DEVELOPING LEADERSHIP FOR SUSTAINABILITY IN HIGHER EDUCATION

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entitled

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DEVELOPING LEADERSHIP FOR SUSTAINABILITY IN HIGHER EDUCATION

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ABSTRACT

This thesis undertook a comprehensive investigation into the role of leadership for sustainability in higher education institutions, employing a multifaceted research approach to illuminate the intellectual landscape and address existing gaps in the literature. A bibliometric review and scoping review were initially conducted to establish the intellectual structure of sustainability leadership and identify research gaps, revealing a fragmented field with emerging clusters of research. Subsequently, the study employed a qualitative research methodology, conducting interviews with 12 sustainability coordinators from universities that had achieved high levels of sustainability implementation on international benchmarks across seven different countries. This approach provided valuable insights into the challenges and change management practices used to integrate sustainability values, policies, and pratices in higher education settings.

To further contribute to the field, the research employed the research and development method to adapt and validate a new online computer simulation, Leading Change for Sustainability in Higher Education (LCSHE). This simulation was designed to enhance the competencies of university lecturers and administrators in leading sustainability initiatives. Training was provided to 50 lecturers and administrators working in Myanmar's higher education sector. Using a single group, quasi-experimental design, the researcher collected and analyzed pre/post-test and time series data on learner engagement, sustainability mindset, and skills in executing change management strategies. The results affirmed that the simulation-based learning produced high levels of student engagement and significant effects on learner attitudes and skills. The findings from this comprehensive study not only bridged significant gaps in the existing literature but also yielded a practical learning tool designed to support the development of effective sustainability leadership in higher education institutions globally.

KEY WORDS: Leading Change for Sustainability, Simulation-Based Learning, Education for Sustainable Development, Change Management, Myanmar

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CHAPTER I
INTRODUCTION

1.1 Introduction

Sustainability has emerged as one of the key unifying concepts for human development in the 21st century. Although leadership for sustainability has been conceptualized in the general management (Avery, 2005; Bendell et al., 2017; McCann & Holt, 2010) and compulsory education context (Hargreaves & Fink, 2006), it has yet to achieve similar attention in the higher education sector (Leal Filho et al., 2020). Research on higher education for sustainable development has focused primarily on campus greening, education for sustainable development, and managing implementation with relatively little attention to leadership and management (Hallinger & Chatpinyakoop, 2019). Leadership for sustainability in higher education is needed as a catalyst for adopting a strategic role for universities in bringing about a more balanced achievement of the social, economic and environmental goals of global society (Menon & Suresh, 2020).

Although some universities have already made progress toward enhancing their sustainability, we still need a better understanding of how leaders can bring about successful change for sustainability in higher education settings, as well as how such leadership can be developed (Leal Filho et al., 2020; Rieg et al., 2021). More specifically, current gaps in knowledge include understanding if and how different leadership styles (e.g., transformational, shared, distributed, ethical, authentic) succeed when leading change for sustainability, how higher education leaders perceive and interpret their roles in regards to sustainability issues, and what strategies and approaches leaders use to make the change to sustainability happen.

In this dissertation, higher education is chosen as a context because universities are strategically positioned in society to contribute toward sustainable development in four significant ways. First, universities prepare future generation with the skills, knowledge, mindset, and attitudes needed for building a sustainable future

(Lozano et al., 2013; Menon & Suresh, 2020). Second, research and development conducted in universities has contributed innovative solutions to pressing problems in a wide range of sustainability domains including energy use, power generation, construction, human resource management, and supply chain management (Hallinger, 2020). Third, as large organizations, the management practices of universities impact the social, economic and environmental sustainability of the society in which they operate. Finally, universities impact their communities through engagement with the society, businesses, industries, government, and non-government organizations (Farner, 2019; Robinson & Pedersen, 2021).

1.2 Research Purpose and Methodology

Whether or not a university chooses to develop a proactive orientation and determination to incorporate a sustainability dimension in its mission can be traced directly to its leadership (Leal Filho et al., 2020). The broad purpose of this study was to understand how leadership throughout the university could catalyze and support the implementation of sustainability in higher education institutions. This purpose was expressed in two more specific goals. The first goal of the research was to gain a clearer understanding of how leaders manage the change for sustainability in higher education institutions. The second goal was to develop and evaluate the efficacy of a computer simulation designed to prepare university leaders with the mindset, knowledge, and skills needed to lead change for sustainability in higher education institutions. The dissertation was structured so as to make contributions to the global knowledge base on leading change for sustainability as well as yielding new online simulation to support the learning of university leaders in Myanmar about sustainability.

This study employed an exploratory sequential, mixed methods research design within the context of a research and development project. Educational research and development (R&D) is an approach that uses research-based information as the foundation for the development of products that can be used in education and training (Borg & Gall, 1983). R&D projects employ a systematic series of stages that involve planning, information gathering, product development, product testing, product

revision, and dissemination (Borg & Gall, 1983). In this dissertation, the R&D process was used to adapt an existing English language computer simulation – *Leading Change for Sustainability in Business* (LCS-B) (Chatpinyakoop et al., 2022) – for use in educating higher education leaders about their role in implementing sustainability in universities. Finally, the new *Leading Change for Sustainability in Higher Education* (LCSHE) will be translated for use in Myanmar resulting in a LCSHE-M variant, and tested in terms of its efficacy as an educational tool in the Myanmar context.

During the information gathering phase of the R&D process, the researcher conducted a small-scale qualitative study. Purposes of the qualitative study included gaining insights into the change process experienced by the universities at different stages of their change journeys, identifying common obstacles and solutions encountered as universities have sought to embed sustainability values, norms and practices, and understanding the role played by leaders at different organizational levels.

