Karwat et al., 2013; Leal Filho et al., 2016; Lockrey & Bissett Johnson, 2013; Wiek et al., 2014). Teaching through lectures is still among the dominant teaching modes.

Benefits and Challenges of Teaching Sustainability

As shown in Figure 6, this study identified 22 benefits, strengths, and positive outcomes described by the authors of these articles after their experience in teaching

Figure 6

Benefits of teaching sustainability in planning and design education

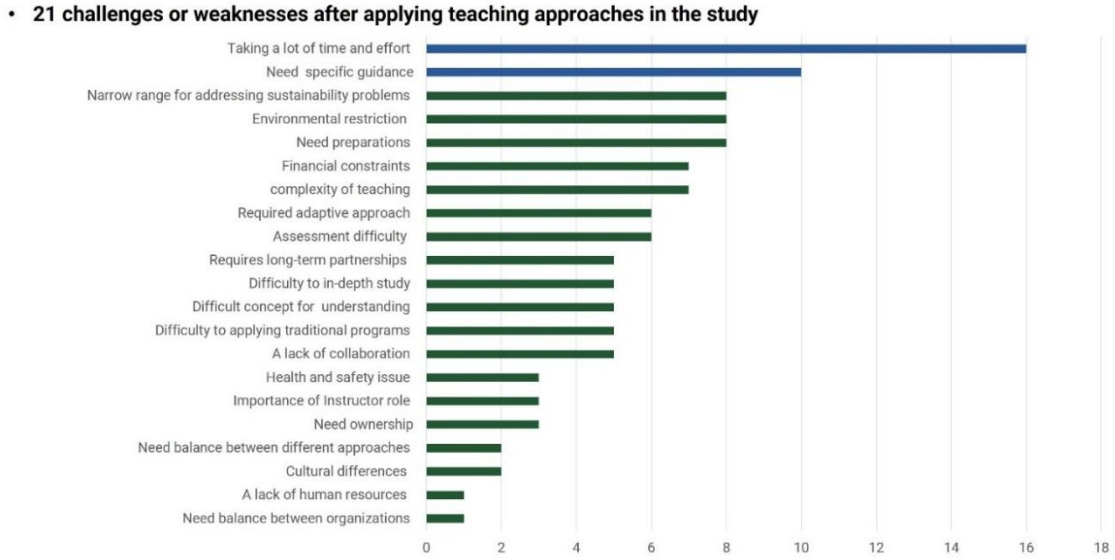


sustainability. These authors documented benefits through surveys, workshops, or direct feedback from students. The most notable benefits are developing problem-solving skills, obtaining critical thinking, development of design and planning abilities, and building collaboration skills (Coppens et al., 2020; Howlett et al., 2016; Kinoshita et al., 2019; Nichols, 2010; Persov et al., 2017), shown the blue color in Figure 6. Additionally, students addressed complex real-life issues during these courses. The study assumes that considering real and complex issues through sustainability courses can help future planners and designers to develop stronger critical thinking skills.

Figure 6 also shows that teaching sustainability also helps students to develop design and planning abilities, such as design thinking (Gosselin et al., 2016; Stibbe, 2009). The implementation of sustainability teaching in planning and design also faces some challenges and restrictions.

Figure 7

Challenges of teaching sustainability in planning and design education



Contrarily, Figure 7 shows the main issues, barriers, and challenges that instructors and students have faced while employing ESD approaches in their courses. The need for significant amount of time and effort to develop learning opportunities to teach sustainability is the most significant problem and need specific guidance stated in the articles reviewed, shown the blue color in Figure 7 Higher demands are placed on instructors in the classroom, such as re-quiring a lot of time and effort, requiring specific guidelines, and using environmental restrictions. Team- or project-oriented difficulties frequently appeared while conducting ESD in design and planning education. Ultimately, the complex and long-term issues that de-fine the core of sustainability views also affect how sustainability can be taught. Efforts to incorporate long-term views, interdisciplinary perspectives, or participatory processes, require longer term studies, time to discuss and assimilate issues, and sometimes a more supportive administrative structure to carry these efforts to successful outcomes.

Discussion

As found in our exploratory review of publications, many studies that expand the understanding of sustainability do not explain the relationship between teaching methods and ESD approaches. Our current study connects teaching methods and pedagogical approaches in the classroom by recognizing two relevant topics for discussion.

First, the literature review confirms that instructors' responsibility for the course is vital to teaching sustainability. This result might suggest that teachers need more training, experience, or knowledge of the complex learning process in teaching sustainability.

Second, as with the preliminary research findings (step 1), step 2 also indicates that the complexity of teaching sustainability calls for utilizing more than one teaching method and ESD approach, and that these approaches should be innovative, evolved, and specific. Therefore, implementing complex ESD approaches should involve several considerations, including well-designed learning environments, resources, and careful support from institutions, and educators' sufficient capability might help to teach sustainability better in planning and design education. An important finding is a clear link between ESD approaches and teaching methods. The current results revealed how sustainable development approaches and teaching methods contribute to students' ability to solve complex planning and de-sign problems.

Our results thus confirm the vital role that ESD approaches can play in improving the learning environment and the required capabilities of future

planners and designers. Furthermore, it might suggest that existing traditional courses teaching sustainability should undergo major revision to achieve positive outcomes through ESD approaches.

Conclusions

The current study aimed to investigate and characterize contemporary ESD approaches in design and planning fields, to understand teaching modes, and to combine these approaches with teaching modes to build a framework. In addition, we identify a variety of issues and experiences in teaching sustainability.

The research findings clearly show that applying ESD approaches benefits design and planning students, even though it requires intentional effort and flexibility on the part of both faculty and students. Instructors play a critical role in successfully integrating ESD approaches into curricular and course content through their responsibility. Consequently, instructors need to understand the complex concepts of sustainability, be open to integrating new educational modalities, and master ESD approaches and teaching methods to offer specific guidance and solutions-based processes.

Next, the study results encourage planning and design programs to be up to date on ESD approaches and related teaching methods. For instance, some existing teaching methods in planning and design education may be too simple for teaching complex sustainability concepts. We suggest that integrating teaching approaches and modes from different disciplines may provide current ideas on addressing complex social issues. Additionally, collaborative efforts from

institutions, faculty, students, and the community may augment interdisciplinary approaches.

Our research on planning and design disciplines contribute to a comprehensive understanding of how the disciplines teach sustainability. However, this broad research scope and area made it challenging to organize the research results regarding ESD approaches and teaching modes. Further studies may establish specific guidance on integrating innovative teaching methods from other disciplines into planning and design.

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CHAPTER 3

IMPLEMENTATION OF SUSTAINABILITY PRINCIPLES IN LANDSCAPE ARCHITECTURE EDUCATION: AN EXAMINATION OF FACULTY ATTITUDES AND COURSE SYLLABI[2]

Abstract

Purpose – This research investigated the integration of Education for Sustainable Development (ESD) into Landscape Architecture (LA) programs in North American universities to understand its benefits and challenges and provide insights into the implementation of sustainability principles, pedagogies, and teaching methods.

Design/methodology/approach – This study analyzed survey data from 128 LA faculty members from 85 CELA member schools. The survey assessed the implementation of sustainability principles, pedagogies, teaching benefits, and challenges to integrating sustainability into their courses. To complement the survey data, 62 LA course syllabi were analyzed using a grounded theory approach to identify the topics covered, learning objectives, and learning activities.

Findings – The study revealed that LA programs incorporate sustainability topics in various courses using project-based and interdisciplinary learning approaches. Integrating ESD into LA curricula promotes sustainability literacy, improved understanding of

[2] Major Author: Hye Yeon Park
Co-Authors: Carlos V. Licon, Jennifer Givens & Ole R. Sleipness
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sustainability concepts, and the development of sustainability skills. The study also found positive correlations between teaching methods, the enhancement of sustainability literacy, and the development of design and planning skills.

Originality/value – This research examined the effects of teaching methods on student learning outcomes and the challenges instructors faced, providing practical insights into the integration of ESD in LA education. It offers recommendations to enhance the ESD knowledge of future LA practitioners, considering the inclusion of ESD as a core value of the standard by the Landscape Architectural Accreditation Board (LAAB).

Keywords: Sustainability education; Landscape Architecture education; Higher education; Curriculum; Instructor survey; Syllabi analysis

Paper type Research paper

Introduction

As the world faces complex ecological, economic, and social challenges, higher education plays a crucial role in preparing students to navigate these challenges (Lozano, 2008). To address these challenges, many higher education institutions have incorporated sustainability concepts into their teaching programs and activities in recent years (Barlett & Chase, 2004; Leal Filho et al., 2015; Papenfuss et al., 2019; Von Hauff & Nguyen, 2014). Notably, Education for Sustainable Development (ESD) emphasizes the interconnection between social, economic, and environmental systems and aims to promote sustainable development through a wide range of topics, strategies, interdisciplinary methods, research, analysis, measurements, skills, and foci (Barlett & Chase, 2004; Corney & Reid, 2007; Von Hauff & Nguyen, 2014). In addition to promoting an understanding of sustainability issues, ESD highlights the need to develop students' critical thinking and problem-solving skills related to achieving sustainable development (Barlett & Chase, 2004; UNESCO, 2019). The inclusion of ESD in planning-related disciplines, including Landscape Architecture (LA), is crucial for addressing environmental protection, economic activity, and social expectations (Beatley & Manning, 1997; Wheeler, 2004).

Since 2006, the Landscape Architecture Accreditation Board (LAAB) has strongly emphasized the inclusion of sustainability in the knowledge, skills, and competencies outlined in learning outcomes. LAAB standards have made ESD an integral component of LA programs' accreditation in North America. The International Federation of Landscape Architects (IFLA) also recognizes the importance of incorporating ESD into LA education to achieve sustainable development (A Landscape

Architectural Guide to the United Nations 17 Sustainable Development Goals, 2022). Consequently, the incorporation of ESD principles into LA curricula has become crucial for the education of future landscape architects.

In recent years, the recognition of ESD's importance in LA has been growing. However, empirical research on the implementation of ESD in LA programs remains limited. While a notable body of literature has joined ESD pedagogical approaches and teaching methods in LA, empirical evidence supporting their integration is still needed. For instance, Park et al. (2022) found that incorporating ESD pedagogical approaches, such as project-based learning and field trips, has encouraged LA instructors to adopt holistic and interdisciplinary teaching methods. These methods involve engaging students in real-world projects, collaborating with professionals from different disciplines, and incorporating sustainable design principles in their coursework. This approach enables students to gain practical experience and develop a deep understanding of sustainability in the context of landscape architecture. In particular, implementing comprehensive ESD approaches requires well-designed learning environments, adequate resources, institutional support, and adequate educators' capabilities, all of which contribute to effective sustainability education in planning and design. Also, insights from other disciplines, such as the positive effects of ESD integration on environmental awareness and sustainable development (Acosta-Castellanos & Queiruga-Dios, 2022), can inform effective integration strategies.

Despite increasing awareness of the importance of integrating sustainability into LA programs, challenges persist (Ashford, 2004; Bacon et al., 2011). These challenges

arise from the complex nature of sustainability, the need for interdisciplinary collaboration, and the evolving demands of the field. One challenge is the complexity of sustainability, requiring educators to balance diverse goals and objectives. Since sustainability extends beyond LA, interdisciplinary collaboration with communities, including industries, associations, public institutions, businesses, and NGOs, to develop specific educational programs is crucial, as evidenced by studies in other disciplines (Hermann & Bossle, 2020). Further, empirical research on pedagogical approaches, sustainability principles, and teaching methods in LA curricula is necessary to address these challenges and foster effective integration. Addressing these challenges entails adapting teaching methods and curricula to reflect evolving environmental concerns and technological advancements. Hence, additional empirical research is needed to effectively integrate sustainability into LA curricula.

To bridge this research gap and contribute to sustainability concepts in LA, this study aimed to investigate ESD implementation in LA programs. We examined sustainability-related courses offered in LA programs and gathered insights regarding teaching experiences by surveying LA instructors in undergraduate and graduate programs in North American universities. The survey asked instructors about their views on ESD, the methods they use to teach sustainability, and the principles that guide their instruction. Concurrently, the analysis of syllabi content examined topics on sustainability or sustainable development covered in LA courses because identifying curriculum, pedagogy, and learning assessments help address issues related to teaching and learning in courses (Dyment & Hill, 2015). This research can help strengthen the

LAAB standard (see Table 6), which require accredited LA programs to incorporate sustainability in the curricula (LAAB, 2021).

Table 6

The core values of the LAAB Standard (Source: Adapted from by (LAAB, 2021, The LAAB Standard Link)

LAAB Standard		Content (examples)
Theory	History, theory, philosophy, principles, and values	Sustainability, resiliency, and stewardship/ health, safety, and welfare /diversity, equity, and inclusion
Design	Design processes and methodology	Critical, creative, and strategic thinking, analysis, ideation, synthesis, site program, iterative design development, interdisciplinary collaboration, design communication
Systems	Systems and processes—natural and cultural	Related to design, planning, and management
Communication	Communication and documentation	Written and oral communication, visual and graphic modeling and communication, conceptual, design, construction documents, numeracy, quantitative problem-solving, communication, and community and client engagement
Implementation	Implementation	Construction technology and site engineering, site materials, use and management of plants and vegetation, integrated water management, policies, and regulation
Assessment	Assessment and evaluation	Site assessment, pre-design analysis, post-occupancy evaluation, visual and scenic assessment, landscape performance (may include ecological, climate, human health, social, and economic factors)
Professional practice	Professional practice	Values, ethics, practice requirements, settings, and scales construction administration
Research	Research and scholarly methods	Quantitative and qualitative methods, establishing are search hypothesis, framing research questions, literature/case study/precedent review research integrity and protection of human subjects, communication of research

Hence, the findings of this research provide insights into the current state of ESD teaching and contribute to developing effective pedagogies. Moreover, this study supports the monitoring and identification of ESD programs as mandated by the UN Decade of Education for Sustainable Development (DESD) report (UNESCO, 2014, 127). By exploring the pedagogical interactions among teachers, students, learning environments, and learning tasks as highlighted by Murphy et al. (2012, 35), this study

sought to improve the effectiveness of ESD programs and LA curricula. The findings of this research enhance our understanding of the challenges and opportunities associated with ESD integration in LA programs and provide practical insights for curriculum development and instructional practices. In our research, we utilized the terms "integrate" and "incorporate" to describe this process, consistent with the definition of "integration" as the act of adding or incorporating parts into a cohesive whole (Integrate Definition & Meaning, 2023).

Research Questions

We posed three questions to understand approaches, principles, and teaching methods implemented in teaching of sustainability, in graduate and undergraduate Landscape Architecture programs in North American universities.

- RQ1: What specific pedagogical approaches do instructors employ to teach sustainability within LA programs, and how does the inclusion curriculum align with the core values and standards of the LAAB?
- RQ2. What are the benefits and challenges of educational opportunities and teaching methods used in teaching sustainability within LA, and is there a correlation between them?
- RQ3. What are the common sustainability topics covered in LA programs' syllabi, and what similarities exist between them?

Methodology

Research Design

We used a mixed-methods approach, comprised of a survey and syllabi analysis, to understand the current state of ESD and teaching sustainability in graduate and undergraduate LA programs in North American universities. To complement survey data, a grounded theory approach was used to analyze the syllabi and thus clarify instructors' views on teaching sustainability in LA courses. Using a grounded theory approach, researchers could evaluate data flexibly and systematically to articulate an emerging theoretical framework (Charmaz, 2006; Corbin & Strauss, 2008; Creswell & Poth, 2016). The survey employed in this study consisted of 18 carefully selected questions sourced from previously published instructor surveys (Boake, 1995; Crane, 2008). These questions were then modified and adapted to encompass the core values of the LAAB standards (LAAB, 2021). Additionally, the survey instrument was tailored to incorporate the various teaching modes identified through a comprehensive literature review conducted before this study (Park et al., 2022b). To assess the current status of ESD and sustainability concepts in LA programs, the survey incorporated 26 sustainability curricula themes. These themes, as Wyness and Sterling (2015) proposed, provided a comprehensive framework for assessing the extent to which sustainability principles were integrated into LA programs.

To ensure a systematic approach, this survey followed the established five-stage procedure developed by Czaja and Blair (1995). This recognized methodology has

proven effective in gathering and analyzing survey data in numerous studies. The five stages were as follows:

1) Survey design and preliminary planning, including making sampling decisions and designing the questionnaire, determining the time available for analyzing data, and reporting survey results;
2) Pretesting, including developing the draft questionnaire and determining the survey method;
3) Accomplishing the final design and planning of the survey;
4) Distributing the survey questions, collecting the data until the designated date, monitoring and reducing the collected data; and
5) Coding selected data, analyzing the data, and writing the final report.

The survey questionnaire used in this study consisted of four main sections. The first section collected demographic and background information about the instructors. The second section recorded their understanding of sustainability concepts as they related to current LA courses. The third section explored the application of sustainability education in LA courses, including themes, pedagogical approaches, and teaching methods. The fourth section examined the benefits and challenges of teaching sustainability in LA. The questionnaire comprised open-ended and close-ended questions, including multiple-choice and rating scales. It was administered online after a pilot study was conducted with a smaller sample of instructors. The collected survey responses were analyzed using descriptive and correlational analysis. In addition to the survey questionnaire, we

analyzed course syllabi to gain insights into the sustainability themes covered in LA courses.

Syllabi serve as crucial sources of course information, summarizing the instructor's teaching philosophy and intended learning outcomes (Brock & Steiner, 2009; Parkes & Harris, 2002; Robinson, 2009; Stanny et al., 2015). We used a coding methodology to examine LA's course themes and curriculum theory to identify how educational processes reflected goals, content, and pedagogy (McCutcheon, 1982; Wahlström & Sundberg, 2015) in their syllabi. The coding procedure followed the processes in grounded theory: open coding, focused coding, and theoretical coding, which classified and categorized concepts and clustered codes into themes until new themes emerged (Charmaz, 2006). We used the qualitative data analysis software NVivo 12.

Survey Analysis

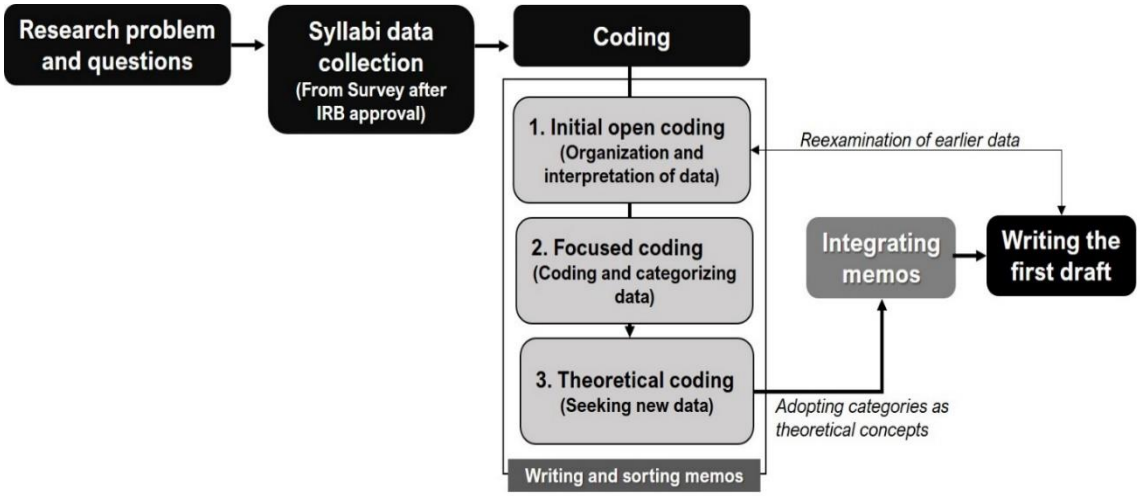
We surveyed 128 educators in the position of instructor, adjunct professor, assistant professor, associate professor, and professor from 85 CELA (Council of Educators in Landscape Architecture) member institutions. The survey data was collected and organized using Microsoft Teams and Excel. We analyzed the data utilizing Jamovi (2.2.5), an open-source and R-based software application that enabled us to perform descriptive statistics and correlational analysis.