More specifically, in-depth semi-structured interviews were conducted with sustainability coordinators from 12 universities that have met high standards in the global STARS system (Sustainability Tracking Assessment & Rating System) that rates universities on sustainability processes and outcomes (stars.aashe.org). Findings gleaned from these interviews were then synthesized along with findings extracted from a literature review on sustainability leadership and change implementation in higher education. These data were used to generate a database of change stages, organizational roles, key change activities, decisions, obstacles, and outcomes that can be applied in the adaptation of the existing LCS-B for the higher education context.

Once a new LCSHE simulation had been produced, the researcher tested its efficacy as a professional development training tool with lecturers and administrators working in higher education sector in Myanmar. In this phase of the mixed methods design, the researcher conducted a quasi-experiment designed to explore the extent to which the new simulation yielded change in the knowledge application, attitudes, and strategic thinking of the higher education leaders. Thus, the R&D project also required the development of a linguistically and culturally adapted version of the LCSHE simulation.

1.3 Structure of the Dissertation

This dissertation is organized into four related essays on leadership for sustainability in higher education. The four essays are outlined below.

Chapter II, titled "The Intellectual Structure of the Literature on Sustainability Leadership in Higher Education: An Author Co-Citation Analysis," provides a detailed examination of how the concept of sustainability leadership has been framed within academic discourse, identifying key authors, works, and thematic clusters that have shaped the field. Through author co-citation analysis, the essay traces the evolution of sustainability leadership literature and highlights the foundational theories and methodologies that have informed subsequent research. This essay was published in the *International Journal of Educational Management* (Aung & Hallinger, 2022).

Following the mapping of the intellectual structure, the dissertation progressed to a scoping review in Chapter III, titled "Research on Sustainability Leadership in Higher Education: A Scoping Review." This essay provides scoping review of existing research on sustainability leadership specifically within the higher education context. The review synthesized findings from a broad range of studies to outline the current state of knowledge, identify gaps, and explore the diversity of approaches used to study leadership for sustainability in universities. This essay was published in the *International Journal of Sustainability in Higher Education* (Aung & Hallinger, 2022).

Building on the insights garnered from the two literature review essays, Chapter IV presents a qualitative study, titled "Leading the Change to Sustainable Universities: A Qualitative Study." This essay presents findings from a qualitative study that explored the experiences and strategies of sustainability leaders in higher education institutions that have gained high ratings on international sustainability benchmarks. Through semi-structured interviews with university leaders who have successfully implemented sustainability initiatives, the essay extends findings reported in the literature by providing an in-depth description of the challenges, strategies, and outcomes of leading change for sustainability in universities.

Using the insights gleamed from the systematic reviews and the qualitative study, Chapter V, titled “Design and Evaluation of a Computer Simulation on *Leading Change for Sustainability in Higher Education* (Myanmar Context).” This essay details the development and quasi-experimental evaluation of a novel computer simulation designed to train university leaders in Myanmar on leading change for sustainability. This chapter describes the research and development process used to adapt and translate the Leading Change for Sustainability - Business simulation (Hallinger, 2019) for use in the higher education context. The essay then describes the results of a quasi-experimental study of the simulation’s use with 50 faculty members drawn from several different high education institutions.

The final chapter of the dissertation is devoted to a summary and synthesis of the key findings drawn from the four essays. Implications for research, policy, and practice are then elaborated.

CHAPTER II
THE INTELLECTUAL STRUCTURE OF THE LITERATURE ON SUSTAINABILITY LEADERSHIP IN HIGHER EDUCATION: AN AUTHOR CO-CITATION ANALYSIS[1]

2.1 Introduction

The world faces urgent challenges to the development models that have driven economic growth over the past century. Widespread social injustice is evident in unequal access to quality education, affordable health care, and economic opportunity both within and across societies (Purcell et al., 2019). Environmental sustainability of the planet is threatened due to the untrammeled exploitation of natural resources, continued reliance on fossil fuels, and unsustainable consumption habits of consumers (Menon & Suresh, 2020). Our capacity to meet these challenges depends on an urgent generational change in beliefs, attitudes, and behaviors at the individual, organizational, and societal levels (Taşçi & Titrek, 2020).

Scholars assert that universities possess a unique potential for socializing the next generation of citizens to attitudes that are more conducive to the sustainability of people and the planet (Ferrer-Balas et al., 2010; Lozano et al., 2013; Purcell et al., 2019; Stephens et al., 2008). In addition, universities also have the capacity to redirect research and development efforts toward the development of innovative solutions to sustainability challenges (Menon & Suresh, 2020). Finally, universities have the power to influence their communities through proactive engagement with stakeholders that both raises awareness and initiates changes in modal practices (Lozano et al., 2013). Consequently, several global initiatives have sought to reframe the goals of universities so as to bring greater clarity to their efforts to contribute positive solutions to sustainability challenges (Lozano et al., 2013; UN General Assembly, 2015).

[1] An earlier version of this chapter was published in *The International Journal of Educational Management* (Aung & Hallinger, 2022)

These efforts to reorient the mission of universities have stimulated new inquiries into the nature and functions of 'sustainability leadership in higher education' (Ferrer-Balas et al., 2010; Leal Filho et al., 2020; Lozano et al., 2015). This recognizes that institutional change seldom comes about in the absence of proactive leadership (Leal Filho et al., 2020; Lozano et al., 2015). But what kind of leadership is needed to successfully meet these sustainability challenges in higher education institutions (Leal Filho et al., 2020)? According to Hallinger and Suriyankietkaew (2018), formal inquiries into 'sustainability leadership' have been primarily associated with business management (Avery, 2005; Metcalf & Benn, 2013). Moreover, when sustainability leadership has been addressed in the education sector, discussions have been located primarily in K-12 schooling (e.g., Davies, 2007; Goolamally & Ahmad, 2014; Hargreaves & Fink, 2006). Less attention has been given to examining the nature and effects of leadership in higher education institutions, through conceptual or empirical analysis (Hallinger & Suriyankietkaew, 2018).

Indeed, the only research review that the authors were able to identify on sustainability leadership in higher education (SLHE) was an integrative review which was limited to the years 2015-2019 (Sanchez-Carillo et al., 2021). Moreover, closer examination of the Sanchez-Carillo et al. (2021) review found that they focused not on 'leadership', but rather on the institutional integration of sustainability goals. Thus, sustainability science continues to lack any systematic effort to consolidate what has been learned over the past two decades about the nature of leadership required to articulate and execute a sustainability agenda in universities.

This represents the gap in the literature that is addressed in this article. More specifically, the purpose of this research review is to map the emerging landscape of the literature on sustainability leadership in higher education (SLHE) from its earliest entry into the literature through 2021. The review seeks to identify the key theoretical streams of research and theory that comprise the 'intellectual structure' (White and McCain, 1998) of SLHE research. The review uses the bibliometric review method which aims to document the development of a literature and analyze its theoretical foundations or intellectual structure (Hallinger & Kovačević, In press; Zupic & Čater, 2015). Author co-citation analysis was applied to a database consisting of 180 Scopus-indexed documents that focused explicitly on sustainability leadership in higher

education. The review seeks to provide higher education scholars and practitioners with empirically derived insights into the current state of SLHE theory and research.

2.2 Method

The bibliometric review method is a variant of systematic review that provides a non-biased, transparent, empirically-grounded approach to analyzing patterns of knowledge production within a discipline or line of inquiry (Hallinger & Kovačević, In press; Zupic & Čater, 2015). In contrast to other review methods (e.g., integrative, scoping, meta-analysis) that focus on synthesizing 'research findings' from a body of literature, bibliometric reviews synthesize 'bibliographic data' associated with a set of research documents (Zupic & Čater, 2015). Moreover, while these other methods of review typically limit their focus to a limited number of studies, bibliometric reviews leverage the capabilities of software to analyze larger numbers of documents in order to reveal broader trends in knowledge production that evolve over time (Hallinger & Kovačević, In press). For example, a recent bibliometric review of research documented the growth trajectory, geographic spread, and theoretical evolution of research on 'instructional leadership' through the analysis of 1,206 documents published between 1940 and 2018 (Hallinger, 2020).

Bibliometric reviews are conducted with the explicit purpose of mapping the full set of relevant literature on a topic. Bibliometric software have been, for example, used to produce 'science maps' that visualize the 'self-organized networks of scholars' who have produced scholarship on a topic (Hallinger & Kovačević, In press; White & McCain, 1998). This approach was deemed suitable for the current review since the literature on higher education leadership for sustainability is an emerging line of inquiry within the sustainability sciences. More specifically, use of bibliometric science mapping tools would enable the authors to identify the theoretical foundations underlying scholarship on higher education leadership for sustainability.

2.2.1 Identification of Sources

Scopus was used as the data source due to its broad coverage across education, management and the social sciences, as well as its capabilities for exporting bibliographic data for analysis in bibliometric software (Hallinger & Chatpinyakoop, 2019; Hallinger & Kovačević, In press). The keyword-based search process followed PRISMA guidelines for conducting systematic reviews of research (Moher et al., 2015).