Syllabi Analysis

The study collected qualitative data from 62 syllabi developed for teaching undergraduate and graduate students. Before coding the data, the research considered

Figure 8

Steps of applied Constructivist Grounded Theory (Adapted from Constructing Grounded Theory (Charmaz, 2006, p.11)



three key components of syllabi to gather information. Inductive and deductive coding frameworks based on Charmaz's (2006) procedure and theory development (Figure 8) were utilized to code the data. Since the core ideas and teaching practices form the focal points of teaching sustainability (Michel, 2022), the syllabi analysis focused primarily on identifying sustainability themes in course topics, learning outcomes, and teaching activities. This analysis aimed to complement the survey results to better understand how sustainability is being incorporated into LA curricula.

The coding process followed 1) open coding, 2) axial coding based on open coding to cluster codes, and 3) theoretical coding to analyze clustered codes. While initial codes and theoretical coding were made inductively, we predefined codes and assigned them to the qualitative data, which was applied to the focused coding stage based on LAAB standards. First, we conducted an open coding of course descriptions in 62 syllabi using NVivo software.

The purpose of this coding was to identify the recurring themes, instructors' language, and perspectives reflected in the syllabi. To achieve this, we tried to interpret the data and make the codes "simple and precise." We wanted to find "general terms everybody knows that have significant meaning and reflect their perspectives" (Charmaz, 2006, p.47-66)

One researcher conducted the initial coding, and the codes were reviewed by experts from both the Department of Sociology and the Department of Landscape Architecture and Environmental Planning. This collaborative approach brings together diverse perspectives and expertise, enhancing the quality and validity of the coding process and analysis. We used focused coding to analyze the most frequently occurring or significant codes and to identify relationships between codes from open coding. This stage aimed to categorize the codes and identify their relationship based on course topics, expected learning outcomes, and teaching activities. Lastly, we conducted a theoretical analysis to identify overarching themes and theories in the data, such as sustainability curriculum themes, sustainability network or relationship (see Figure 9), the core values of LAAB standards (LAAB, 2021), and the learning activities in Bloom's Taxonomy (Anderson & Krathwohl, 2001). This stage involved categorizing the focused codes into subcategories and analyzing them to identify recurring themes and theories. The current study examined the content of the syllabi, including descriptions, objectives, and requirements, and classified them into three main categories: topics, expected learning outcomes, and teaching activities (see Table 7).

Figure 9

Green Infrastructure Sustainability network, showing a balance of benefits between society, environment, and economy (Adapted from WFRC, 2012)

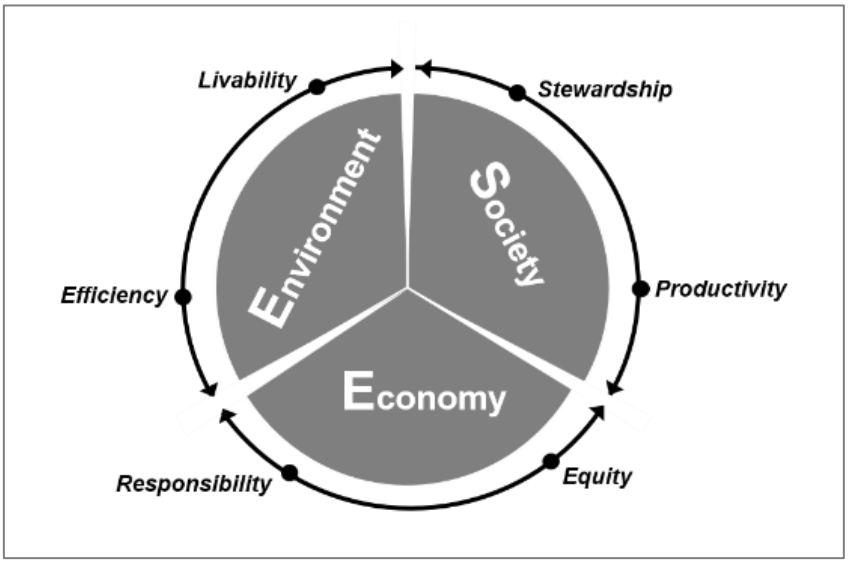


Table 7

Typical Example of Course Syllabus Content Analysis

Elements in Syllabus	Provided information about
Title	**Course Topic**: Sustainability curricula themes (Wyness and Sterling, 2015) & Sustainability network
Course Overview (Description)	
Course Goals and Objectives	**Expected Learning Outcomes**: Core values of the LAAB Standards (LAAB, 2021)
Course Format and Methods	**Teaching Activities**: Learning activities in Bloom's Taxonomy (Anderson and Krathwohl, 2001).
Course Requirements	
Evaluation and Grading	
Semester Schedule	
Learning Resources	
Course Policies (Ethics)	

Results

The survey results revealed that most respondents, 91 out of a total of 128, have incorporated sustainability themes into their curricula. However, 37 respondents either did not or rarely touched on the topic in their courses.

Survey Result (Quantitative data)

The results of the study showed that most LA programs in the US and Canada include ESD principles and teaching methods in their curriculum. Demographic data indicated that 65.6% of the instructors were Landscape Architects (n=84), either (n = 76, 59.4%) or in a tenure track position (n = 34, 26.6%) (See Table 8).

Table 8

Descriptive statistics of demographic characteristics

Demographic characteristics	Sample (n=128)	
	N	%
Q1. Gender		
Male	84	65.6%
Female	39	30.5%
Prefer not to say	5	3.9%
Q2. Region of the country		
Northeast - CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT	38	29.7%
Midwest - IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI	27	21.1%
Southeast - AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV	23	18.0%
West - AK, CA, CO, HI, ID, MT, NV, OR, UT, WA, WY	23	18.0%
Southwest - AZ, NM, OK, TX	14	10.9%
Other countries (Canada, Colombia)	3	2.3%
Q3. Disciplines of educators (overlapped answer)		
Landscape Architecture	84	44.9%
Architecture	22	11.8%
Design	11	5.9%
City and Regional Planning	11	5.9%
Urban Planning	6	3.2%
Biology	6	3.2%

Forestry	6	3.2%
Others (Art, Computer science, Natural resource, etc..)	41	21.9%
Q4. Positions of educators		
Associate Professor	41	32.03%
Professor	35	27.34%
Assistant Professor	34	26.56%
Adjunct	10	7.81%
Instructor	2	1.56%
Other (Dean, Executive Professor, Graduate Assistant, etc.)	6	4.69%

The survey findings revealed that the current LA courses embrace sustainability or sustainable development concepts in studio and lecture classes. Specifically, the graduate-level courses demonstrated a high incorporation rate (n=78, 76). Similarly, the senior-level (n=72, 66) and the junior-level (n=67, 64) courses frequently adopted sustainability topics (see Table 9). In our analysis, we observed that lecture and studio classes were the most commonly utilized methods for teaching sustainability, with 97 instructors (24.01%) and 96 instructors (23.76%) indicating their use. Field trips, guest lectures, or departmental events were also frequently employed, each mentioned by 70 lecturers (17.33%). Moreover, instructors employed various other teaching methods to incorporate sustainability into their courses, such as community service projects, student organizations, study abroad programs, and hands-on installation and maintenance activities, among others (see Table 10). These findings underscore the wide range of instructional approaches instructors employ to integrate sustainability into their teaching practices.

Table 9

Sustainability Incorporation by Course Levels (Overlapped response)

Q7. Which of your studio classes include sustainability within all courses taught in the LA department/program?	N	%	Q8. Which of your lecture classes include sustainability within all courses taught in the LA department/program?	N	%
Freshman	30	9.74%	Freshman	41	12.85%
Graduate	78	25.32%	Graduate	76	23.82%
Junior	67	21.75%	Junior	64	20.06%
None	6	1.95%	None	10	3.13%
Senior	72	23.38%	Senior	66	20.69%
Sophomore	55	17.86%	Sophomore	62	19.44%
Total	308	100.00%	Total	319	100.00 %

Table 10

Ways of Incorporating sustainability, or sustainable development into the course (Overlapped response)

Q9. How is sustainability and/or sustainable development integrated into the course? (Please select all that apply)	N	%
As a stand-alone sustainability course	34	8.42%
Field trip	70	17.33%
In lecture class(es)	97	24.01%
In studio class(es)	96	23.76%
Internship	24	5.94%
Occasional events (e.g., guest lectures, departmental events)	70	17.33%
Other (Community Service Projects, Student Organizations, Site engineering including sustainable practices. Study abroad, Hands-on installation and maintenance, etc.)	13	3.22%
Total	404	100.00%

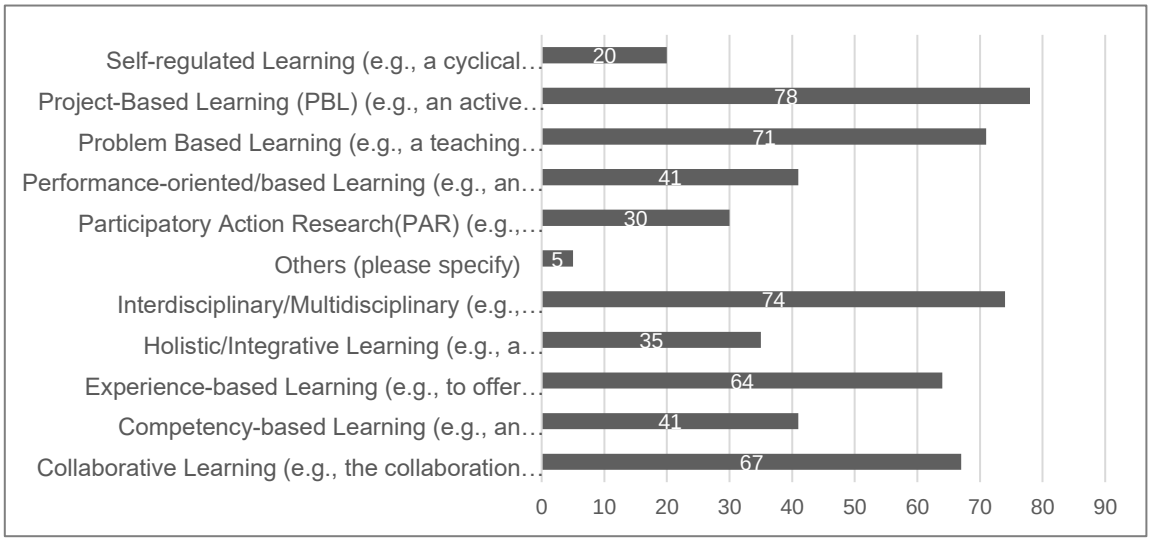
The prevalence of lecture and studio classes suggests their foundational role as pedagogical tools, while including experiential learning opportunities through field trips and guest lectures or departmental events enhances students' learning experiences.

RQ1. *What pedagogical approaches do instructors use to teach sustainability, and what is the inclusion curriculum in LA programs according to LAAB standards?*

The survey results showed that the respondents adopted a diverse range of ESD approaches. The most frequently reported approaches were project-based learning (n=78), an interdisciplinary approach (n=74), and problem-based learning (n=71). In addition, a small number of respondents (n=5) mentioned other approaches, such as integrating environmental philosophy and promoting a growth mindset, indicating a diverse set of strategies (see Figure 10).

Figure 10

ESD pedagogical approaches in LA courses

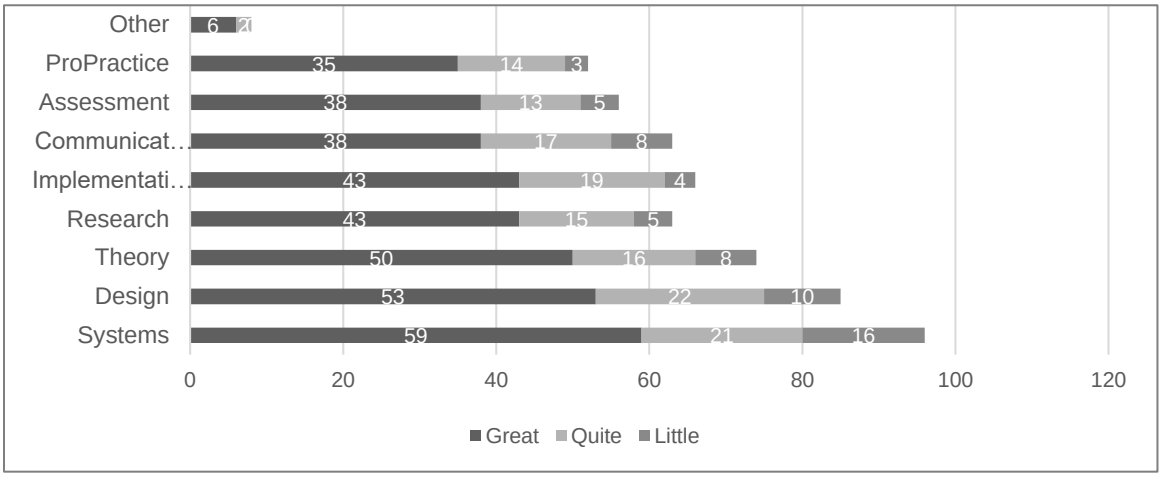


These results provide insight into integrating sustainability concepts into the LA curriculum and highlight the various ESD pedagogical approaches, such as project-based learning, interdisciplinary, and collaborative learning. Furthermore, the results reveal a range of pedagogical methods that instructors employ to effectively incorporate sustainability into their teaching practices. These teaching practices include lecture and studio classes, field trips, guest lectures or departmental events, community service projects, student organizations, study abroad programs, and hands-on installation and maintenance activities. Each of these methods contributes to creating a comprehensive

and engaging learning experience for students, fostering their understanding and application of sustainable principles in the field of LA.

Figure 11

The Extent of sustainability (Q6) Included (Q10) in Teaching Following the Core Values of LAAB Standards



This study utilized the LAAB standards as a benchmark for assessing the inclusion of different teaching themes in the survey. The findings showed that current curricular in LA programs align with the core values of the LAAB standards (see Figure 11). Specifically, the “Theory” standard, which encompasses sustainability, resiliency, stewardship, health, safety, welfare, diversity, equity, and inclusion, is related to sustainability (n=84). However, most respondents preferred incorporating the “System” standard, which covers natural and cultural facets related to design, planning, and management into their curricula(n=96). Furthermore, the survey results indicated that most of the respondents incorporated environmental aspects of sustainability into their courses. These courses covered a broad range of sustainability curricula themes, including environmental, economic, and social. Notably, the respondents tended to

emphasize environmental themes, such as Climate change (n=100, 6.02%) and Ecological systems (n=99, 5.96%) (see Table 11).

Table 11

Aspects of sustainability covered in coursework

Q13. What sustainability curricula themes (Wyness & Sterling, 2015) do you feel are important to include when teaching sustainability?		N	%
ECON (N=530)	Accountability and ethics	58	3.49%
	Alternative futures	69	4.15%
	Consumerism and trade	28	1.69%
	Corporate social responsibility	43	2.59%
	Globalization	47	2.83%
	International development	32	1.93%
	Leadership and change	45	2.71%
	Learning organizations	26	1.57%
	Population	50	3.01%
	Social Enterprise	27	1.63%
	The sustainable and ethical economy	71	4.27%
	Tourism	34	2.05%
ENV (N=524)	Biodiversity	86	5.18%
	Climate change	100	6.02%
	Ecological systems	99	5.96%
	Food and farming	72	4.33%
	Natural resources management	82	4.94%
	Waste/Water/Energy	85	5.12%
SOC (N=601)	Citizenship, governance, democracy	50	3.01%
	Cultural diversity	79	4.76%
	Health and well-being	87	5.24%
	Human Rights and Needs	60	3.61%
	Intercultural understanding	59	3.55%
	Peace, security, and conflict	40	2.41%
	Sustainability in the built environment	86	5.18%
	Sustainable communities	85	5.12%
	Travel, transport, and mobility	55	3.31%
Other	Climate gentrification, all of them, building capacity to implement prescribed fire through improving economic and social drivers, etc.	6	0.36%

RQ2. *What are the benefits and challenges of educational opportunities and teaching methods used in teaching sustainability within LA, and is there a correlation between them?*

The respondents in this study employed a wide range of teaching methods and activities to teach sustainability. Most respondents preferred to use discussion (n=85), design and planning proposals (n= 84), and traditional lectures (n=79) as their instructional approaches in LA courses.