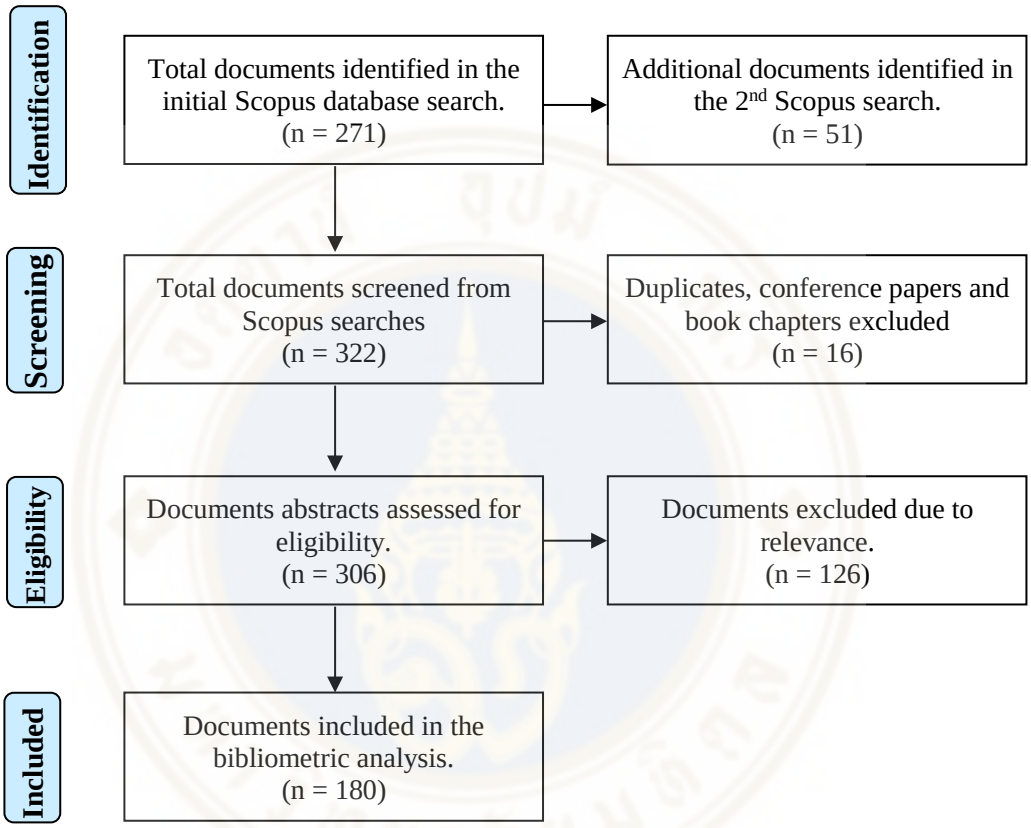

Figure 2.1 PRISMA diagram highlighting the process used in the identification of source documents for the bibliometric analysis of sustainability leadership in higher education

The following keyword string was used in the initial Scopus search without placing limitations by date or type of document: TITLE-ABS-KEY (sustainab*) AND TITLE-ABS-KEY (leadership) AND TITLE-ABS-KEY ("higher education"). Given that 'sustainability' has taken on a unique meaning in current discourse, we believed that this would capture documents relevant to this particular approach to leadership in higher education. This search string directed Scopus to look for these terms, not only in the document keywords, but also in document titles and abstracts.

This initial search yielded a list of 271 documents published between 1998 and 2021 (see Figure 2.1). A supplementary search using additional keywords yielded an additional 51 documents (i.e., 'sustainability leadership', 'sustainable leadership', 'leadership for sustainable development', 'university'). After examining the titles and abstracts of all 326 documents, 146 documents were excluded based on topical relevance and document duplication. Thus, the final review corpus was comprised of 180 Scopus-indexed journal articles, conference papers, and book chapters.

2.2.2 Data Analysis

Bibliographic data associated with the document list were exported from Scopus to an Excel file (Microsoft, 2019) for storage and descriptive analysis. However, before any analyses were performed, the Scopus list was 'cleaned' to ensure that multiple expressions of the same terms were eliminated (Hallinger & Kovačević, In press). Alternative expressions of common data terms were rationalized through the use of a 'thesaurus' file. The thesaurus file is essentially a set of instructions that the bibliometric software (i.e., VOSviewer) uses to replace the same author's name expressed in alternate forms in different publications (e.g., 'wals, a.e.j.'; 'wals, a.e.'; 'wals, a.') with a single form (e.g., 'wals, a.e.') during data analysis (van Eck & Waltman, 2020). This step is essential to achieving a reliable result.

Author co-citation analysis is a method of bibliometric analysis that seeks to reveal the 'self-organized' streams of research and theory that underlie a field of study or line of inquiry as it evolves over time (White & McCain, 1998). Co-citation analysis is a well-defined and validated empirical approach that applies social network analysis to the study of disciplinary composition and topical evolution (Price, 1965; Small, 1973; White & McCain, 1998; Zupic & Čater, 2015). Indeed, two decades ago, Gmür (2003) concluded that, "After 30 years of research, co-citation analysis has become the dominant method for the empirical study of the structures of scientific communication (p. 27).

In this study, VOSviewer software was used to conduct author co-citation analysis in a multi-step process (Van Eck and Waltman, 2020). When conducting author co-citation analysis, VOSviewer first tracks the frequency with which individual authors have been 'cited in the reference lists' of the 180 Scopus-indexed review

documents. This feature of author co-citation analysis contrasts with traditional 'author citation analysis' which tracks the impact of scholars who authored the review documents themselves. Whereas citation analysis highlights high impact authors, co-citation analysis is used to reveal the underlying knowledge base on which a field grounded (Small, 1973). That is, scholars who are *frequently cited by authors working within a particular line of inquiry* can be interpreted as important sources of theoretical influence on the direction of scholarship (Hallinger & Chatpinyakoop, 2019; Small, 1973; Waltman et al., 2010).

In the next step, VOSviewer calculates the frequency with which *'pairs of authors' appear together in the same reference lists* (i.e., 'co-cited'). Co-citation analysis assumes that when two authors are frequently cited together, they often share a theoretical or empirical similarity (Small, 1973; White & McCain, 1998; Zupic & Čater, 2015). Thus, for example, in the current review R. Lozano and W. Leal-Filho were frequently 'co-cited' by other scholars writing on sustainability leadership in higher education. From an analytical perspective, this means that their published works often appeared in the same reference lists of the review documents. From an interpretive perspective, it suggests that they are likely to share a similar theoretical perspective (Small, 1973; Waltman et al., 2010; White & McCain, 1998).

In the third step, VOSviewer software creates a co-citation matrix comprised of authors and co-citations extracted from the references lists in the review documents (Van Eck and Waltman, 2020). Drawing on this author co-citation matrix, VOSviewer constructs a 'science map' which is a kind of social network map of the field (Waltman et al., 2010). Through this conjoint analysis of author similarities based on co-citation patterns, co-citation analysis has been used to visualize the 'intellectual structure' of a body of knowledge (Hallinger, 2020; Hallinger & Chatpinyakoop, 2019; Small, 1973; White & McCain, 1998; Zupic & Čater, 2015). Typically, the intellectual structure of a body of knowledge is comprised of a limited number of dominant yet dynamic 'schools of thought' or author clusters representing alternative theoretical lines of inquiry (Hallinger, 2020; Hallinger & Chatpinyakoop, 2019; White & McCain, 1998; Zupic & Čater, 2015). For example, the aforementioned bibliometric review of research on instructional leadership visualized five schools of thought that had emerged

in the literature over time (i.e., instructional leadership, leadership for learning, leadership for teacher change, integrated leadership).

2.3 Intellectual Structure of the Literature

An author co-citation map was generated in VOSviewer using a threshold of 12 author citations in the reference lists of the review documents (van Eck & Waltman, 2020). The size of each 'node' on the map refers to the relative frequency of author citation in the reference lists. Thus, the smallest nodes on the map represent authors who were cited 12 times and the largest a scholar who was cited 104 times (i.e., R. Lozano).

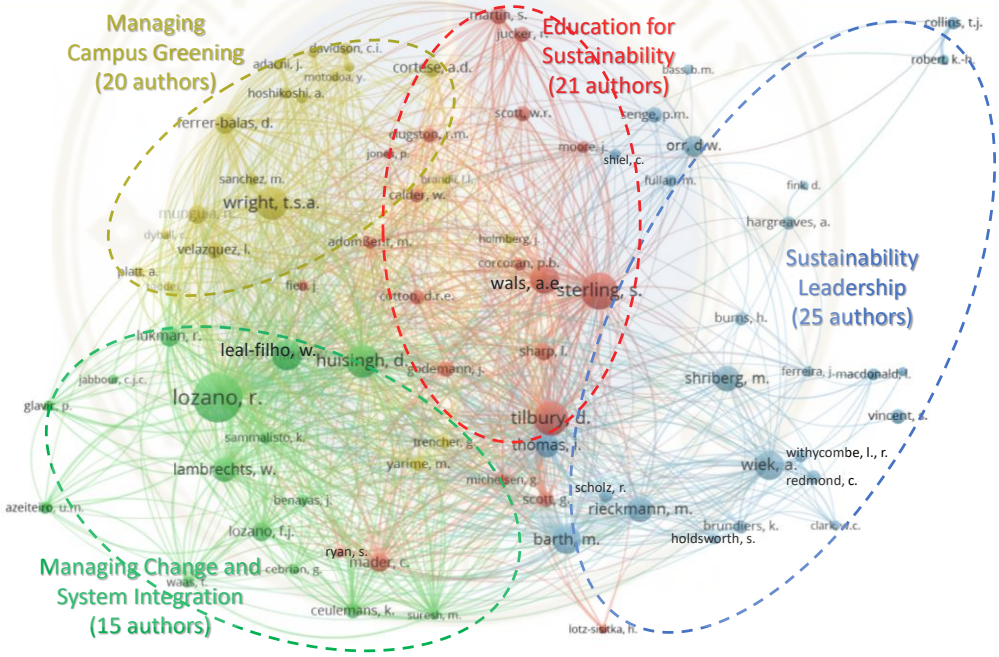

Figure 2.2 Author co-citation map of the literature on sustainability leadership in higher education, 1998 to 2021

'Links', or the lines connecting author nodes, represent 'co-citations' of the two authors by other scholars. Dense links suggest frequent co-citation of the author pair by other scholars writing on SLHE. The 'proximity' of nodes on the map reveals the degree of thematic similarity among the authors (Zupic & Čater, 2015). Authors who are located close together typically share a closer affiliation in perspective. Finally,

the colored clusters of authors on the map signify 'schools of thought' comprised of scholars operating from similar theoretical paradigms.

As seen in Figure 2.2, four clusters of scholars emerged from the author co-citation analysis. In the words of Gmür (2003), these 'schools of thought' represent, "'invisible colleges', i.e. research networks [of scholars] that refer to each other in their documents without being linked by formal organizational ties" (p. 27). The author co-citation map in Figure 2 indicates that the SLHE literature is currently comprised of four such 'invisible colleges': Sustainability Leadership, Education for Sustainability, Managing Campus Greening, Managing Change and System Integration.

2.3.1 Sustainability Leadership

The largest school (blue cluster) consists of authors who have provided the theoretical foundations for nature of Sustainability Leadership, primarily but not exclusively in educational organizations. This school is led by Wiek (52 citations), Barth (51), Rieckmann (45), Shriberg (44), Thomas (41), Orr (34), and Hargreaves (19). Authors located in this school have conceptualized sustainability leadership in K-12 schools (Hargreaves & Fink, 2006) as well as in higher education (Burns & Schneider, 2019; Collins, 2017). Within this school of thought, scholars have also sought to define the competencies underlying sustainability leadership (Barth et al., 2007; Wiek et al., 2011), as well as best practices associated with leadership development programs (Shriberg & MacDonald, 2013).

The wide dispersion of scholars across the physical space of the blue cluster is notable when compared with the other three clusters. The physical distance and dispersion of authors highlight the multiple sectors and theoretical perspectives reflected in the scholarship of authors located in the blue cluster. For example, scholars located in this school have studied sustainability leadership in the private sector (e.g., Bass, Robèrt), public sector (e.g., Orr, Robèrt), K-12 education (e.g., Fink, Fullan, Hargreaves), and higher education (e.g., Burns, G. Dyer, M. Dyer, Thomas). These scholars have also drawn upon a variety of existing models when seeking to conceptualize sustainability leadership in higher education settings: transformational leadership (Barth et al., 2020; Bass & Riggio, 2006; Shriberg & Harris, 2012), authentic leadership (Srivastava et al., 2020), strategic leadership (Robèrt et al., 2004), change

management (Shriberg & Harris, 2012), global leadership (Scholz et al., 2018), higher education leadership (Taşçi & Titrek, 2020). This wide variety of theoretical perspectives on 'sustainability leadership', also reflected in the wide dispersion of authors in this school, suggests an absence of consensus on the nature of sustainability leadership that is best suited to the higher education context.