Table 12

Teaching Methods in LA Courses

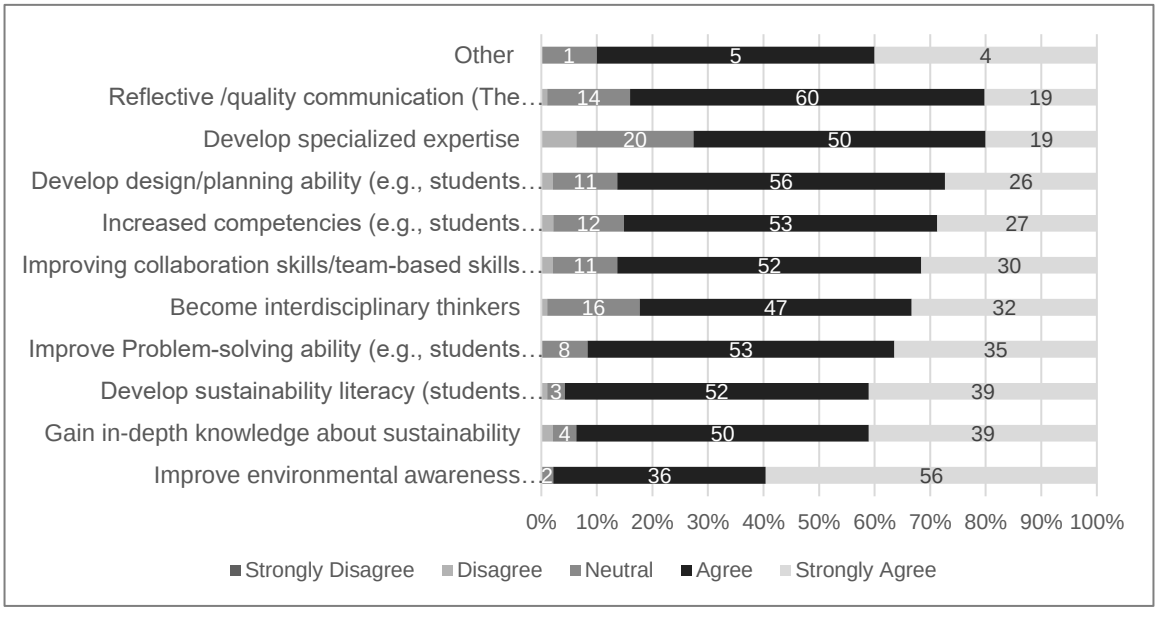
	Q15. What teaching modes or methods do you use to teach sustainability or/and sustainable development in your course(s)?	N	%
1	Discussions	85	7.05%
2	Design/plan	84	6.97%
3	Traditional lectures	79	6.55%
4	Reflection paper/essay	73	6.05%
5	Presentation/Exhibition	71	5.89%
6	Guest speakers/guest lecturers	68	5.64%
7	Research assignments/projects	65	5.39%
8	Group activities with students (Group discussion, working projects, design charrette, etc.)	63	5.22%
9	Field trips (This is a journey lasting a day or more, to a location away from their usual place to work or study and to get direct experience)	62	5.14%
10	Active learning, student-driven course (e.g., games/role-play lecture/engaging the students)	58	4.81%
11	Online teaching	56	4.64%
12	Proposal/report	54	4.48%
13	Teaching a small number of students	54	4.48%
14	Hands-on community projects	51	4.23%
15	Exams/quiz/test	43	3.57%
16	Collaboration with community/Industry	42	3.48%
17	Fieldwork (Fieldwork is the gathering of information about something in a real, natural environment)	42	3.48%
18	Literature review	38	3.15%
19	Peer evaluation (critique/feedback) of projects	38	3.15%
20	A project in real-life (e.g., Students engage in investigations of recycling and saving energy)	35	2.90%
21	Local workshops and meetings	23	1.91%
22	Participate in sustainability conferences	14	1.16%
23	Other (Website, Installation and maintenance of projects, Empathy maps, infographics, case reviews, Herbarium collections, Models that predict the likely future performance of a set of alternative proposals, Development of mapping/3D representation innovations, etc.)	8	0.66%

However, they also incorporated innovative teaching methods, such as developing websites, empathy maps, infographics, and case reviews. A smaller number of respondents designed real-life projects (n=35) and local workshops and meetings (n=23) or participated in sustainability conferences (n=14) as a part of their teaching methods (Table 12).

To gain insights into educators' teaching experiences with these methods, respondents were asked to provide information about the beneficial outcomes and challenges they encountered. The survey results indicated that the teaching methods participants employed positively affected their students. Most respondents reported that these methods contributed to improved environmental awareness (n=92), the development of sustainability literacy (n=91), and a deeper understanding of sustainability (n=89) (see Figure 12).

Figure 12

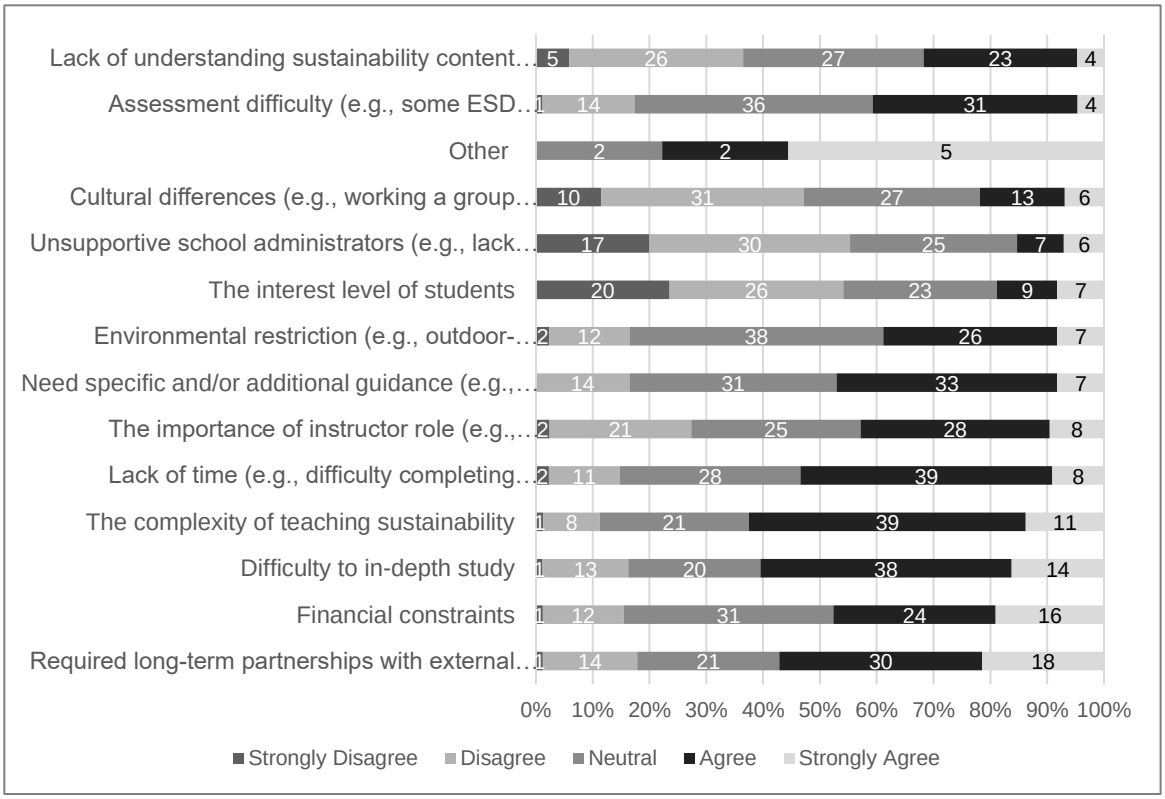
Benefits while teaching sustainability



However, educators also faced challenges in their efforts to teach sustainability effectively. The challenges included difficulties in conducting in-depth studies on sustainability topics (n=52), navigating the complexity of teaching sustainability concepts (n=50), and establishing long-term partnerships with external organizations (n=48). Time constraints (n=47), limited financial support (n=40), and multiple roles and responsibilities (n=76) further worsened these challenges (see Figure 13). These challenges reflect the complex nature of integrating sustainability concepts into the curriculum and the obstacles instructors face in delivering effective sustainability education. Difficulties in conducting in-depth studies highlight limitations in accessing comprehensive and up-to-date sustainability resources within existing curricula.

Figure 13

Challenges while teaching sustainability



Navigating the complexity of teaching sustainability concepts underscores the need for effective pedagogical strategies. Challenges in establishing long-term partnerships with external organizations emphasize the importance of collaboration in enhancing sustainability education.

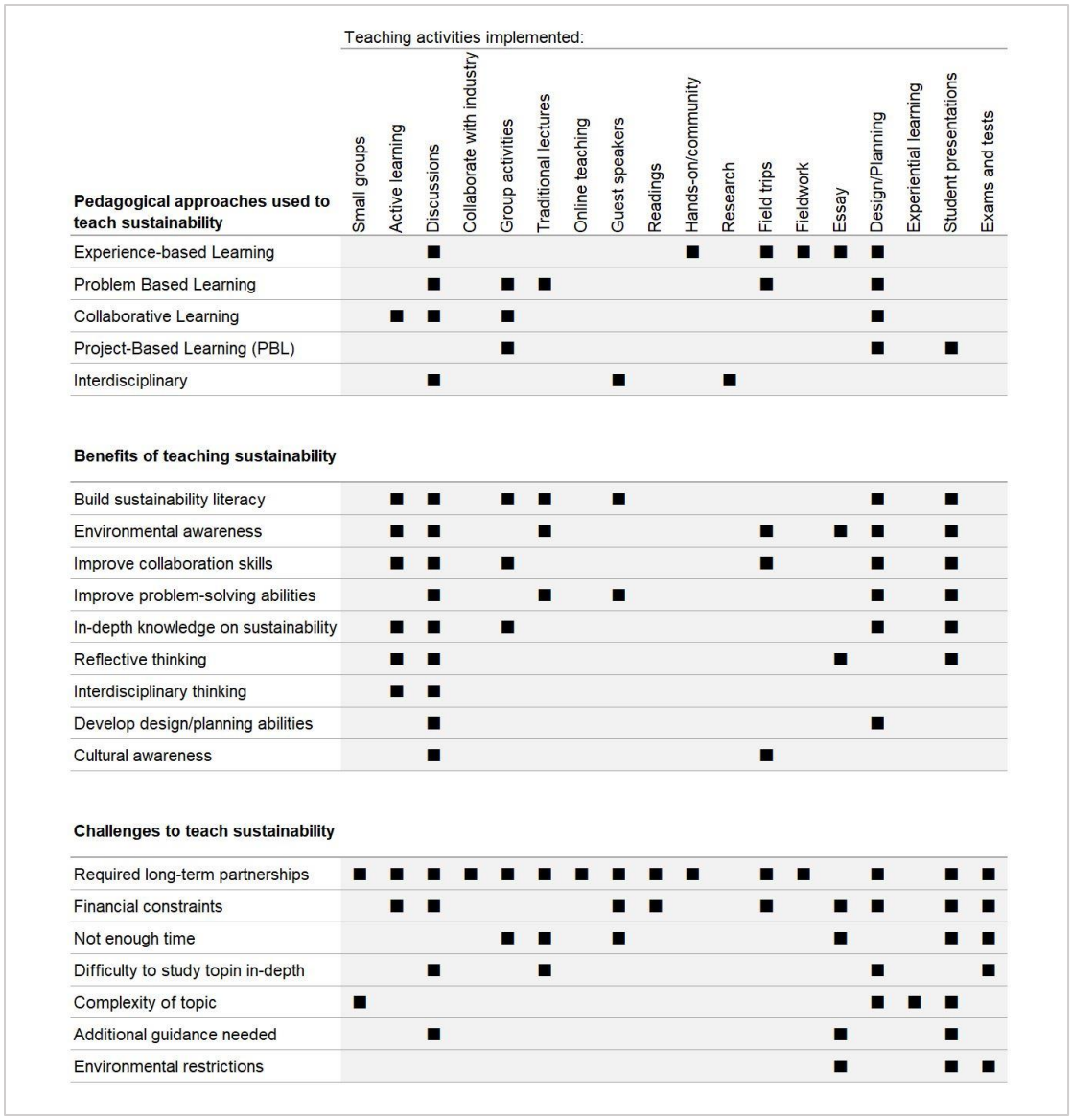
In particular, overcoming time constraints and limited financial support requires innovative approaches and resource allocation. The significant mention of multiple roles and responsibilities emphasizes the demanding nature of teaching sustainability in LA education, necessitating adequate support and recognition. These findings shed light on practical difficulties faced by instructors and provide insights into areas that require attention and support for the successful integration of ESD into the curriculum. Furthermore, the correlational analysis provided valuable insights into the relationships between teaching methods, beneficial learning outcomes, challenges, and ESD pedagogical strategies (see Figure 14).

Notably, engaging in discussions, making design or planning proposals, and participating in group activities showed a high correlation with ESD strategies. Making design or planning proposals had the strongest correlation with project-based learning ($r = .72$, $p < .001$). Significant positive associations also emerged between making design or planning proposals, and the enhancement of design and planning skills ($r = .68$, $p < .001$), as well as sustainability awareness ($r = .67$, $p < .001$). Conducting presentations showed a strong correlation with the development of sustainability literacy ($r = .56$, $p < .001$), although it was less frequently used as a teaching method.

Conversely, the correlation between teaching methods and challenges generally demonstrated weak positive associations. For instance, discussions and design and

Figure 14

Correlations between teaching activities and the pedagogical approaches (p<0.001 significance)



	Teaching activities implemented:																	
Pedagogical approaches used to teach sustainability	Small groups	Active learning	Discussions	Collaborate with industry	Group activities	Traditional lectures	Online teaching	Guest speakers	Readings	Hands-on/community	Research	Field trips	Fieldwork	Essay	Design/Planning	Experiential learning	Student presentations	Exams and tests
Experience-based Learning			■							■		■	■	■	■			
Problem Based Learning			■		■	■						■			■			
Collaborative Learning		■	■		■										■			
Project-Based Learning (PBL)					■										■		■	
Interdisciplinary			■					■			■							
Benefits of teaching sustainability																		
Build sustainability literacy		■	■		■	■		■							■		■	
Environmental awareness		■	■			■						■		■	■		■	
Improve collaboration skills		■	■		■							■			■		■	
Improve problem-solving abilities			■			■		■							■		■	
In-depth knowledge on sustainability		■	■		■										■		■	
Reflective thinking		■	■											■			■	
Interdisciplinary thinking		■	■															
Develop design/planning abilities			■												■			
Cultural awareness			■									■						
Challenges to teach sustainability																		
Required long-term partnerships	■	■	■	■	■	■	■	■	■	■		■	■		■		■	■
Financial constraints		■	■					■	■			■		■	■		■	■
Not enough time					■	■		■						■			■	■
Difficulty to study topin in-depth			■			■									■			■
Complexity of topic	■														■	■	■	
Additional guidance needed			■											■			■	
Environmental restrictions														■			■	■

planning proposals exhibited strong associations with pedagogical strategies such as collaboration skills, experience-based learning, and problem-based learning. Moreover, course types, including studio-type, lecture-type, and occasional events were partially associated with the LAAB standards. Studio-type courses demonstrated positive associations with the system (r= .66, p< .001) and design processes (r= .65, p< .001) of

the LAAB standard. The environmental aspect of sustainability emerged as the most preferred and displayed strong positive associations with the design process and system in the LAAB standards. These correlational findings provide valuable insights into the relationships between teaching methods, beneficial learning outcomes, challenges, ESD pedagogical strategies, and course types.

Syllabus Result (Qualitative data)

To complement survey data, this study analyzed 62 syllabi obtained from 25 universities across North America (see Figure 15). The syllabi were collected to identify the major teaching strategies employed. Findings demonstrated a strong connection between instructor goals and course descriptions about sustainability. We found that most syllabi emphasize offering design topics and claim to support activities that develop skills for designers or planners. Specifically, we examined and coded course descriptions

Figure 15

The distribution of collected syllabi from universities in CELA Member Institutions

inductively and subsequently categorized emergent codes deductively using a sustainability curricula theme (Wyness & Sterling, 2015), an interconnected network of sustainability showing benefits to society, economy, and environment described in Figure 9 (WFRC, 2012), LAAB standards (LAAB, 2021), and the learning activities in Bloom's Taxonomy (Anderson & Krathwohl, 2001).

RQ3. *What are the common sustainability topics covered in LA programs' syllabi, and what similarities exist between them?*

We utilized the existing standards and theories to identify the most common categories from the course descriptions like course topic [CT], expected learning outcomes [ELO], and teaching activities [TA]. Of 418 initial codes, TA was the most frequently mentioned category (n=189, 45.22%) that instructors used to deliver knowledge to students and solve issues and various interactions in design and planning. For example, "discussing several complex topics related to conservation and management of soil, reading several historical and contemporary research articles that address the growing trends and concerns in the field of ecological design, telling the story, etc." To gain a clear understanding of the TA codes, we applied the learning activity themes of Bloom's Taxonomy (Anderson & Krathwohl, 2001), which include remember, understand, apply, analyze, evaluate, and create. These themes helped us categorize and interpret the TA codes effectively. Most course descriptions in syllabi demonstrated instructors' teaching values and perspectives like, "health, wealth and stability are key goals for lower-income communities" and "urban issues will be viewed through several lenses and frameworks, including the ecosystem model, green infrastructure, mapping,

and various performance benchmarks and guidelines." Tables 13 and 14 illustrate the code list and the coding process to identify themes in course descriptions.

Following TA, CT accounted for 40% of the total themes. Specifically, the CT subthemes encompassed sustainability concepts and their interrelated relationships. The identified subthemes within the CT category included environmental issues, social issues, economic issues, as well as combinations such as environmental and social issues, environmental and economic issues, and social and economic issues in sustainability.

Table 13

Theme and Code List

Themes	Subthemes
Course Topic (n=171, 40.9%)	Environmental, Social, Economic, Environmental and Social, Environmental and Economic, Social and Economic
Teaching Activities (n=189, 45.2%)	Remember, Understand, Apply, Analyze, Evaluate, Create
Expected Learning Outcomes (n=58, 13.9%)	Theory, Design, Systems, Communication, Implementation, Assessment, Pro Practice, Research

Table 14

Example of the Coding Process

Raw Data from one syllabus	Initial coding	Focused coding	Theoretical coding
Emphasis will be placed on the application of appropriate technologies and strategies to foster environmentally and economically sustainable community forms, as well as greater environmental and social equity.	To foster environmentally and economically sustainable community forms, as well as greater environmental and social equity.	Environmentally and economically sustainable community	Environmental and Social [CT]
Short vignette exercises, quizzes, lectures and discussions, and preparation of construction documents are used to assess your understanding of the course matter. Each student is also required to compile a comprehensive notebook of all lecture handouts, worksheet templates, supplemental technical resources, and personal notes for future reference.	Short vignette exercises, quizzes, lectures and discussions, and preparation of construction documents are used to assess your understanding.	Short vignette exercises, quizzes, lectures, and discussions	Understand [T.A]

The course is designated as a C (communication) course, and, as such, another part of the purpose is to develop communication skills in writing, verbal presentations, and other methods.	To develop communication skills in writing, verbal presentations and other methods.	Communication skills in writing, presentations	Communicatio n [ELO]

Figure 16

Sustainability themes in course topics

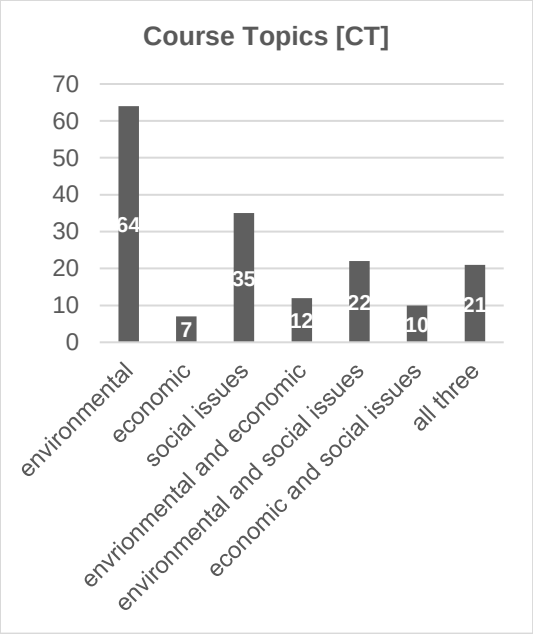


Figure 17

Expected Learning Outcomes

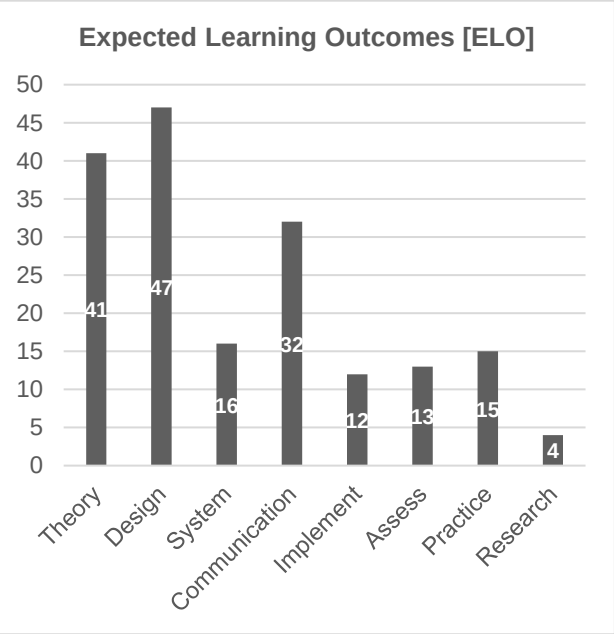
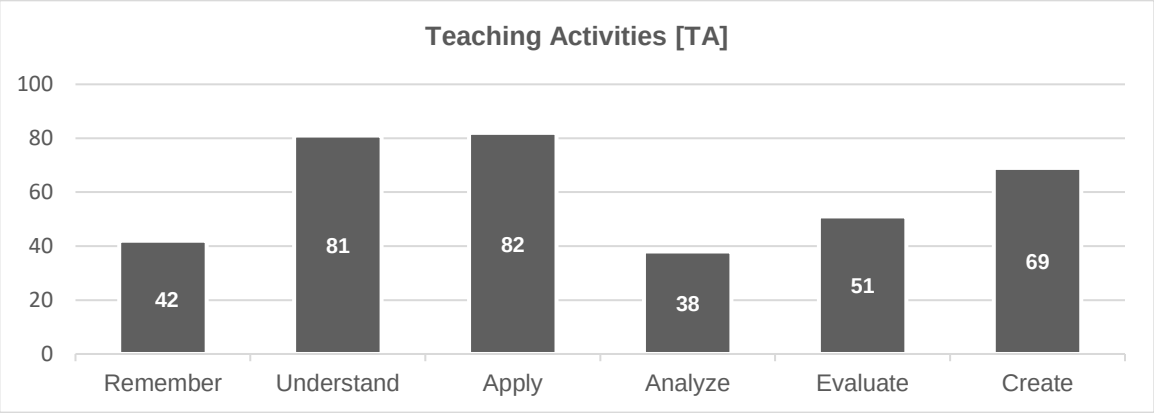


Figure 16 illustrates the frequency of subthemes identified in the analysis. The most commonly recurring subtheme is environmental (n=64), indicating a strong emphasis on environmental sustainability in the syllabi. In contrast, economic themes (n=7) were rarely mentioned. The analysis also revealed that some sustainability concepts were associated with two themes, such as environmental and social issues (n=22), or all three themes (n=21), demonstrating the interconnected nature of sustainability. The findings demonstrate that instructors integrate sustainability into their courses by incorporating examples of current environmental, social, and economic issues.