Features of transformational leadership have been especially influential in conceptualizing sustainability leadership (Barth et al., 2020; Bass & Riggio, 2006). This is most probably due to the imperative embedded in sustainability leadership of articulating a new vision for the university, as well as finding ways of attaining goals that were previously considered unreachable (e.g., triple bottom-line). Moreover, transformational leadership is explicitly oriented toward managing change (Bass & Riggio, 2006; Ferrer-Balas et al., 2008; Purcell et al., 2019). Sustainability leadership is, therefore, by definition transformational.

At the same time, the discourse on sustainability leadership emphasizes a 'participatory' rather than a 'strong leader' approach (Chuvileva et al., 2017; Parnell, 2016). Sustainability leadership tends to embrace shared decision processes that engage a wide range of stakeholders including students (Adomßent et al., 2019; Shriberg & Harris, 2012), faculty (Kaza et al., 2016; Wright & Horst, 2013), and community members (Farner, 2019; Ferrer-Balas et al., 2010). Indeed, not only does sustainability leadership emphasize stakeholder participation, but also the distribution of leadership across different role groups (Avissar et al., 2018). Thus, the exercise of sustainability leadership in higher education is not strictly bound to formal administrative roles. These proposed features of sustainability leadership implicitly recognize and seek to leverage the decentralized, loosely-coupled structure of universities.

Scholars in the Sustainability Leadership school have also been active in identifying key competencies needed by leaders to enhance the sustainability of universities (Barth et al., 2007; Wiek et al., 2011). According to Barth et al. (2007), sustainability leaders need competencies in forward thinking, interdisciplinary knowledge, collaborative skills, transcultural understanding, planning and implementation skills, reflective thinking, compassion, and motivation. Early empirical efforts have been undertaken to examine specific teaching and learning methods aimed

at developing sustainability leadership competencies among prospective and practicing higher education leaders (Burns & Schneider, 2019; Collins, 2017; Wiek et al., 2014).

2.3.2 Education for Sustainability

The second largest school of thought (red cluster) consists of authors associated with education for sustainability. Key authors include Sterling (72 citations), Tilbury (65), Wals (52), Mader (31), and Sharp (27). Scholars in the SLHE literature have drawn on the scholarship of authors located in this school when seeking to understand and define the educational mission associated with sustainability in higher education (Corcoran & Wals, 2004; Grecu & Ipiña, 2014; Tilbury, 2004, 2011; Wals, 2014). Their research spans the development of sustainability-oriented curriculum (Lidgren et al., 2006; Sterling & Thomas, 2006; Thomas, 2004), pedagogy (Clugston et al., 2002), professional development (Holdsworth et al., 2008), and learning (Balsinger et al., 2017; Barth et al., 2007). The central location of this school of thought on the co-citation map suggests that education for sustainability provides the conceptual anchor for scholarship in this literature.

The notable dispersion of authors within this cluster reflects the breadth of the education for sustainability literature applied in higher education. Authors in this school have emphasized the 'transdisciplinary' nature of sustainability science and the implications this has for higher education curriculum and instruction (Barth et al., 2020; Godemann, 2008; Peters & Wals, 2013; Sterling & Thomas, 2006; Thomas, 2004). Transdisciplinarity refers to approaches to education that problem-oriented, emphasizes the integration of theories from multiple disciplines, focuses on implementation of knowledge, and engages non-academic stakeholders in knowledge production (Rigolot, 2020). This further suggests the relevance of collaborative problem-solving (Corcoran & Wals, 2004; Godemann, 2008), and action learning methods (e.g., service learning, project-based learning, problem-based learning, simulation-based learning) in both formal and informal learning settings (Aboytes & Barth, 2020; Menon & Suresh, 2020).

Additionally, scholars in this school have conceptualized how the 'research mission' of universities should include an emphasis on sustainability problems in local, regional and global communities (Balsinger et al., 2017; Thomas, 2004). A strategic focus on sustainability research would incorporate social, economic and environmental

sustainability challenges into the institutional research agenda. This would set the stage for the development of innovative products, tools and services that could be applied in policy and practice (Hadorn et al., 2006; Menon & Suresh, 2020; Rau et al., 2018; Waas et al., 2010). Strategies for embedding inter-disciplinary sustainability foci in mainstream research programs of universities include the use of formal publication incentives, establishment of institution-level research centers focusing on sustainability, and incorporating research KPIs in the sustainability reports of universities (Brundiers & Wiek, 2011; Ceulemans et al., 2015; Rau et al., 2018).

2.3.3 Managing Campus Greening

The third largest school of thought (yellow cluster) is comprised of authors whose research examines innovative approaches to Managing Campus Greening. Leading authors include Wright (61 citations), Ferrer-Balas (33), Munguia (29), Cortese (28). The authors have produced conceptual and empirical papers on environmental sustainability and preservation (Cortese, 2003; Wright, 2002), environmental planning (Ferrer-Balas, 2004), and policies and practices that support campus greening (Dzombak & Davidson, 2004; Velazquez et al., 2006).

Authors within this school have highlighted the important role universities can play in promoting climate neutrality by transforming campus operations to become more sustainable (Leal Filho *et al.,* 2015). This includes campuses by reducing greenhouse gas emissions (Trencher et al., 2014; Wals, 2014), recycling (Ferrer-Balas, 2004; Ferrer-Balas et al., 2008), using renewable energy sources (van Weenen, 2000), conserving natural resources such as water (Velazquez et al., 2013), green building design (Dzombak & Davidson, 2004; Sharp, 2002), and other environmental initiatives (Leal Filho, 2015; Wright, 2002).