CT also emphasized integrating problem-solving and design communications knowledge into the design and planning process. For instance, course descriptions noted, “Landscape design integrates knowledge of land patterns, plant ecosystems, and human processes,” “Design will be developed through a series of ecosystem design planting sections,” “Explore how this concept might be applied to topics such as land use planning, transportation planning,” etc. The findings show learning outcomes with instructors’ teaching directions. The expected learning outcomes (ELO) theme provides insights into the learning goals set by instructors. Figure 17 shows the alignment of ELO with the core values of the LAAB standards. The most frequently selected core values in the survey are Design (n=47) and Theory (n=41), which directly relate to sustainability and design communications. Interestingly, the System (n=16) was frequently chosen in the survey but less preferred in actual course descriptions. Most ELO emphasize design topics and aim to develop skills relevant to designers and planners. Specific learning goals include understanding the natural landscape, successful placemaking, and analyzing remote sensing data for habitat corridors and urban growth. For instance, they present specific learning goals, such as “To provide the necessary scientific background on the

Figure 18

Teaching Activities



patterns, processes, and performance of the natural landscape to inform design options ranging from plant choice to patch size to corridor configuration," "To provide an awareness and understanding of the built environment and the elements in successful placemaking," "To learn how to analyze remote sensing data and model habitat corridors, urban growth, and land change."

The identified main themes included remember, understand, apply, analyze, evaluate, and create, which came from Bloom's Taxonomy (Anderson & Krathwohl, 2001). Figure 18 showcases the distribution of TA codes based on learning activities in the Bloom's Taxonomy. The most frequently recurring themes in TA are Apply (n=82) and Understand (n=81) out of 189 identified codes. LA courses predominantly focus on applying knowledge to solve problems through activities such as design charrettes, site visits, and case studies. For instance, they included, "Design charrette to focus on how design fundamentally influences the overall impact of landscape architecture," "Visit sites within the New York -New Jersey metropolitan area," and "Conducting case studies of cities around the world and are encouraged to become a "virtual" traveler in this course." At the same time, they chose to understand knowledge by translating and interpreting it in presentations, group discussions, and quizzes. These findings provide a comprehensive understanding of the integration of sustainability concepts, teaching activities, and learning outcomes in the LA curriculum, shedding light on the pedagogical approaches employed by instructors.

Discussion

This study investigated prevalent teaching themes, instructors' perspectives, and the relationship between teaching sustainability and LA education through an analysis of faculty surveys and course syllabi. The findings revealed that most LA programs in the US have integrated sustainability education into their curricula, signifying the recognition of sustainability as a core component of LA education. However, to strengthen this integration, it is essential to be more explicit and deliberate about the central role of sustainability education in LA discipline.

Conventional teaching methods, including discussions, design/planning proposals, lectures, and reflection papers, are widely utilized in LA programs. These methods are incorporated into studio work, lectures, field trips, and guest lectures. However, despite their common usage, there is still an opportunity to explore innovative pedagogical approaches that can further enhance sustainability education in LA. The implementation of sustainability in LA education requires interdisciplinary, participatory, and collaborative approaches to address current development challenges. The study found that many LA programs employ student-centered ESD approaches, including project-based learning, problem-based learning, collaborative learning, and interdisciplinary approaches. These approaches align with the critical elements of interdisciplinary collaboration and addressing real issues, demonstrating that current LA education is moving in the right direction.

However, the study also revealed that LA programs use individual work or outreach-focused approaches, such as self-regulated learning and participatory research, to a lesser extent in integrating sustainability education. On the other hand, innovative

teaching methods such as real-life projects, website creation, empathy maps, infographics and case reviews have been successfully integrated into the curriculum. To enhance sustainability education, it is important to pay more attention to individual work and outreach-focused approaches while exploring their effective incorporation. Additionally, innovative teaching methods provide engaging and interactive learning experiences that promote a deeper understanding of sustainability concepts and enhance design and problem-solving skills.

The incorporation of sustainability into LA programs has positively affected students' environmental awareness, sustainability literacy, understanding of sustainability concepts, and design skills. For instance, sustainability awareness improved through design and planning proposals, while presentations contributed to the development of sustainability literacy. To fully embrace our commitment to sustainability, it is crucial to reduce challenges. To overcome challenges, and advance sustainability education, allocating greater financial support and resources for ESD in LA programs is crucial. Limited resources and practical experiences pose obstacles for instructors seeking to effectively integrate sustainability into their teaching. Additionally, instructors face difficulties due to time constraints, resource limitations, and disagreements about the definition of sustainability. These challenges can be addressed by allocating funds for necessary resources, programs, and professional development opportunities.

The study also highlighted the need for explicitness to fully embrace sustainability across LAAB standards, sustainability themes, and ESD pedagogical approaches. The result revealed that while structure, teaching methods, and curriculum content in LA education are appropriate, the lack of explicit embracing of sustainability remains a

challenge. Professional organizations, like LAAB, should play a more explicit role in emphasizing sustainability in their standards across practice, theory, and curriculum content. This explicitness will contribute to the discipline's commitment to sustainability and provide clearer guidance for instructors.

Conclusion

In conclusion, this mixed-method study provided valuable insights into incorporating sustainability principles and pedagogies in LA courses. The goal was to gain a deeper understanding of the benefits and challenges of integrating ESD into the LA curriculum.

The analysis of the survey and syllabi revealed prevalent teaching themes, instructors' perspectives, and the associations between teaching sustainability and LA courses. It demonstrated the extent to which LAAB standards, sustainability themes, and ESD pedagogical approaches are incorporated into LA programs. Moreover, the study highlighted the teaching methods, beneficial outcomes, challenges instructors faced when teaching sustainability, and the relationships between these factors. Additionally, the study uncovered emergent themes from the course descriptions, reflecting the sustainability aspects of the courses and, the instructors’ teaching values, and activities.

Overall, this study sheds light on the integration of sustainability education in LA programs, the use of teaching methods and approaches, and the associated challenges. It emphasizes the importance of explicitness, financial support, and resources in needed to fully embrace sustainability in LA education. By employing effective teaching strategies, addressing challenges, and emphasizing sustainability value, LA programs can

effectively foster sustainability literacy, critical thinking, and practical application of sustainable principles among students. The findings of this study can inform the development of practical ESD curricula, offering ideas, options, and perspectives to those interested in integrating sustainability into higher education design and planning programs.

Note: This empirical study collected data through an online survey that contained questions about instructors' opinions on teaching sustainability in an LA program. First, the researchers acquired the necessary approval from the Utah State University Institutional Review Board (IRB) for data collection. Next, we contacted faculty members at various institutions and send consent letters at the same time with an online survey link. The survey was distributed confidentially and anonymously over ten consecutive weeks from March 30th to May 31st, 2022.

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CHAPTER 4

THEMATIC ANALYSIS OF STUDENTS' SUBMISSIONS: SUSTAINABILITY EDUCATION IN LA COURSES[3]

Abstract

Design and planning are integral for sustainable development goals, including but not limited to: environmental protection, economic opportunities, and social justice (Khan et al., 2013; Wheeler, 2004). The application of key educational tools for achieving sustainable development and integrating theory with practices has produced a new paradigm in education called Education for Sustainable Development (ESD). This study focuses on the undergraduate course Foundations of Sustainable Systems, where students created postcards with images and text expressing their understanding and position on sustainability in a distilled and compact format.

This study identifies what themes of sustainability students believe are essential and considers how the results have changed in different years. The analysis uses a sequential explanatory mixed-method approach to identify themes and changes in student views. The research findings show that the open-ended teaching strategy can instill motivation and a positive attitude towards understanding sustainability in students.

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[3] Major Author: Hye Yeon Park
Co-Authors: Carlos V. Licon & David Feldon
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Understanding and identifying students' thinking is critical in moving forward with a comprehensive vision to achieve a successful sustainability focus. In addition, identifying students' learning will allow design and planning programs to improve their curricula and help educators advance the awareness to fully and explicitly integrate sustainability into their education offerings.

Keywords: Education for sustainable development (ESD), Landscape architecture education, Thematic content analysis

Introduction

Education is a vital strategy for achieving sustainable development (Bokova, 2015; Seelos & Mair, 2004; Vucetich & Nelson, 2010; Yli-Panula et al., 2020) due to the role in providing the knowledge necessary for society to adopt more sustainable practices. The United Nations Decade of Education for Sustainable Development stresses incorporating the theory and practices of sustainable development into education (Buckler & Creech, 2014). The integrating theory and practices movement caused the advance of a new paradigm in the education field, the Education for Sustainable Development (ESD) (Barlett & Chase, 2004; Blewitt, 2014; Kishita et al., 2018). ESD includes the characteristics of sustainability which consist of three dimensions: economic, social, and environmental (Lozano, 2008), allowing students to understand the importance of global, social, and human changes (Komiyama & Takeuchi, 2006).

Due to societal, economic, and environmental considerations, ESD became recognized as necessary for all levels of the educational system, including higher education (Bedawy, 2014). ESD aims to nurture future generations, encourage them to make informed decisions, and resolve complex

Problems (Chen & Liu, 2020), while also motivating them to gain knowledge, values, and theories related to sustainable development (UNESCO, 2019). These goals indicate a connection between ESD and the design and planning field. For instance, given the long-term environmental and social impacts of planners' and designers' decisions (Bolan, 1969; Sandercock, 1997; Wheeler, 2004), design and planning education is integral for sustainable development goals, including, but not limited to: environmental protection, economic opportunities, and social justice (Khan et al., 2013; Wheeler, 2004).

Among design and planning disciplines, landscape architecture (LA) has experienced a crisis of theory and practice during its development. These trials and errors have influenced future landscape architects who "need to continuously ask and respond to the complexities of the natural and built environments" (Ozdil, 2021).

These aspects strongly call for the advance of ESD in the LA field to provide insights and directions to LA education and practice. This study aimed to identify the students' thoughts regarding sustainability to improve LA courses with the hope of influencing their philosophies and attitudes towards sustainability (Leeming et al., 1997; Mangas et al., 1997). Understanding students' thinking is critical to moving forward with a comprehensive vision and successful curriculum with ESD since there are many positive outcomes (Cotterell et al., 2019; Ferreira & Tilbury, 2012; Howlett et al., 2016; Rogers, 2001). Therefore, the study tried to analyze students' reflections about sustainability using an assignment in an LA course (Cotterell et al., 2019).

Conceptual Framework

Epistemology is an area of philosophy related to the nature and justification of human knowledge (Hofer & Pintrich, 1997). Epistemological beliefs allow researchers to play an essential role in the concept of teaching and learning (Schauss & Sprenger, 2019). As the current research explores students' thinking and beliefs about sustainability and how these ideas frequently appear, this approach can be a suitable theoretical approach for postcard content analysis research.

Above all, this conceptual framework can gather subjective evidence based on individual studies and allow researchers to understand what they know from firsthand

information (Creswell & Poth, 2016). For example, students taking a sustainability class might interpret sustainability based on their experiences, knowledge, or cultural backgrounds.

The Analysis of Visual Content

In this study, postcards from students show the construction and representation of essential images on sustainability. Visual content analysis is indispensable for the postcards, including images and text. For instance, Garrod (2009) assessed photos and postcards by focusing on comparing visual materials and identification of image composition. Many qualitative researchers have been interested in analyzing the visual content using photographs (S. E. Bell, 2002; Garrod, 2008; Hao et al., 2016; Kerkhoven et al., 2016; Rose, 2016; Sleipness, 2014). Interpreting the photos can be a research method (Hao et al., 2016). Travel brochures or guidebooks are also used as a visual content study in the travel and planning field (Bhattacharyya, 1997; Edelheim, 2007; Hunter, 2008; Jenkins, 2003). Most travel brochure studies focused on images rather than the writing of materials for analyzing brochures, but some researchers integrated images and text as a whole content (Ramachandran, 2005; Sleipness, 2014). Visual content variables consist of dimensions, such as size, color, or positions, and should be representative for analysis(Bell, 2011).

Thus, the visual analyzing process needs to make clear definitions and criteria. Another approach to visual content is to analyze the frequency of particular elements, such as the arrangement of images and embedded messages. This approach focused on identifying the frequency of elements, the arrangement of images and text, as well as the

color used to identify the relationship between variables (Jenkins, 2003). Since visual or image analysis describes the appearance of specific themes, and often exceeds the text content or words spoken (Berger et al., 1972; Sleipness, 2014), researchers need a more profound insight when dealing with the images' latent content.

Research Objectives

This research seeks to understand and interpret important ideas embedded in students' postcards. Due to the similarities between the postcards and travel brochures, both having descriptions and photographic images, this research followed literature analyzing travel brochures. This study interpreted texts and images of 90 postcards. The analysis procedure was to interpret images first, and then interpret texts or descriptions to identify overall students' thinking.

The goals of the study are to identify students' ideas about sustainability through their postcards and to explore the principal student beliefs and attitudes regarding sustainability in 2016 and 2020 through their postcards, then to categorize and compare the themes of these postcards, and to find the congruity and differences. This study addresses the following research questions:

- RQ1. What ideas are reflected in the students' postcards?
- RQ2. What are the dominant attributes of students' perceptions regarding sustainability, as presented through 2016 and 2020 postcards?
- RQ3. Is there congruity between 2016 and 2020 postcards concerning the frequencies of attributes?

Methods

This research used a sequential explanatory mixed-method design (Creswell et al., 2003) to examine what undergraduate students captured as a vital idea in sustainability by analyzing the students' postcard submissions for their midterm assignments in the LA course. Using thematic qualitative analysis (Stemler, 2000), the study explores students' ideas and attitudes on significant aspects of sustainability. The current study also deductively generated constructs from literature and refined these based on the image and texts of the postcards. Lastly, the study quantified the frequencies of identified prominent themes and constructs to examine how their priorities change and differ between the 2016 and 2020 data sets.

Overview of Process

The explanatory designs in most research papers show that researchers collect qualitative data, analyze the qualitative data, and then build on the qualitative data for the quantitative analysis (Harrison, 2013). The current research process involves a two-phase explanatory design (Greene et al., 1989). The results of the first method (qualitative) influences the second method (quantitative). In other words, the study collected the data simultaneously but analyzed it sequentially.

Initially, the current study conducted a literature review regarding sustainability education and the thematic analysis research method approach. Secondly, this study selected 90 postcards. The Data samples consist of assignment submissions from a project in the Foundations of Sustainable System course in the LAEP department (LAEP 2039), instructed by Professor Carlos Licon. The LAEP 2039 course aims to help

students understand a comprehensive sustainability vision while also explaining concepts of system approaches regarding issues and dimension of sustainability (Licon & Anderson, 2019). Thirdly, this study analyzed and coded 90 samples using the NVivo program, a software for performing coding analysis for qualitative research, and a thematic analysis approach for identifying and determining individuals' understanding of subjects (Stemler, 2000). During the coding process, this study used a six-phase process for thematic analysis (Braun & Clarke, 2006; Vaismoradi et al., 2013) to classify codes into themes and patterns and interpret the meaning of the product. Lastly, this research used a Chi-Square analysis to examine the relative frequencies with which the qualitatively derived categories occurred.

Research Samples

The sample consists of 90 postcards (50 postcards from 2016 and 40 postcards from 2020 Fall semester submissions) completed as a midterm assignment for credit within an LA course. To conduct the card-making mission, the instructor asked students what

Figure 19

The example of the Instruction of postcards from Utah State University (2019). Photo by the author.

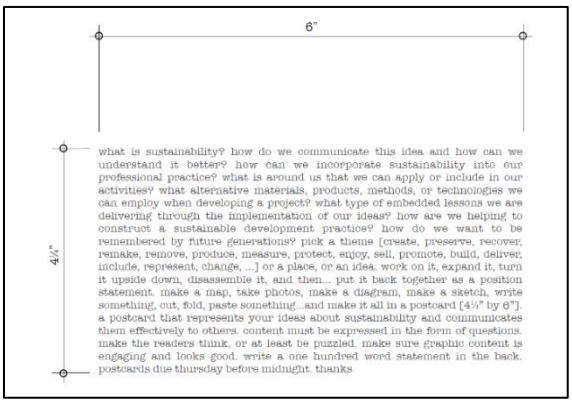
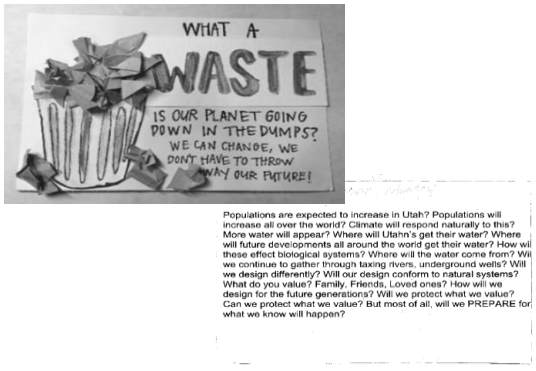


Figure 20

The submission example of the post card making from Utah State University (2019). Photo by the author.



sustainability is, how we communicate this idea, what embedded lessons we are delivering via implementing our concept and how we can better understand it, etc. (Figure 19).