Notably absent, however, from this school of thought are any authors associated with ‘sustainable supply chain management’. Supply chain management is the primary management tool used by companies to foster environmental and social sustainability in the private sector (Hallinger, 2020; Nimsai et al., 2020). Yet, while a few articles have been published on sustainable supply chain management in higher education (Basu et al., 2016; Comm & Mathaisel, 2008; Jauhar et al., 2018), it remains

a largely unexplored topic related to Managing Campus Greening. This is reflected in the fact that it did not gain sufficient co-citations to appear on the map in Figure 2.

2.3.4 Managing Change and Systemic Integration

The smallest school of thought (green cluster) is comprised of scholars writing on Managing Change and Systemic Integration. This school is led by R. Lozano (104 citations), Huisingh (61), Leal Filho (55), Lambrechts (42 citations), Lukman (33 citations). These scholars have focused on the structural and cultural elements that shape the capacity of higher education organizations to adopt and institutionalize new sustainability practices (Leal Filho, 2015; Lozano, 2006). These scholars have emphasized the need to approach sustainability initiatives from the perspectives of systemic and holistic integration as opposed to project implementation (Lidgren et al., 2006; Lukman & Glavič, 2007).

The emergence of this school of thought on the map reinforces the earlier highlighted finding from the Sanchez-Carillo (2021) review. Specifically, institutional issues related to the integration of sustainability into the university represent a key challenge of organizational change (Avissar et al., 2018; Dyer & Dyer, 2017). Changes identified under the rubric of 'sustainability' include reorienting campus operations (Akbulut-Bailey et al., 2011; Alshuwaikhat & Abubakar, 2008), integrating sustainability into the curriculum and learning experiences of students (Godemann, 2008; Lidgren et al., 2006; Sterling & Thomas, 2006), enhancing the university's role in research and development for sustainability (Lukman & Glavič, 2007; Waas et al., 2010), and strengthening community sustainability through engagement (Farner, 2019; Leal Filho et al., 2020; Lozano, Beulemans, et al., 2015). Yet, the decentralized structure and unique power relations among stakeholders in universities must be taken into account when university leaders seek to put these sustainability programs into practice. Thus, the systemic transformation toward becoming a 'sustainable university' has been proposed as a change that is both top-down and bottom-up, and achieved over a significant span of years, not overnight.

Thus, scholars have note the importance of top management in the university articulating a long-term vision and demonstrating an ongoing commitment toward sustainability implementation (Lozano, Beulemans, et al., 2015). Sustainability

assessment and reporting has been identified as a practice that can foster the integration of sustainability across different domains, such as campus greening, curriculum, and research (Ceulemans et al., 2015; Lozano, 2011). An international study conducted by Lozano (2011) highlighted the largely untapped potential that sustainability reporting has for supporting the efforts of universities to institutionalizes new sustainability practices.

2.4 Discussion

This author co-citation analysis of the literature has visualized the intellectual roots of the SLHE literature. Four 'schools of thought' were identified as pillars of this emerging literature: Sustainability Leadership, Education for Sustainability, Managing Campus Greening, Managing Change and System Integration. Several findings from the analysis can be interpreted in relation to prior reviews of research on sustainability leadership (Hallinger & Suriyankietkaew, 2018), sustainability in higher education (Hallinger & Chatpinyakoop, 2019), and sustainability leadership in higher education (Sanchez-Carrillo et al., 2021).

First, it was noted that much of the 'leadership' literature on supporting this line of inquiry have drawn is drawn from corporate and K-12 education settings. Although leadership in higher education no doubt shares important features with these other organizations, it is, nonetheless critical to understand how differences in the institutional context shapes the enactment of sustainability leadership in universities. We assert that the institutional context of higher education offers both possibilities and constraints relevant to leadership aimed at enhancing sustainability outcomes. Inquiry into the institutional structure of higher education conducted during the 1970s, for example, highlighted goal diversity, technological ambiguity, and fluid participation as context-related factors that distinguish universities from business enterprises (Cohen & March, 1974; Cohen et al., 1972; Weick, 1976). Thus, the authors wish to highlight the 'institutional context' as a potential missing link in the current academic discourse captured in this review. This prompts the question: How do organizational features of

universities shape the needs for sustainability leadership, as well as the strategies that are most likely to achieve results?

Second, if we compare the author co-citation map generated for this review with an earlier cross-sector bibliometric analysis of 'sustainability leadership', several potentially significant differences emerge. First, whereas the cross-sector co-citation analysis yielded multiple 'leadership-centric' schools of thought (e.g., Managerial Leadership, Sustainable Leadership, Leadership for Corporate Sustainability, Leadership for Sustainable Change, Responsible Leadership), the higher leadership education map features only a single 'leadership school' entitled Sustainability Leadership. Moreover, nowhere in the co-citation results or the database itself, did we find comprehensive efforts to define what sustainability leadership should look like in higher education organizations. Thus, while we titled the school of thought, Sustainability Leadership, it was actually a widely dispersed cluster of authors associated with different leadership models. Thus, we suggest that there is an explicit need for additional theorizing on both the nature and effects of sustainability leadership in higher education.