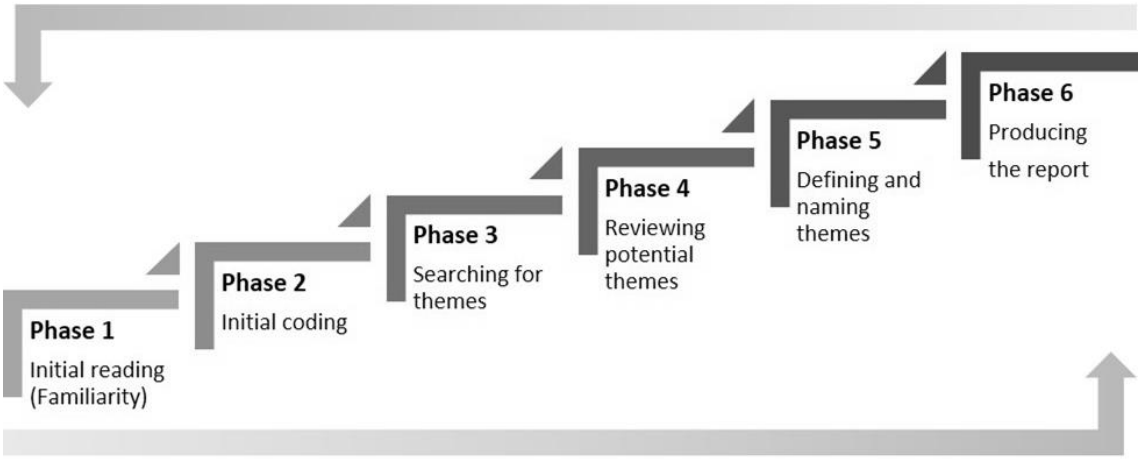
This task aimed to understand students' attitudes and beliefs about sustainability, make the students think about or pursue activities using ideas from the lesson, construct a sustainable development practice, and send a message for future generations. After studying a broad range of ideas on sustainability, students can select a place, design, or theme, such as create, preserve, recover, remake, remove, produce, measure, protect, enjoy, promote, build, deliver, represent, or change, among others. The answers should represent students' ideas about sustainability and communicate these ideas effectively to others. Also, the ideas should be included in a four-and-a-quarter inch by six-inch postcard (4¼" by 6"). The submitted postcards consist of various shapes, materials, and contents (Figure 20). For instance, some formed a diagram, sketch, or map, while others also used paper money, leaves, or grains of corn for popcorn. In this paper, I argue that identifying and interpreting the cards' contents is necessary because these might reveal students' unconscious or conscious thoughts regarding sustainability.

Qualitative approach: Thematic analysis

Researchers required students to express their thinking by making graphic content with one-hundred-word statements representing their ideas about sustainability. This qualitative approach followed deductive and inductive approaches from thematic content analysis (Braun & Clarke, 2006; Maschi et al., 2019; Vaismoradi et al., 2013; Walters, 2016).

Figure 21

The six-phases of thematic analysis. Revised Diagram from Braun & Clarke (2006) and Walters (2016). Diagram by the authors.



First, to analyze the latent meanings of images and text contents in postcards, we used thematic analysis to identify patterns or themes within qualitative data (Braun & Clarke, 2006). Its low reliance on a specific theoretical lens enables researchers to identify and analyze patterns and meanings using flexible approaches in their research (Braun & Clarke, 2006; Nowell et al., 2017). The current study used NVivo to code participant's language (Miles & Huberman, 1994) and adopted a combination of inductive and deductive thematic analysis. A six-phase approach to thematic analysis (see Figure 21) is an effective way to gain more profound insights into data, make the coding process quicker and easier, and develop themes confidently (Braun & Clarke, 2006, 2012). Thus, we followed six phases by coding postcards' image and text context to conduct a deductive thematic analysis. This analysis has 'top and bottom' and 'back and forth' features (Walters, 2016).

Specifically, in phases one and two (Initialization), we reviewed visual and textual data of postcard submissions to familiarize ourselves with the data, considered the

meanings within the data, and tried to find potential codes for developing themes. After reading and scrutinizing the data set to understand essential ideas and highlighted meanings, we developed an initial coding scheme. In phases three to four (Construction and Rectification), we read students' descriptions several times and reduced the codes to categorize initial subthemes by describing students' ideas.

This study identified 32 subthemes based on the meaning units as an inductive approach in this stage. Initial subthemes were organized by clustering similar codes. Then, we adopted seven existing sustainability themes and abstracted students' ideas and subthemes to define and name themes in phases five and six (Finalization). As a result, the main themes are named environmental, economic, social, socio-economic, socio-environmental, environmental-economic, and integrative. Finalized themes are related to research questions (Braun & Clarke, 2012) and sustainable development indicators (Spangenberg & Bonniot, 1998; Turcu, 2013; ul Haq & Boz, 2020). This study changed descriptions and classified codes into themes and patterns and tried to represent students' ideas in the products during the coding process. Notably, the coding process was conducted thoroughly and comprehensively by a member checking that someone on the team double-checked the coding process to validate this work

Quantitative approach: Frequency and Chi-square test of independence

This study evaluated the joint frequency of themes and years using the Chi-square test of independence by comparing observed frequencies and expected frequencies (McHugh, 2013). In this case, we applied the Chi-square test to whether the joint frequencies of the respective themes occur with likelihoods greater than chance. The current study also

conducted Z-tests of proportion to determine whether the 2016 group and 2020 group were different from each other. Specifically, this research asked about the predominant attitudes of students' depictions regarding sustainability. We hypothesized that the probability of themes or depictions about sustainability presented that students' priority is changing.

Results

Qualitative Results

The research followed inductive and deductive coding and used 32 sustainability indexes from related studies as an initial coding guideline (Spangenberg & Bonniot, 1998; Turcu, 2013; ul Haq & Boz, 2020). As a result, researchers analyzed 290 coding for the 2016 year (N=51) and 244 coding for the 2020 year (N=39). The thematic analysis found that for students in 2016, sustainability was more likely to emphasize human interaction with nature while students in 2020 highlighted environmental resources and an existential mindset that reflects values and what makes life worth living (Prinds et al., 2014). Students' concentrated ideas regarding sustainability found the following:

> [Sustainability] is 'human interaction with the environment; a preservation; a balancing act; how we humans interact with the environment and how we live our day to day lives; conscious and conservative use of resources; replenishing the resources an important part of living on this earth, etc.' [2016]
>
> [Sustainability] is 'a mindset that requires action at every turn; hope to restore and preserve than overshoot the resources; creating a balance between the input and output in our lives and nature; the act of using natural resources without the worry; the ability to remake and renew; avoidance of the depletion of natural resources to maintain an ecological balance, etc.' [2020]

Additionally, most of the students' postcards described the important aspects of sustainability, focusing on environmental and integrative themes more than other themes,

such as social, economic, and socio-economic. The following are identified students' descriptions and reflections regarding sustainability. The descriptions show that many students tended to be aware of the urgency of waste issues in the ocean and land. Students also highlighted a comprehensive approach with philosophical thinking for achieving sustainability. While considering the complexity of sustainability, students emphasized various themes in sustainability; however, the majority focused on environmental and integrative themes.

> *[Environmental (Resources natural)] 'a lot of plastic, trash, waste, and recycling; we should widespread composting, and only use durable, recyclable materials; a lot of plastic in the ocean shows how unsustainable our current methods of packaging and disposal; as a nation, we need to be more aware of our resource usage and how much we waste daily; living in America we often don't realize that there is a limit on the amount of resources in the world, etc.'*
>
> *[Integrative (Mix)] 'are there a variety of solutions that incorporate all these aspects in varying ways; sustainability can be defined that society, economy, and the environment are all equally satisfied; a closed-loop system looks to strengthen sustainable concepts by removing the waste from a system; do you feel confident that the planet is on a course that leaves it in an acceptable condition for future generations once you are gone; if you want to anything to change in this world; you need to represent sustainability means, etc.'*

Quantitative Results

Frequency of Themes

Qualitatively identified themes were coded as categorical variables and subject to a frequency analysis using NVivo and Excel. Students' sustainability themes in 2016 and 2020 showed that the environmental theme was used most frequently in 2016 (22.76%) and 2020 (36.07%). Also, the mix/all topics in integrative themes followed the second highest frequency in both 2016 (21.03%) and 2020 (22.95%) (see Table 15).

Table 15

The themes generated by students' descriptions and theme frequencies

Themes and Subthemes	Years	
	2016yr	2020yr
Environmental		
Resources (natural)	66 (22.76%)	88 (36.07%)
Housing & Built environment (Man-made)	8 (2.76%)	2 (0.82%)
Service & facilities (infrastructure)	4 (1.38%)	3 (1.23%)
Eco-efficiency	0	3 (1.23%)
Global impact	10 (3.45%)	8 (3.28%)
Economic		
Business activity	22 (7.59%)	9 (3.69%)
Labor productivity	1 (0.34%)	0
Land	0	3 (1.23%)
Technical and economic efficiency	9 (3.10%)	3 (1.23%)
Solvability	9 (3.10%)	1 (0.41%)
Consumption	15 (5.17%)	13 (5.33%)
Social		
Sense of community	2 (0.69%)	0
Crime and safety	0	1 (0.41%)
Equity	0	3 (1.23%)
Education	4 (1.38%)	6 (2.46%)
Social involvement	20 (6.90%)	11 (4.51%)
Policy	0	1 (0.41%)
Conscious	12 (4.14%)	13 (5.33%)
Socio-environmental		
Conservation policies	0	1 (0.41%)
Environmental justice	3 (1.03%)	0

Global stewardship	16 (5.52%)	8 (3.28%)
Risk-Intensity	4 (1.38%)	2 (0.82%)
Threat to Health	2 (0.69%)	1 (0.41%)
Transport Intensity	1 (0.34%)	0
Socio-economic		
Business ethics	2 (0.69%)	0
Consume sustainably	1 (0.34%)	0
Fair trade	1 (0.34%)	0
Green technology	1 (0.34%)	0
Income level and distribution	0	1 (0.41%)
Enviro-economic		
Energy efficiency	5 (1.72%)	0
Green technology	1 (0.34%)	0
Resource intensity of production	7 (2.41%)	6 (2,46%)
Returns and investments	2 (0.69%)	1 (0.41%)
Services	1 (0.34%)	0
Integrative		
Mix	61 (21.03%)	56 (22.95%)
Total	290	244

Comparison of students' attitudes in different year

This study indicates a difference in two different years and student thinking on sustainability and their ideas (See Table 16 and Figure 22). We expected most students to show a positive attitude because sustainability consists of positive meaning. However, most students showed neutrality and reflective attitude in 2016 (43.45%) and 2020 (36.48%). The postcard study emphasized the predominance of an environmental theme among the seven main themes. This research found that students' concentrated ideas about sustainability were environmental themes, which focused on natural resources, and integrative themes. The next part of the study sought to investigate statistical changes in students' ideologies between 2016 and 2020.

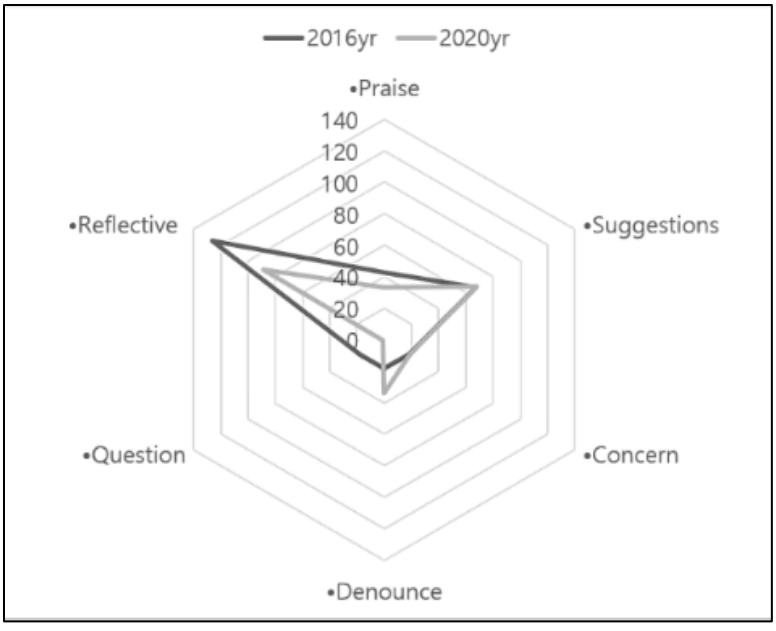
Table 16

Comparison of Students' attitudes

Attitude	Years	
	2016yr	2020yr
Positive		
Praise	43 (14.83%)	33 (13.52%)
Suggestions	67 (23.10%)	68 (27.87%)
Negative		
Concern	18 (6.21%)	19 (7.79%)
Denounce	18 (6.21%)	34 (13.93%)
Neutrality		
Question	18 (6.21%)	1 (0.41%)
Reflective	126 (43.45%)	89 (36.48%)
Total	290 (100%)	244 (100%)

Figure 22

The trend of students' attitude. Diagram by the authors (2021).
Diagram by the authors.



Chi-square test and Z-tests of proportion

The current study conducted a Chi-square test of independence and Z-tests of proportion to compare the frequencies of the themes of postcards statistically and to determine the congruity between the 2016 and 2020 years. As a result, statistical differences were found for four out of seven categories.

As shown in Table 17, the Environmental theme displays the highest percentage in 2016 and 2020. The Environmental (2016 16.47%, 2020 19.47%) and Integrative (2016 11.42%, 2020 10.48%) themes had statistically significantly difference compared to other themes (Environmental z= 7.111, Integrative z = 4.333, $p < 0.001$). They also showed statistically different interests between students' descriptions in 2016 and 2020.

Table 17

Chi-square test and Z-tests of proportion results

Themes	2016yr (*N* = 290)	Prop. [a] (%)	2020yr (*N* = 244)	Prop. [a] (%)	Total (*N*,%)	Z-score	*p*-value[b]
Environmental	88	16.47	104	19.47	192 (36.0%)	7.111	1.151e-12*
Economic	56	10.48	29	5.43	85 (15.9%)	3.148	0.002**
Social	38	7.11	35	6.55	73 (13.7%)	2.704	0.007**
Socio-environmental	26	4.86	12	2.24	38 (7.1%)	1.407	0.159
Socio-economic	5	0.93	1	0.18	6 (1.1%)	0.222	0.824
Enviro-economic	16	2.99	7	1.31	23 (4.3%)	0.851	0.394
Integrative	61	11.42	56	10.48	117 (21.9%)	4.333	1.469e-05*

Note

[a] A proportion of the theme among all themes (margin = null)

[b] All *p*-value are shown, *$p < .001$, **$p < .01$

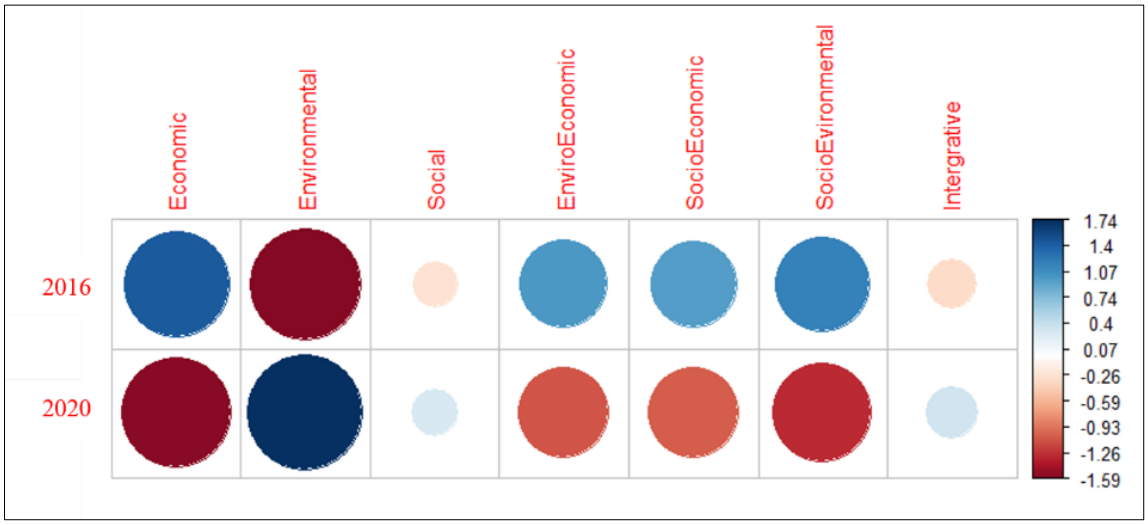
Table 18

Residual analysis results

Years	Themes						
	Environmental	Economic	Social	Socio-environmental	Socio-economic	Enviro-economic	Integrative
2016	-1.593	1.448	-0.261	1.181	0.965	0.993	-0.319
2020	1.737	-1.579	0.285	-1.287	-1.052	-1.083	0.347

Figure 23

Residual analysis of sustainability themes in 2016 and 2020 (2022). Diagram by the authors.



A chi-square test of independence was performed to examine the relationship between sustainability themes and different years. The relation between these variables was significant, X2 (6, N = 534) = 17.762, p < .01. Based on the results, we can tell students' concentrated thoughts of sustainability are more likely to be changed based on different years.

To interpret the association between sustainability themes and different years, this study conducted the residual analysis from the chi-square test. Environmental (2016 z=-1.539, 2020 z=1.737) and Economic (2016 z=1.448, 2020 z=-1.579) presented a

significant difference between the observed and predicted values (See Table 18 and Figure 23).

Figure 23 also shows positive and negative residuals. Blue shows a positive association that specifies an attraction between the corresponding row and column variables. While red displays negative residuals, it's evident that there is an association between the years and the themes. Specifically, there are strong positive associations between 2016 and the Economy theme and between 2020 and the Environmental theme. This research revealed that the 2020 postcards tended to have more interest in Environmental themes like climate changes, recycling, and natural resources.

However, the 2016 postcards are not associated with the row Environment. Combined themes like Socio-Environmental are more likely to show negative association in 2020 than in 2016. In conclusion, the distribution of sustainability themes and years is not independent, and there are significant changes between sustainability themes and different years.

Discussion

This study aimed to identify and analyze students' understanding of the most important aspects of sustainability and how these thoughts have changed over the recent years. The current study analyzed 90 postcards created in 2016 and 2020 through qualitative and quantitative approaches. As an answer to RQ1 and RQ2, an examination of the study represented that the foremost aspects of sustainability for students were environmental topics and integrative themes, revealing that most students showed neutral and reflective attitudes. Interestingly, students wanted to create suggestions but had

minimal questions. Why were students not asking questions? Since asking questions can be a teaching tool to assess students' knowledge and stimulate critical thinking (Tofade et al., 2013), we can consider improving these parts in future research or teaching.

The results of this thematic analysis clearly show that there are no universal ideas and attitudes on sustainability, supporting the argument of (Lambrechts et al., 2018). A more detailed examination of individual students' ideas showed that their thoughts regarding sustainability are more likely to be changed over time (RQ 3). Their ideas in 2016 emphasized on human interactions with nature. However, 2020's postcards highlighted environmental resources and an existential mindset as vital ideas about sustainability. Our results provide evidence of an association between the two years included in the study and students' perspectives regarding sustainability. In other words, the primary ideas on sustainability are different at different times.

We concede that the results of this thematic analysis study are insufficient in terms of providing substantial sample sizes. However, this study believes that the study's sample sizes are robust enough to be used because sample sizes are various depending on the topic and the scope while conducting the thematic analysis (Morse, 2015). This argument is consistent with the statement that thematic analysis emphasizes "a clear conceptualization of what those themes represent and why we treat them as significant, rather than chasing the relatively large sample sizes" (Braun & Clarke, 2016).

This study demonstrates that the postcard assignment was effective in teaching content of ESD in LA. This result can be supported by ÇIFÇI and KÖYBAŞI (2017) who stated that teaching sustainability requires the support of positive images of the future and skills to explore important sustainability topics. This study believes that this open-ended

teaching strategy can help students prioritize issues in sustainability and acquire the knowledge needed to understand sustainability, including environmental resources, global stewardships, social involvement, technical and economic efficiency, etc.

Understanding and identifying students' thinking is critical in moving forward with a comprehensive vision to achieve a successful sustainability-focused curriculum (Ferreira & Tilbury, 2012; Howlett et al., 2016; Rogers, 2001). Therefore, the current study intended to reveal that ESD content needs to be developed further in alignment with students' perspectives on sustainability change. For instance, the postcard approach proposed in this study benefits students by organizing and considering important ideas on sustainability. Accordingly, it can be supportive content for current curricula development when teaching sustainability. It is also applicable in various disciplines and with different types of data such as (surveys, interviews, mind maps, and other text and image data). Therefore, innovative and appropriate content should accompany students' perspectives on teaching sustainability. The ESD content should combine open-ended teaching strategies with student reflections to improve the LA curricula.

Conclusion

The study results reveal that students' ideas and attitudes on sustainability are changing in integrative and reflective way. It seems apparent that in order to teach sustainability, current teaching methods need to evolve and change, not maintain traditional methods or a one-fit-for-all approach Lambrechts et al. (2018) to draw students' attention and engage them.

What this study has demonstrated in students' thoughts and interests shows that there are changes in students' thinking in different years. Therefore, it can be concluded that ESD contents need revision for future courses, accompanying students' changing perspectives, attitudes, or understandings of sustainability because identifying students' positions and thoughts will allow design and planning programs to improve their curricula. This will also help educators advance the awareness and contributions to fully and explicitly integrate sustainability into their education offerings. This study can initiate developing course content for student-driven sustainability education in which the education is based on the learners' perspectives (Herranen et al., 2018). We conclude that developing courses based on students' thinking and attitude toward sustainability can yield quality curricula.

Above all, evolving learning and curriculum needs in teaching sustainability to educate future landscape architects. Lastly, the authors recommend that further research could be oriented toward surveys or students' targeted interviews to incorporate a triangulation to improve the validity and reduce bias (Jonsen & Jehn, 2009).

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CHAPTER 5

SUMMARY AND CONCLUSION

The importance of integrating sustainability into landscape architecture education and practice cannot be overstated, as it plays a crucial role in addressing sustainability challenges and promoting sustainable design practices. Therefore, empirical research that provides practical insights and directions for incorporating sustainability into LA curricula is essential to achieving this goal. By studying ESD pedagogical approaches and collecting practical methods for teaching sustainability, we can ensure that future landscape architecture professionals are equipped with the knowledge and skills necessary to address sustainability challenges and promote sustainable design practices. Furthermore, this research can aid in the development of effective and innovative teaching methods that promote sustainability literacy among landscape architecture students.

The structure of this dissertation revolved around exploring sustainability education in the design and planning fields (Chapter 2), as well as collecting practical methods for LA education (Chapter 3 and 4). To address the need for empirical research, this study aimed to answer three research questions:

1. What ESD approaches can be found in planning and design education, and what issues are faced when applying ESD?

2. How do current LA instructors employ ESD pedagogical approaches and content to teach sustainability, and which learning opportunities or teaching methods have been provided in LA programs?
3. How do students in LA courses reflect sustainability ideologies and apply sustainability attributes in their assignments?

The first question was explored using a systematic literature review. The second question was examined through mixed-method research, including the analysis of surveys and syllabi; and mixed-method research and content analysis were employed to identify themes emerging from students' submissions in an effort to answer the third question.

The research conducted in this dissertation revealed that, while the integration of ESD into LA education is gaining recognition, there is still a need for more comprehensive and practical approaches. Based on the findings, several practical ways of incorporating ESD into LA programs can be suggested. The three primary research chapters have significantly improved our collective understanding of the characteristics of sustainability, the relationship between ESD approaches and teaching methods, and the perspectives of instructors and students in LA programs.

Chapter two, the review of relevant literature, highlighted a lack of consensus on the best approaches for teaching sustainability across all higher education disciplines. It also shed light on how educators introduce the concept of sustainability in their courses using key ESD approaches that can be adapted for LA. Most prominent ESD approaches in planning and design fields are action-oriented, interdisciplinary, problem-based and project-based learning.

The study found that most programs used a combination of several ESD approaches to implement sustainability concepts in the course, such as combining problem-based learning with a case study and action-oriented with transformative approaches. Interestingly, programs use a combination of ESD approaches, not only for teaching method but also for conducting community service projects. According to the results, this innovative blending of ESD learning approaches is effective and is applicable to undergraduate and graduate programs. For instance, the study revealed action competence and transformative learning, active learning, problem and project-based learning, place-based and experiential learning, etc.

The literature review also identified barriers to integrating ESD, including a lack of faculty training and resources, resistance to change, and the challenge of balancing disciplinary requirements with sustainability principles. However, implementing ESD leads to strong positive learning outcomes like developing problem-solving skills, obtaining critical thinking, developing design and planning abilities, and building collaboration skills that can help future planners and designers to cultivate stronger critical thinking skills. Moreover, the study discovered that intentional effort from instructors is key to success in incorporating ESD approaches into their curricular and course content. Above all, instructors' acceptance of innovative educational methods and approaches, and their training for sustainability principles and related content is required to deliver well-rounded knowledge and practice.

In chapter three, the analysis of faculty surveys and course syllabi revealed prevalent teaching themes, instructors' perspectives, and the associations between teaching sustainability and LA courses. The study found that most LA programs in the

US and Canada have incorporated sustainability, or sustainable development, into their curricula. In particular, graduate programs mainly teach sustainability in studio, lecture, field trips, and guest lectures through typical teaching methods discussion, developing design or planning proposal, traditional lectures, and reflection papers.

Nevertheless, the formats of incorporating ESD are varied in LA curricula. Most LA curricula use active, student-centered ESD approaches, such as project-based learning, problem-based learning, collaborative learning, and interdisciplinary approaches. However, the curricula have less preference toward individual work or outreach focused ESD approaches, like self-regulated learning, competency-based learning, and participatory research. Additionally, the study found innovative teaching methods applied into the courses. Examples include real-life projects, making websites, empathy maps, infographics, and case reviews.

While incorporating sustainability into the LA programs, instructors increased students' environmental awareness and sustainability literacy as well as enhanced the understanding of sustainability concepts and design research skills. This dissertation proved significantly positive correlations between the teaching methods used and beneficial learning outcomes. For instance, making design or planning proposals has a positive impact on increasing students' design and planning skills and sustainability awareness. Further, conducting presentations results in developing sustainability literacy.

However, the need for greater financial support and resources for ESD in LA programs emerged as a significant challenge. A lack of resources and practical experience also presents challenges for instructors seeking to effectively integrate

sustainability into their teaching. To address these challenges, institutions should provide funding for faculty resources, programs, and professional development opportunities.

Additionally, the study highlighted the extent to which LAAB standards, sustainability themes, and ESD pedagogical approaches are integrated into LA programs, as well as the challenges instructors faced in effectively integrating sustainability into their teaching.

The study found that while instructors value sustainability education, they face challenges in implementing it due to time constraints, lack of resources, and a lack of agreement on what sustainability means. The syllabi analysis showed that sustainability themes and approaches are present in most landscape architecture courses but are often not explicitly stated or integrated into course objectives or assignments.

These findings serve as a valuable starting point for future research to gain a deeper understanding of ESD practices in LA and the contribution of teaching sustainability to student learning. The results can also inform the development of practical ESD curricula by offering ideas, options, and perspectives for those interested in incorporating sustainability into higher education design and planning programs.

In chapter four, the thematic analysis of student submissions in LA courses provided valuable insights into the impact of sustainability education on students' learning outcomes, offering perspectives on the benefits and challenges of incorporating ESD into the LA curriculum. A mixed-methods approach was employed to examine undergraduate students' postcard submissions in the LA course. The results demonstrated changes in students' thinking and perspectives on sustainability over time, with no

universal ideas or attitudes on sustainability. Compared to the past, current students demonstrate more care about environmental issues, such as a lack of natural resources.

The study also revealed that many students were aware of the urgency of waste issues and the importance of a comprehensive approach with philosophical thinking to achieve sustainability. While students recognized the significance of sustainability, they struggled to fully understand its complex concepts.

This dissertation suggests instructors need to effectively communicate with students, consider students' flexibility, and employ teaching methods that promote a deeper understanding of sustainability. Institutional efforts are also necessary to update innovative teaching methods considering ESD approaches. Additionally, the study identified a desire among students for more hands-on learning experiences and opportunities for interdisciplinary collaboration. Thus, this study asserts that collaborating with different disciplines would provide innovative perspectives on complex social and environmental projects through interdisciplinary design solutions.

While researchers increasingly recognize the importance of incorporating sustainability into LA education, current studies tend to focus on conceptual understandings of sustainability rather than practical ways to implement it in LA curricula. However, this dissertation underscores the importance of practical ways to incorporate ESD into LA programs to effectively address complex sustainability challenges.

Overall, the findings of this dissertation reveal that incorporating ESD into LA programs is a complex and multifaceted process that requires the commitment of faculty, students, and administrators and a willingness to experiment with innovative teaching

methods. Interdisciplinary collaborations are crucial in this process, and landscape architecture programs should explore opportunities to integrate sustainability education with other disciplines, such as engineering, environmental science, and public health.

Although the findings of this study offer insight into current teaching practices, there are still many possibilities for further exploration and innovation in incorporating sustainability education into landscape architecture programs. To advance this field of study, future research should focus on several key areas:

1. Further research can focus on developing more specific guidelines and best practices for incorporating sustainability education into LA programs, exploring the effectiveness of various approaches and teaching methods in promoting sustainable design practices.
2. The results of this study encourage planning and design programs to stay up-to-date with emerging ESD approaches and related teaching methods. New research is expected to examine the impact of interdisciplinary collaborations on sustainability education and student learning outcomes.
3. The study highlights the importance of understanding the perspectives, attitudes, or views of students towards sustainability. To achieve this, future research should incorporate surveys and targeted interviews with students to enhance validity and reduce bias.
4. Comparative studies of sustainability education in landscape architecture and planning programs across different regions and countries would be beneficial.

In conclusion, this dissertation's research contributes to the understanding of ESD in the planning and design fields and provides practical directions for integrating sustainability into LA curricula. The study can guide instructors and institutions in developing effective and innovative teaching methods that foster sustainability literacy among LA students. It is crucial to recognize that sustainability is a comprehensive process requiring changes in various aspects. The findings of this study can help shape future research and practical curricula, ultimately contributing to a more sustainable future.

APPENDIX A. Approved IRB protocol (#12394)

Protocol # 12394
IRB Exemption Date: March 24, 2022
Consent Document Expires: May 31, 2022

Implementation of sustainability principles: A study of course syllabi and a faculty survey

LETTER OF INFORMATION

You are invited to participate in a research study by

- **Hye Yeon Park,** a Ph.D. candidate in the Department of Landscape Architecture and Environmental Planning at Utah State University
- **Jennifer Givens,** an Assistant Professor in the Department of Sociology, Social Work, and Anthropology
- **Carlos Licon**, an Associate Professor in the Department of Landscape Architecture and Environmental Planning

PURPOSE: We are interested in understanding existing education for sustainable development (ESD) approaches, sustainability principles, and teaching modes or methods in undergraduate landscape architecture programs. In particular, we are interested in benefits and barriers based on your teaching experiences to gain insights into developing ESD programs in landscape architecture education. Participants will be asked about their course(s) information, sustainability principles, ESD pedagogy, and teaching experiences. You will be presented with information relevant to sustainability education and asked to answer some questions about it. Please be assured that your responses will be kept completely confidential.

DURATION: If you take part in this study, you will be asked to participate in a single survey. The study should take you around 10 minutes to complete. This survey is intended to be taken on a laptop or desktop, not on a mobile device.
Your participation in this research is voluntary. You have the right to withdraw at any point during the study, for any reason, and without any prejudice.

CONFIDENTIALITY: All data collected is confidential. Data will be stored on USU-approved systems. Upon completion of data collection, all data will be anonymized. We will collect your information through Qualtrics (this survey platform). Online activities always carry a risk of a data breach, but we will use systems and processes that minimize breach opportunities. This survey data will be securely stored in a university-approved cloud storage system. The survey results will be pooled for the dissertation project, and individual results of this study will remain absolutely confidential and anonymous. Should this study be published, only pooled results will be documented.

RISK: Possible risks of participation include loss of confidentiality. In order to minimize the risk of the loss of confidentiality, only the investigator and authorized staff may access data. The identities of individual subjects will never be released without the

subject's express consent. The risks of participating in this study are no more than what is experienced in daily life.

BENEFITS: Although you will not directly benefit from this study, results may help participants better understand pedagogical approaches for teaching sustainability in landscape architecture programs and practical teaching methods used by other programs.

If you would like to contact the investigators in the study to discuss this research, you can contact PhD candidate, Hye Yeon Park (hyeyeon.park@usu.edu), or the designated PI, Jennifer Givens (jennifer.givens@usu.edu). Thank you again for your time and consideration. If you have any concerns about this study, please contact Utah State University's Human Research Protection Office at (435) 797-0567 or irb@usu.edu.

By clicking the button below, you acknowledge that your participation in the study is voluntary. You are 18 years of age. You are aware that you may choose to terminate your participation in the study at any time and for any reason.
You indicate that you understand the risks and benefits of your participation and that you know what you will be asked to do. You also agree that you have asked any questions you might have and are clear on how to stop your participation in this study if you choose to do so. Please be sure to retain a copy of the form for your records; you can download this document by clicking here.

- ○ I consent, begin the study
- ○ I do not consent, I do not wish to participate

APPENDIX B. The Online Faculty Survey

*Please read the definitions of keywords to better understand the survey.

Definitions of Keywords:

• **Sustainability**: "Meeting the needs of the present without compromising the ability of future generations to meet their own needs.", "Sustainability requires the enforcement of wide responsibilities for the impacts of decisions. This requires changes in the legal and institutional frameworks that will enforce the common interest" from the World Commission on Environment and Development's Brundtland Report (WCED, 1987). Since the first definition in 1804, the concept of sustainability becomes a multidisciplinary and complex topic, and requires an understanding of the interconnection and interdependency among ecological, economic, and social aspects of sustainability (Sverdrup & Stjernquist, 2002)

• **Sustainable Development**: the Brundtland Report is defined as a "Development which meets the needs of the present without compromising the ability of future generations to meet their own needs"(WCED, 1987). Along with this concept, sustainable development offers a holistic approach to addressing decisions' complexities and interrelated aspects (Vucetich & Nelson, 2010; Waas etal., 2010)

• **Education for Sustainable Development (ESD)**: "ESD empowers learners with knowledge, skills, values, and attitudes to make informed decisions and take responsible actions for environmental integrity, economic viability, and a just society future"

Part 1: Demographic & General Questions

This section of the questionnaire is about demographics and the general background of teaching.

1. What gender do you identify as?
    - Male
    - Female
    - Non-binary / third gender
    - Prefer not to say

1. Which region of the country do you live in?
    - Midwest - IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD, WI
    - Northeast - CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VT
    - Southeast - AL, AR, FL, GA, KY, LA, MS, NC, SC, TN, VA, WV
    - Southwest - AZ, NM, OK, TX
    - West - AK, CA, CO, HI, ID, MT, NV, OR, UT, WA, WY
    - Other countries

2. What discipline do you have a degree in? Degree in Landscape Architecture, Planning, Architecture, other?

3. Please indicate your position in your school / organization

- Professor
- Associate Professor
- Assistant Professor
- Adjunct
- Instructor
- Other (please specify)

4. To your knowledge, does the existing curriculum at your department address issues of sustainability and/or sustainable development issues?

   - A great deal
   - Quite a bit
   - A little
   - None
   - Don't know

Part 2: Understanding existing sustainability education in LA courses

This section of the questionnaire is about understanding the current situation of the existing LA courses, which include sustainability and/or sustainable development concept.

5. Do you teach sustainability or include sustainability as a component/element/topic/focus in your course(s) (Studio, Lecture, etc.)? If so, to what extent is sustainability embedded in your curriculum?

   - A great deal
   - Quite a bit
   - A little
   - None
   - No, I do not teach sustainability

6. Which of your studio classes include sustainability within all courses taught in the LA department/program? (Select all that apply)

   - Freshman
   - Sophomore
   - Junior
   - Senior
   - Graduate
   - None

7. Which of your lecture classes include sustainability within all courses taught in the LA department/program? (Select all that apply)

   - Freshman

- Sophomore
- Junior
- Senior
- Graduate
- None

8. How is sustainability and/or sustainable development integrated into the course?(Please select all that apply)

    - As a "stand-alone" sustainability course
    - In studio class(es)
    - In lecture class(es)
    - Field trip
    - Seminar-type course (e.g., reading seminar)
    - Occasional events (e.g., guest lectures, departmental events)
    - Internship
    - Other (please specify)

Part 3: Application of sustainability education in LA courses

This section of the questionnaire is about sustainability education, themes, pedagogical approaches, teaching methods

9. Which themes do you include based on Accreditation Standards for Professional Programs in Landscape Architecture (LAAB, 2021) if you teach sustainability? (Select all that apply)

    LAAB. (2021). ACCREDITATION STANDARDS for Professional Programs in Landscape Architecture. Landscape Architectural Accreditation Board.

    - **History, theory, philosophy, principles, and values** (e.g., sustainability, resiliency, and stewardship/ health, safety, and welfare /diversity, equity, and inclusion)
    - **Design processes and methodology** (e.g., critical, creative, and strategic thinking, analysis, ideation, synthesis, site program, iterative design development, interdisciplinary collaboration, design communication
    - **Systems and processes**—natural and cultural (related to design, planning, and management)
    - **Communication and documentation** (e.g., written and oral communication, visual and graphic modeling and communication, conceptual, design, and construction documents, numeracy, quantitative problem-solving, and communication, community and client engagement
    - **Implementation** (e.g., construction technology and site engineering, site materials, use and management of plants and vegetation, integrated water management, policies, and regulation
    - **Assessment and evaluation** (e.g., site assessment, pre-design analysis, post-occupancy evaluation, visual and scenic assessment, landscape performance (may include ecological, climate, human health, social, and economic factors))

- **Professional practice** (e.g., values, ethics, practice requirements, settings, and scales construction administration)
- **Research and scholarly methods** (e.g., quantitative and qualitative methods, establishing are search hypothesis, framing research questions, literature/case study/precedent review research integrity and protection of human subjects, communication of research)
- **Other** (please specify)

10. If possible, please upload your current syllabus or syllabi as background information. We will analyze it anonymously and will not use any personally identifiable information (e.g., your name, contact information, course name, institution name) Also, you can remove or redact any identifying information (particularly instructor name) from their syllabus before sharing if you wish (Please upload the syllabus file: pdf, doc, jpeg, or png)

    1) **Please upload the syllabus here if you teach more than one sustainability-related course.**
    2) **Please upload the syllabus here if you teach more than two sustainability-related courses.**

11. What aspects of sustainability are covered in your coursework (Select all that apply)

    - **Economic**
    - **Social**
    - **Environmental**
    - **Other** (please specify)

12. What sustainability curricula themes (Wyness & Sterling, 2015) do you feel areimportant to include when teaching sustainability? (Select all that apply) If you want to find out more, please use the link. (Reference Link)

Environmental Sustainability
- Natural resources management
- Food and farming
- Ecological systems
- Waste/Water/Energy
- Biodiversity
- Climate change

Economic sustainability
- Alternative futures
- Leadership and change
- Learning organizations
- Corporate social responsibility
- Consumerism and trade

- Accountability and ethics
- International development
- Sustainable and ethical economy
- Tourism
- Population
- Social enterprise
- Globalization

Social sustainability

- Sustainable communities
- Cultural diversity
- Intercultural understanding
- Sustainability in the built environment
- Travel, transport, and mobility
- Health and well-being
- Peace, security, and conflict
- Citizenship, governance, democracy
- Human rights and needs

Other

- Other (please specify

13. What Education for Sustainable Development approaches do you use to teach sustainability or/and sustainable development in your course(s)? (Please select all that apply)

    - **Interdisciplinary/Multidisciplinary** (e.g., cooperation among different scientific disciplines and the integration of different disciplinary perspectives, theories, and methods)
    - **Project-Based Learning (PBL)** (e.g., an active student-centered form of instruction within the real-world practice)
    - **Collaborative Learning** (e.g., the collaboration between a diverse range of students, faculty, and stakeholders related to multiple disciplines.)
    - **Holistic/Integrative Learning** (e.g., a comprehensive approach to seek to address students' emotional, social, and academic needs in an integrated learning format.)
    - **Experience-based Learning** (e.g., to offer students the opportunity to explore and experience sustainability issues in the real world)
    - **Problem Based Learning** (e.g., a teaching method in which complex real-world problems are used as the vehicle to promote student learning of concepts and principles)
    - **Competency-based Learning** (e.g., an approach to education that focuses on the student’s demonstration of desired learning outcomes as central to the learning process)

- **Self-regulated Learning** (e.g., a cyclical process, wherein the student plans for a task, monitors their performance, and then reflects on the outcome)
- **Participatory Action Research (PAR)** (e.g., stressing participation and action components that aim to identify social issues and enact change in that community)
- **Performance-oriented/based Learning** (e.g., an approach to teaching and learning that emphasizes students being able to do, or perform, specific skills as a result of instruction.)
- **Others** (please specify)

14. What teaching modes or teaching methods do you use to teach sustainability or/and sustainable development in your course(s)? (Please select all that apply)

Process

- Teaching a small number of students
- Active learning, student-driven course (e.g., games/role-play lecture/engaging the students)
- Discussions
- Participate in sustainability conferences
- Local workshops and meetings
- Collaboration with community/Industry
- Group activities with students (Group discussion, working projects, design charrette, etc.)
- Traditional lectures
- Online teaching
- Guest speakers/guest lecturers
- Literature review
- Hands-on community projects
- Research assignment/projects
- Peer evaluation (critique/feedback) of projects
- Field trips (This is a journey lasting a day or more, to a location away from their usual place to work or study and to get direct experience)
- Fieldwork (Fieldwork is the gathering of information about something in a real, natural environment)

Products

- Reflection paper/essay
- Proposal/report
- Design/plan
- A project in real-life (e.g., Students engage in investigations of recycling and saving energy)
- Presentation/exhibition
- Exams/quiz/test

Other

- Other (please explain)

Part 4: Benefits and challenges of sustainability education in LA courses

This section of the questionnaire is about benefits and challenges while conducting sustainability education in LA courses. We are looking to understand the benefits of learning sustainability and the challenges in the teaching process.

15. How do you think students experienced benefits when applying sustainability and/or sustainable development topics in your course work?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Improve Problem-solving ability (e.g., students gained improvement in their skills in addressing problems)	○	○	○	○	○
Gain in-depth knowledge about sustainability	○	○	○	○	○
Become interdisciplinary thinkers	○	○	○	○	○
Develop specialized expertise	○	○	○	○	○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Develop design/planning ability (e.g., students developed a working, understanding of design methodologies and connected environmental design theories with design practice)	○	○	○	○	○
Improving collaboration skills/team-based skills (Students can develop team-based skills, which future employers will value during the process, including project management, research skills, and interpersonal competence)	○	○	○	○	○
Develop sustainability literacy (students understand sustainability issues at different scales, to identify real-life sustainability problems)	○	○	○	○	○
Reflective /quality communication (The course(es) improved students' critical reflection and opinion development in oral presentations)	○	○	○	○	○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Improve environmental awareness (Conducting class projects raised students' awareness regarding environmental considerations in urban and regional planning.)	○	○	○	○	○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Increased competencies (e.g., students improved competencies in working with people from different cultures and building their communication and collaboration skills)	○	○	○	○	○
Other (please specify)	○	○	○	○	○

16. How do you measure or determine the benefits from the course? (Please select all that apply)
    - ○ Through group discussion
    - ○ Through reflective paper/essay
    - ○ Through proposal/report
    - ○ Through presentation/exhibition
    - ○ Through exams/quiz/test

- Other (please specify)
- None

17. How do you think challenges when applying sustainability and/or sustainable development topic in your coursework?

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The complexity of teaching sustainability	○	○	○	○	○
Need specific and/or additional guidance (e.g., it required adequate guidance from the instructor for reducing challenges caused by the bottom-up process, limiting abstractions, or students' decision-making)	○	○	○	○	○
Environmental restriction (e.g., outdoor-oriented courses or fieldwork)	○	○	○	○	○
Financial constraints	○	○	○	○	○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Required long-term partnerships with external groups or community	○	○	○	○	○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Lack of time (e.g., difficulty completing activities in the suggested time)	○	○	○	○	○
Difficulty to in-depth study	○	○	○	○	○
Assessment difficulty (e.g., some ESD approaches focus on the learning process rather than outcomes, and it isn't easy to assess program impact and students' knowledge)	○	○	○	○	○
Lack of understanding sustainability content (e.g., difficulties to understand fundamental concepts of sustainability)	○	○	○	○	○
The importance of instructor role (e.g., instructors need to accept new educational methods to achieve ESD to deliver knowledge, maintain the learning process, and help students)	○	○	○	○	○

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Unsupportive school administrators (e.g., lack of technological support like school network across countries, film and video games making)	○	○	○	○	○
The interest level of students	○	○	○	○	○
Cultural differences (e.g., working a group project with students from different cultures)	○	○	○	○	○
Other (please specify)	○	○	○	○	○

APPENDIX C. Correlational Analysis Tables regarding Teaching Methods

Teaching Methods & Pedagogical Strategy

	SMALL GROUPS	ACTIVE LRNG	DISCUSS IONS	CONFER ENCES	LOCAL	INDUST RY	GROUP ACTIVITI ES	LECTUR ES	ONLINE TCHNG	GUESTS	READIN GS	HANDS-ON	RESEAR CH	PEER EVAL	FIELD TRIPS	FIELD WORK	ESSAY	DESIGNI NG	EXPERIE NTIAL	PRESEN TATION S	EXAMS
INTERDISCIP	0.333	0.353	**0.521**	0.156	0.286	0.343	0.479	0.427	0.328	**0.516**	0.361	0.389	**0.506**	0.293	0.497	0.310	0.371	0.441	0.393	0.465	0.257
p-value	<.001	<.001	<.001	0.074	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.003
PBL	0.316	0.364	0.475	0.187	0.22	0.403	**0.517**	0.450	0.309	0.426	0.325	0.439	0.326	0.325	0.443	0.436	0.399	**0.716**	0.430	**0.589**	0.184
p-value	<.001	<.001	<.001	0.032	0.011	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.035
COLLABO_L	0.265	**0.536**	**0.502**	0.241	0.373	0.380	**0.577**	0.368	0.324	0.470	0.425	0.470	0.425	0.492	0.411	0.478	0.395	**0.578**	0.454	0.485	0.264
p-value	0.002	<.001	<.001	0.005	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.002
HOLLIISTIC	0.268	0.367	0.375	0.295	0.267	0.290	0.319	0.212	0.214	0.308	0.300	0.228	0.267	0.262	0.363	**0.400**	0.298	0.383	0.300	0.316	0.168
p-value	0.002	<.001	<.001	<.001	0.002	<.001	<.001	0.015	0.014	<.001	<.001	0.008	0.002	0.002	<.001	<.001	<.001	<.001	<.001	<.001	0.054
EXPERIENCE	0.426	0.454	**0.531**	0.355	0.434	0.476	0.408	0.393	0.363	0.456	0.455	**0.600**	0.348	0.321	0.545	0.574	0.598	0.513	0.413	0.474	0.264
p-value	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.002
PROBLEM_B	0.246	0.423	**0.548**	0.171	0.266	0.372	**0.581**	**0.512**	0.334	0.439	0.388	0.423	0.427	0.388	**0.507**	0.340	0.389	**0.594**	0.316	0.451	0.320
p-value	0.004	<.001	<.001	0.05	0.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
COMPETENCY	0.207	0.197	0.362	0.194	0.296	0.209	0.375	0.283	0.252	0.356	0.152	0.274	0.289	0.333	0.320	0.280	0.406	0.337	0.227	0.327	0.302
p-value	0.017	0.023	<.001	0.026	<.001	0.016	<.001	0.001	0.004	<.001	0.082	0.001	<.001	<.001	<.001	<.001	<.001	<.001	0.009	<.001	<.001
SELF_REGUL	0.078	0.179	0.27	0.198	0.252	0.120	0.188	0.260	0.193	0.283	0.105	0.185	0.133	0.151	0.280	**0.437**	0.167	0.276	0.225	0.095	0.067
p-value	0.373	0.04	0.002	0.023	0.004	0.172	0.03	0.003	0.027	0.001	0.232	0.033	0.128	0.083	0.001	<.001	0.055	0.001	0.01	0.278	0.446
PARTICIPATE	0.174	0.321	0.29	0.165	0.323	0.134	0.387	0.186	0.229	0.309	0.214	0.424	0.225	0.214	0.250	0.328	0.306	0.222	0.248	0.285	0.086
p-value	0.046	<.001	<.001	0.058	<.001	0.125	<.001	0.033	0.008	<.001	0.014	<.001	0.009	0.014	0.004	<.001	<.001	0.01	0.004	<.001	0.327
PERFORM_O	0.274	0.296	0.465	0.141	0.296	0.209	0.375	0.349	0.252	0.324	0.369	0.207	0.289	0.260	0.352	0.280	0.307	0.303	0.264	0.359	0.232
p-value	0.001	<.001	<.001	0.107	<.001	0.016	<.001	<.001	0.004	<.001	<.001	0.017	<.001	0.003	<.001	0.001	<.001	<.001	0.002	<.001	0.007
OTHERS	-0.004	0.064	0.065	0.061	0.118	0.120	0.128	0.082	0.071	0.113	0.049	0.169	0.122	0.049	0.131	0.120	0.099	0.067	-0.029	0.025	0.031
p-value	0.967	0.465	0.461	0.491	0.177	0.17	0.143	0.352	0.421	0.197	0.576	0.053	0.163	0.576	0.133	0.17	0.261	0.442	0.739	0.778	0.721

*Note: Coefficients printed in colors are sigfnificant (p<.001) and show stronger correlations

Teaching Methods & Benefits

	SMALL GROUPS	ACTIVE LRNG	DISCUSS IONS	CONFER ENCES	LOCAL	INDUST RY	GROUP ACTIVITI ES	LECTUR ES	ONLINE TCHNG	GUESTS	READIN GS	HANDS-ON	RESEAR CH	PEER EVAL	FIELD TRIPS	FIELD WORK	ESSAY	DESIGNI NG	EXPERIE NTIAL	PRESEN TATION S	EXAMS
B PSOLV	0.36	0.432	**0.515**	0.244	0.325	0.414	0.483	**0.503**	0.347	**0.504**	0.343	0.330	0.407	0.308	0.440	0.345	0.399	**0.535**	0.316	**0.505**	0.286
p-value	<.001	<.001	<.001	0.005	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
GAINK	0.414	**0.518**	**0.563**	0.239	0.319	0.405	**0.502**	0.453	0.433	0.458	0.371	0.419	0.458	0.335	0.492	0.405	0.448	**0.617**	0.418	**0.523**	0.345
p-value	<.001	<.001	<.001	0.006	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
INTERD	0.336	**0.538**	**0.521**	0.282	0.295	0.327	0.411	0.369	0.328	0.442	0.282	0.269	0.374	0.350	0.461	0.294	0.445	0.473	0.317	0.481	0.273
p-value	<.001	<.001	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001	0.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.002
EXPERT	0.271	0.235	0.398	0.28	0.359	0.295	0.306	0.300	0.360	0.378	0.340	0.291	0.334	0.239	0.352	0.360	0.331	0.476	0.299	0.270	0.146
p-value	0.002	0.007	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.006	<.001	<.001	<.001	<.001	<.001	0.002	0.094
DE&PL SKILL	0.3	0.471	**0.561**	0.269	0.318	0.366	0.402	0.444	0.291	0.399	**0.427**	0.267	0.301	0.290	0.453	0.366	0.397	**0.676**	0.363	0.435	0.210
p-value	<.001	<.001	<.001	0.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.016
COLLAB	0.332	**0.503**	**0.561**	0.269	0.359	0.433	**0.527**	0.475	0.386	0.492	0.324	0.491	0.363	0.324	**0.516**	0.433	0.460	**0.578**	0.434	**0.529**	0.276
p-value	<.001	<.001	<.001	0.002	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001
SUS_LITERATURE	0.392	**0.528**	**0.595**	0.231	0.308	0.388	**0.510**	**0.519**	0.477	**0.528**	0.391	0.465	0.465	0.318	0.468	0.423	0.483	**0.616**	0.403	**0.560**	0.327
p-value	<.001	<.001	<.001	0.008	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001
REFLECT	0.336	**0.507**	**0.585**	0.232	0.336	0.427	0.442	0.433	0.265	0.442	0.350	0.301	0.405	0.248	0.461	0.294	**0.507**	0.473	0.247	**0.512**	0.273
p-value	<.001	<.001	<.001	0.007	<.001	<.001	<.001	<.001	0.002	<.001	<.001	<.001	<.001	0.004	<.001	<.001	<.001	<.001	0.004	<.001	0.002
AWARE	0.381	**0.517**	**0.611**	0.227	0.303	0.380	**0.498**	**0.536**	0.399	0.482	0.383	0.388	0.452	0.346	**0.521**	0.415	**0.501**	**0.667**	0.359	**0.546**	0.282
p-value	<.001	<.001	<.001	0.009	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.001
COMPETE	0.355	0.464	**0.501**	0.278	0.329	0.318	0.367	0.383	0.316	**0.428**	0.376	0.258	0.360	0.307	**0.510**	0.351	0.398	0.486	0.344	0.466	0.263
p-value	<.001	<.001	<.001	0.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.003	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.002

*Note: Coefficients printed in colors are sigfnificant (p<.001) and show stronger correlations

Teaching Methods & Challenges

	SMALL GROUPS	ACTIVE LRNG	DISCUSS IONS	CONFER ENCES	LOCAL	INDUST RY	GROUP ACTIVITI ES	LECTUR ES	ONLINE TCHNG	GUESTS	READIN GS	HANDS-ON	RESEAR CH	PEER EVAL	FIELD TRIPS	FIELD WORK	ESSAY	DESIGNI NG	EXPERIE NTIAL	PRESEN`	EXAMS
COMPLEXITY	0.367	0.253	0.287	0.188	0.094	0.171	0.192	0.162	0.183	0.226	0.228	0.182	0.106	0.124	0.266	0.204	0.262	0.363	0.309	0.317	0.124
p-value	<.001	0.003	<.001	0.031	0.283	0.05	0.028	0.064	0.036	0.009	0.009	0.036	0.228	0.155	0.002	0.019	0.002	<.001	<.001	<.001	0.158
NEED_GUIDE	0.29	0.28	0.318	0.041	-0.042	-0.061	0.129	0.237	0.168	0.244	0.090	0.120	0.109	0.090	0.205	0.116	0.328	0.293	0.127	0.314	0.280
p-value	<.001	0.001	<.001	0.644	0.631	0.486	0.14	0.006	0.054	0.005	0.302	0.17	0.214	0.302	0.018	0.186	<.001	<.001	0.148	<.001	0.001
ENV_RESTRIC	0.231	0.264	0.283	0.028	0.104	0.169	0.219	0.223	0.106	0.245	0.290	0.117	0.201	0.213	0.158	0.131	0.308	0.255	0.129	0.360	0.308
p-value	0.008	0.002	0.001	0.746	0.236	0.053	0.012	0.01	0.226	0.005	<.001	0.182	0.021	0.014	0.071	0.133	<.001	0.003	0.141	<.001	<.001
FINANCIAL	0.223	0.313	0.318	0.148	0.132	0.187	0.228	0.271	0.201	0.310	0.382	0.188	0.241	0.163	0.370	0.222	0.394	0.361	0.164	0.380	0.421
p-value	0.01	<.001	<.001	0.091	0.132	0.032	0.009	0.002	0.021	<.001	<.001	0.031	0.005	0.061	<.001	0.011	<.001	<.001	0.06	<.001	<.001
PARTNERSHIP	0.332	0.378	0.398	0.2	0.192	0.329	0.413	0.394	0.307	0.387	0.424	0.306	0.263	0.145	0.393	0.329	0.299	0.408	0.259	0.353	0.348
p-value	<.001	<.001	<.001	0.022	0.027	<.001	<.001	<.001	<.001	<.001	<.001	<.001	0.002	0.096	<.001	<.001	<.001	<.001	0.003	<.001	<.001
LACK_TIME	0.154	0.266	0.256	0.052	-0.008	0.137	0.303	0.351	0.226	0.310	0.156	0.157	0.249	0.156	0.251	0.069	0.318	0.299	0.127	0.308	0.361
p-value	0.079	0.002	0.003	0.553	0.928	0.116	<.001	<.001	0.009	<.001	0.074	0.072	0.004	0.074	0.004	0.429	<.001	<.001	0.147	<.001	<.001
DEEP_INDEPTH	0.118	0.192	0.308	0.024	-0.043	0.215	0.254	0.344	0.218	0.286	0.070	0.188	0.229	0.138	0.142	0.148	0.226	0.319	0.078	0.281	0.333
p-value	0.18	0.027	<.001	0.781	0.622	0.013	0.003	<.001	0.012	<.001	0.428	0.031	0.008	0.115	0.104	0.09	0.009	<.001	0.376	0.001	<.001
ASSESS_DIFFI	0.059	0.16	0.196	0.128	0.041	0.216	0.285	0.247	0.109	0.274	0.225	0.087	0.095	0.187	0.226	0.032	0.091	0.204	0.106	0.247	0.168
p-value	0.504	0.067	0.024	0.145	0.642	0.013	<.001	0.004	0.212	0.001	0.01	0.319	0.279	0.032	0.009	0.717	0.298	0.019	0.228	0.004	0.054
LACK_UNDER	0.151	0.157	0.22	0.13	0.015	0.097	0.117	0.109	0.059	0.191	0.051	0.176	0.064	0.134	0.200	0.178	0.229	0.149	0.121	0.244	0.168
p-value	0.084	0.073	0.011	0.136	0.868	0.268	0.181	0.214	0.504	0.028	0.562	0.043	0.466	0.126	0.021	0.041	0.008	0.088	0.167	0.005	0.053
INSTRUCT_ROLE	0.182	0.143	0.242	0.065	0.077	0.203	0.164	0.259	0.163	0.220	0.137	0.283	0.111	0.061	0.276	0.203	0.243	0.251	0.172	0.295	0.191
p-value	0.036	0.101	0.005	0.457	0.377	0.02	0.06	0.003	0.062	0.011	0.118	0.001	0.204	0.484	0.001	0.02	0.005	0.004	0.049	<.001	0.028
S_ADMIN	0.087	0.066	0.086	-0.114	-0.018	-0.007	-0.061	0.167	0.025	0.117	-0.042	0.051	0.030	-0.098	0.147	0.047	0.195	0.091	-0.026	0.153	0.096
p-value	0.321	0.452	0.324	0.194	0.84	0.932	0.485	0.056	0.777	0.181	0.635	0.561	0.729	0.264	0.092	0.591	0.025	0.298	0.77	0.079	0.275
INTER_LEVEL	0.021	0.092	0.082	-0.128	-0.109	-0.204	-0.076	0.067	0.010	-0.058	0.123	-0.009	0.145	-0.031	0.209	0.145	0.100	0.088	0.250	0.158	0.188
p-value	0.807	0.293	0.348	0.144	0.212	0.019	0.386	0.442	0.91	0.511	0.161	0.921	0.097	0.724	0.016	0.097	0.252	0.317	0.004	0.07	0.031
CULTURAL	0.054	0.246	0.17	-0.071	-0.018	-0.048	0.083	0.160	-0.003	0.052	0.216	0.162	0.071	0.025	0.263	0.137	0.152	0.131	0.243	0.207	0.083
p-value	0.54	0.005	0.052	0.418	0.841	0.581	0.341	0.067	0.976	0.551	0.013	0.063	0.419	0.774	0.002	0.118	0.083	0.136	0.005	0.017	0.342
OTHER2	0.078	0.063	-0.036	0.138	0.07	0.056	-0.023	0.056	0.002	0.027	0.074	0.021	-0.098	-0.076	0.048	0.129	-0.059	0.109	0.164	-0.052	-0.020
p-value	0.373	0.473	0.683	0.114	0.428	0.523	0.793	0.524	0.981	0.762	0.402	0.815	0.264	0.388	0.583	0.141	0.5	0.215	0.06	0.555	0.818

*Note: Coefficients printed in colors are sigfnificant (p<.001) and show stronger correlations

CourseType & LAAB

	STAND-A	STUDIO	LECTURE	FIELD_T	SEMINAR	OCCASION	INTERSHIP	Other
THEORY	0.242	0.418	0.482	0.36	0.138	0.360	0.219	0.139
p-value	0.005	< .001	< .001	< .001	0.115	< .001	0.011	0.112
DESIGN	0.185	0.646	0.372	0.22	0.308	0.251	0.186	0.140
p-value	0.034	< .001	< .001	0.011	< .001	0.004	0.032	0.11
SYSTEM	0.166	0.656	0.423	0.276	0.199	0.242	0.112	0.031
p-value	0.057	< .001	< .001	0.001	0.022	0.005	0.2	0.723
COMMUNICATE	0.096	0.449	0.279	0.17	0.193	0.261	0.257	0.244
p-value	0.273	< .001	0.001	0.051	0.027	0.002	0.003	0.005
IMPLEMENT	0.139	0.476	0.375	0.304	0.305	0.395	0.314	0.076
p-value	0.113	< .001	< .001	< .001	< .001	< .001	< .001	0.385
ASSESS	0.23	0.422	0.403	0.347	0.321	0.439	0.311	0.025
p-value	0.008	< .001	< .001	< .001	< .001	< .001	< .001	0.777
PROFESSION	0.199	0.389	0.337	0.324	0.255	0.324	0.303	0.202
p-value	0.022	< .001	< .001	< .001	0.003	< .001	< .001	0.02
RESEARCH	0.166	0.449	0.315	0.352	0.376	0.291	0.179	0.142
p-value	0.058	< .001	< .001	< .001	< .001	< .001	0.04	0.104
OTHER	0.068	0.084	0.066	-0.015	0.031	0.048	0.127	0.342
p-value	0.437	0.337	0.453	0.861	0.724	0.583	0.146	< .001

*Note: Coefficients printed in colors are sigfnificant (p<.001) and show stronger correlations

LAAB & Sustainability Aspect

	THEORY	DESIGN	SYSTEM	COMMUNICATE	IMPLEMENT	ASSESS	PROFESSION	RESEARCH	OTHER
ECO	0.231	0.289	0.229	0.151	0.379	0.320	0.353	0.242	0.067
p-value	0.008	< .001	0.008	0.084	< .001	< .001	< .001	0.005	0.443
SOC	0.43	0.385	0.461	0.32	0.282	0.421	0.284	0.386	0.095
p-value	< .001	< .001	< .001	< .001	0.001	< .001	< .001	< .001	0.279
ENV	0.483	0.507	0.638	0.397	0.457	0.387	0.360	0.397	0.046
p-value	< .001	< .001	< .001	< .001	< .001	< .001	< .001	< .001	0.601
OTHERS	0.179	0.201	0.098	0.163	0.03	0.011	0.089	0.163	0.183
p-value	0.04	0.021	0.263	0.062	0.732	0.9	0.308	0.062	0.035

*Note: Coefficients printed in colors are sigfnificant (p<.001) and show stronger correlations

APPENDIX D. Curriculum Vitae

Hye-Yeon Park

Ph.D. Candidate, ABD, Instructor
Department of Landscape Architecture and Environmental Planning,
Utah State University, UT
- Email: hyeyeon.park@usu.edu,
- Phone: +1-435-881-1791

Geospatial and Visualization Website: (Link)

RESEARCH AREAS

- Sustainability, Sustainability Education, Environmental Issues, Design, Planning and Design in communities, Social–Environmental Justice research, Built Environment and Human Healt h, Place-Based Transformation in Community, UAV Vertiports land use planning,

EDUCATION

AUG 2018 - MAY 2023 (Anticipated)	Utah State University **Ph.D. Candidate, ABD,** Landscape Architecture and Environmental Planning
SEP 2011 - AUG 2013	Jeon Buk National University **Master of Landscape Architecture (MLA)**
MAR 2009 – AUG 2011	Jeon Buk National University **Bachelor of Landscape Architecture (BLA)**

ACADEMIC AND PROFESSIONAL EMPLOYMENT (Underline denotes responsibility and impact)

UTAH STATE UNIVERSITY, UT

2022 – Present	**Lab Manager & Full-time Graduate Research Assistantship.** Help conduct 3D modeling efforts for new virtual reality environments, support the workshops and conduct the UDOT project on UAV Vertiports land use planning, coordinate research activities in the VIVID Lab, USU. Advisor: Professor Brent Chamberlain.
2021 – 2022	**Sole Instructor**. Introduction to Graphics and Illustration (LAEP 1200), Spring (53 students)/Fall (71 students)/Spring (43 students), Undergraduate and Graduate, 4credits. Improved a unique teaching curriculum within the online class to introduce studio cultures, using Canvas, Zoom, Concept board, and offline meetings.

2020	**Co-teaching instructor.** Introduction to Graphics and Illustration (LAEP 1200), Fall (67 students), Undergraduate and Graduate, 4credits. Co-taught course with Professor David Evans, establishing a demanding workload, the students learn early in their education the intense production reality of practice.
2020	**Teaching Assistant.** Foundations of Sustainable Systems (LAEP 2039), Fall (39 students), 3 credits, A required course for students in the Sustainable Systems Minor, Supported to facilitate discussion boards and to grade assignments, Mid-term assignments of the course (Post-card submissions) was used as data for my dissertation.
2019 – 2020	**Research Assistant,** Landscape Architecture and Environmental Planning Department, Advisor: Professor Carlos V. Licon, Analyzed sustainability indicators scenarios focus on Intermountain West area. Also, initiating data visualization of sustainability indicators scenarios, using GIS, Tableau, and Microsoft Excel. Sustainability research experiences led me to establish a dissertation theme.
2018 – 2019	**Teaching Assistant,** Introduction to Landscape Architecture (LAEP 1030), 3 credits, Fall (358 students)/Spring (335 students), A selected course for students in the Sustainable Systems Minor, focusing on energy and earth systems, Supported to manage guest speaker series, advise students, grade assignments, and supervise in-class park design process and assignment projects. Taking care of a big class requires me to spend many times, but these experiences allowed me to manage time efficiently and enjoy sharing knowledge.
HANBEK CONSTUCTION, SOUTH KOREA	
2016 – 2018	**Assistant Manager,** The Department of Engineering, Supported technical assistance by developing landscape architecture planting plans and managing construction processes, including the planning of apartment complex.
NATIONAL INSTITUTE OF ECOLOGY(NIE), SOUTH KOREA	
2014 – 2015	**Professional Research Associate,** The Department of Conservation Ecology, Under the Ministry of Environment, the institution pursues ecological research and research, restoration of endangered species, exhibition, and education, Assisted environmental plantings, computer graphic designs, data collection, and preliminary GIS analysis, supported humanities and cultural data collection and analysis, and field surveys, including wildlife and vegetations, Managed human resources and activities such as workshops, business team meetings, and research forums.

JEON BUK NATIONAL UNIVERSITY, SOUTH KOREA

2010 – 2014 **Full-time Undergraduate/Graduate Research Assistant,** The Eco-Design and Planning Lab, Advisor: Professor Myungwoo Lee, Contribute to establishing environmental master plans, projects, papers, field survey and reports from university to national scales using GIS, AutoCAD, SketchUp, and Adobe Photoshop, Supported field research and data analysis, focusing on environmental and cultural resources, Participated in ecological resources surveys and circulating questionnaires, Assisted to compose the content of the book, Landscape Architecture Laws for conservation of ecology and creation of parks and green area. (Link)

PUBLICATIONS AND REPORTS

PEER REVIEWED ARTICLE

2023 **Park, H,** Licon, C. V., and Feldon, D., **Thematic analysis of students' submissions:**
sustainability education in LA courses, Associated with Park's dissertation **(**Landscape Research Record 1, Link).

2022 **Park, H. Y.,** Licon, C. V., and Sleipness, O. R., **Teaching Sustainability in Planning and Design Education**: A Systematic Review of Pedagogical Approaches. (Link) This research is part of the dissertation and led me to identify and understand the overview of sustainability, planning, and design education.

2016 **Park, H**., Lee, M. and Jung, M., Application of Storytelling Practices to Sae-man-geum Arboretum Design, Journal of Urban Design Institute of Korea, 17(2), 85-101. (KCI) **Spatial planning of arboretum through storytelling for restoring natural streams and the local landscape** in Sae-man-geum occupied about 65% (about 200km2) of tidal flat adjacent to the Yellow Sea, South Korea. (Link) This research is my master's thesis and led me to increase ecological and cultural perspectives.

MANUSCRIPTS IN PREP/UNDER REVIEW

2023 Under Review **Park, H.,** Givens, J., and Licon, C. V., **Implementation of sustainability principles**: A
study of course syllabi analysis and faculty survey, Associated with Park's dissertation

2023 **Park, H.,** Lee, D., and Chamberlain, B., The **framework for UAV vertiport land use planning** (Expected submission date: March 2023)

2023 **Park, H.,** Lee, D., and Chamberlain, B., **UAV vertiport land use planning guidebook** (Expected date: May 2023)

NON-PEER REVIEWED ARTICLE

2015 Woo, D., Choi, T., **Park, H.** and Choi, J., et al., **A study on analysis of habitat fragmentation and improvement of wildlife passage effectiveness**, National Institute of Ecology, South Korea

2015	Cha, J., Choi, T. and **Park, H.,** et al., **Conservation and Restoration based research on the Core Ecological Axis** of the Korean Peninsula, National Institute of Ecology, South Korea
2014	Woo, D., Choi, T., and **Park, H.**, et al., **The Master Plan for Ecological Corridor Restoration** of Chu-pung-nyeong in the Mt. Baek-du-dae-gan ranges, National Institute of Ecology, South Korea (Supported restoration plan, and influenced the development of new ecological policy in government, the agreement for the connection and restoration of the ecological axis of Chu-pung-nyeong. The national fund, ($210billion). (Link)
2014	Woo, D., Choi, T., and **Park, H.**, et al., A Study on **Improvement Methods of Wildlife Passages Based on Evaluation Survey**, National Institute of Ecology, South Korea
2014	Seo, H., Choi, T., **Park, H.** and Lee, D., et al., **The Human Impact Trail Use by Wildlife**, National Institute of Ecology, South Korea
2014	Jeon, S., Lee, M. and **Park, H.**, et al., The Master Plan of the Riparian Area Assessment and Conservation Management, Ministry of Environment, South Korea
2013	Kim, Y., Lee, M. and **Park, H.**, et al., **The National Sae-man-geum Arboretum Plan**, Korea Forest Service, South Korea, Influenced Ministry of Oceans and Fisheries to develop Master Plan on Management and Ecological Restoration of Tidal flat and Adjacent Areas (2021-2025), (Link)
2011	Lee, M., Lim, H., and **Park, H.**, et al., **The Master Plan of the Green and Pedestrian Spaces** in Jeon Buk National University, South Korea

PRESENTATIONS

ORAL PRESENTATION

2022	**Park, H.** and Licon, C., Thematic analysis of students' submissions: Sustainability education in a LA course, CELA 2022 Annual Conference, USA
2021	**Park, H**. and Licon, C., How Do We Learn about Implementing Sustainability in Planning and Design? A Systematic Review with Contents of Planning and Design Education, Seventeenth International Conference on Environmental, Cultural, Economic & Social Sustainability, USA
2013	**Park, H.** and Lee, M., Fish Shelter Forest and Design for National SMG Arboretum, The Urban Design Institute of Korea Annual Conference, Seoul, South Korea
2013	**Park, H.** and Lee, M., A Study on the Fish Shelter Forest Design for National SMG Arboretum, The Korea Society of Environmental Restoration Technology Annual Conference, Seoul, South Korea
2011	**Park, H.**, Kim, H. and Na, K., et al., Master Plan of the Ecovillage in Deog-yu Mountain, Graduate project of Jeon Buk National University, Jeon-ju, South Korea

POSTER PRESENTATION

2019	**Park, H**., Wind pattern analysis for creating green infrastructure to reduce windblown dust in Salt Lake City, Utah, Student Research Symposium, Utah, USA
2015	Lee, D., **Park, H.**, Moon, H. and Cha, J., Comparative NDVI Using UAV Images and Landsat Images, The Korean Association of Geographic Information Studies Annual Conference, Daegu, South Korea

AWARDS AND HONORS

ACADEMIC

2022	OA Funding Initiative Award ($938.00)
2022	LAEP Student Research Presentation Travel Funding ($1,000)
2022	GRAD AGRI NR Tuition Award ($1,416.26)
2021	GRAD AGRI NR Tuition Award ($3,675.38)
2021	**Nominated for the 2021 Graduate Student Teacher of the Year award**, the College of Agriculture and Applied Sciences, USU
2020	GRAD AGRI NR Tuition Award ($1,590.18)
2019	GRAD AGRI NR Tuition Award ($3,183.30)
2018	GRAD AGRI NR Tuition Award ($2,624.42)
2013	Excellence Award for the thesis on the Special Session of Sae-man-guem, the Urban Design Institute of Korea, South Korea (Competitive Article Award)
2011	Excellence Award for the planning of Eco-village, the Ho-nam Landscape Architecture Competition, South Korea (Competitive Design Award)
2010	Participation Prize for the planning of Urban forest, the 2nd Republic of Korea Forest City Design Competition, South Korea (Competitive Planning Award)
2010	Participation Prize for the restoration planning of traditional landscape, the Tong-young City Design Works Competition, South Korea
2010	Excellence Award for the planning of the healing garden, The 1st Purune Healing Garden Design Competition, South Korea (Competitive Design Award)
2010	Semester Honor Scholarships, Jeon Buk National University, (fall)
2003 - 2004	Honors College Scholarships, Jeon-ju Kijeon College (Spring/Fall/Spring)

EXTRACURRICULAR ACTIVITIES (SELECTED)

2008	**Excellence Award**, Ban-di Land Photography Competition, South Korea
2013	**Gold Prize**, the Jeonju-City River Photography Competition, South Korea
2009	**Third Prize**, the Cultural Heritages Photography Competition, South Korea

SOFTWARE AND SKILLS

- **Geographic Information Systems:** ArcGIS Analysis, ArcGIS Model Builder, and Python Programming)
- **Graphic & 3D modeling**: Adobe Creative Suite, Adobe After Effects (Video editing software), Auto CAD, Sketch-up, Google Earth Pro, City Engine, Unity
- **Statistical Analysis:** R, Statplus, ATLAS.ti, Qualtrics, Tableau, NVivo, WindNinja (a program that computes spatially varying wind fields for wildland fire application)
- **Hand Graphics**
- **Additional Interest**: Photography, Traveling, and Film

CERTIFICATES

- **The Engineer in Landscape Architecture**, Administered by the Korean Ministry of Land, Infrastructure and Transport & Human Resources Development Service of Korea
- **Engineer in Nature Environment and Ecological Restoration**, Administered by The Korean Ministry of Environment. & Human Resources Development Service of Korea
- **Industrial Engineer Office Automation, Administered by the Korean Ministry of Science, ICT and Future Planning & Human Resources Development Service of Korea**
- **Python Scripting for Geoprocessing Workflows Certificates, Esri**
- **Getting Started with ArcGIS Pro Certificates, Esri**
- **Overseas Tour Escort License, Administered by the Korean Ministry of Culture and Tourism**