Reference to the author co-citation map offers hints as to the direction this might take. First, the challenge of sustainability involves inspiring multiple stakeholder groups to achieve a vision and goals that seem out of reach in the present (Kantabutra & Saratun, 2013; Trencher et al., 2014). This highlights the relevance of transformational leadership (Bass & Riggio, 2006), which was identified as a 'theoretical root' of the literature in this review, as well as in the earlier cross-sector review of sustainability leadership (Hallinger & Suriyankietkaew, 2018). Transformational leadership is oriented toward inspiring and supporting the movement of stakeholders toward new and ambitious goals (Barth et al., 2020).

Similarly, the 'organizational learning' orientation of transformational leadership also aligns well with the change management challenges and approaches identified in this literature (Ferrer-Balas et al., 2008; Lozano, 2006; Senge et al., 2007). The increasingly common adoption of performance measurement by universities further suggests that elements of 'strategic leadership' (e.g., vision, strategy) will be relevant in conceptualizing sustainability leadership in higher education (Dyer & Dyer, 2017; Robèrt et al., 2004). The earlier cross-sector review of sustainability leadership

(Author, 2018) also highlighted the relevance of ethical, authentic and responsible leadership models (Srivastava et al., 2020). Thus, we conclude that these values-oriented leadership models also hold relevance for leadership that aims to enhance sustainability in universities (Avery, 2005; Kantabutra & Saratun, 2013).

Reflection on the loosely coupled structure of higher education organizations highlights the relevance of a perspective on sustainability leadership in universities as 'distributed' rather 'unitary' in nature (Avissar et al., 2018; Gronn, 2002; Spillane, 2012). Whereas unitary leadership (e.g., lodged in the President or Vice Chancellor) will struggle to maintain the viability of ideas, programs and projects as they are implemented across the loosely coupled levels of the university, distributed leadership grounded in shared values may have greater potential for achieving the coherence that is required for institutional transformation, as opposed to project implementation. This was reflected in the recent literature which suggested that scholars have recently begun to incorporate a stakeholder-based view of participation (Leal Filho et al., 2020; Mazon et al., 2020) and a distributed perspective toward leadership (e.g., Avissar et al., 2018). We believe that these 'seeds' visible in the current literature deserve more attention and could bear fruit in future efforts to conceptualize sustainability leadership in higher education. They also point the way toward practices that should be adopted or avoided as universities move along on the sustainability journey.

Leadership capable of systemic change and integration was noted in both of the prior reviews of sustainability leadership cited in this article (Hallinger & Suriyankietkaew, 2018; Sanchez-Carillo et al., 2021). Understanding universities as loosely coupled organizations further implies a need for approaching sustainability as a systemic or transformative change (Leal Filho, 2015; Lozano, 2006; Mazon et al., 2020). Several highly co-cited scholars (e.g., Barth, Leal Filho, R. Lozano, Shriberg, Wright) asserted that the challenge of embedding sustainability in higher education is not merely an 'add-on' but a cultural change that requires a comprehensive integration of sustainable development in all the systems and practices (Cebrián et al., 2013; Lozano et al., 2013; Senge et al., 2007). Leadership is needed not only to provide the catalyst for this change, but also to support the institutionalization of sustainability values, policies and practices across multiple domains of the university: facilities and

operations (Dyer & Dyer, 2017), education and research (Cebrián et al., 2013; Menon & Suresh, 2020), organizational culture (Grecu & Ipiña, 2014), and community engagement (Cebrián et al., 2013). Thus, we also wish to encourage further research and theorizing along this dimension of sustainability leadership.

Finally, when interpreting the Managing Campus Greening school of thought on the co-citation map, we noted the absence of any scholars associated with sustainable supply chain management. Prior reviews of the literature have identified supply chain management as the most prevalent management domain associated with sustainability implementation in the corporate sector (Kainzbauer et al., 2021). The absence of authors associated with supply chain management from this school on the co-citation map suggests a potential 'blind spot' in this literature. Thus, we also suggest that is a potentially fruitful avenue for future research and practice in this domain.

In conclusion, this paper has generated a snapshot intended to visualize the intellectual pillars of sustainability leadership in higher education. Our findings should provide useful intellectual leverage for scholars and practitioners interested in the means through which leaders can enhance the sustainability of universities and their impact on society. At the same time, we assert that conceptualizations of sustainability leadership in higher education institutions must take into account the unique organizational features of universities.

CHAPTER III
RESEARCH ON SUSTAINABILITY LEADERSHIP IN HIGHER EDUCATION: A SCOPING REVIEW[2]

3.1 Introduction

Organizations throughout the world contribute to unbalanced social, economic, and environmental development based upon a capitalist model that rewards short-term economic profitability. The 'inconvenient truth' is that sustainability challenges facing societies did not develop due to a lack of knowledge, but rather a lack of will to act. Indeed, many of the policies, practices, and technologies associated with "unsustainable development" were designed and managed by university-educated business leaders, scientists, engineers, political leaders, and entrepreneurs (Buszard & Kolb, 2011; Orr, 2004).

The tripartite mission of education, research, and service situates higher education institutions (HEIs) in a unique strategic position with respect to sustainability challenges (Leal Filho, 2015; Lozano et al., 2013). HEIs are responsible for educating new generations of citizens who possess the knowledge, skills, and mindset needed to recognize and address sustainability challenges (Leal Filho et al., 2020). However, transforming the existing operational paradigms of universities will require leadership capable of catalyzing, empowering and sustaining changes in support of long-term sustainability goals (Metcalf & Benn, 2013).

Surprisingly, despite its centrality to the successful implementation of change in universities, sustainability leadership in HEIs remains a poorly developed area of research and practice (Leal Filho et al., 2020). Sustainability leadership has been conceptualized for both corporate (Metcalf & Benn, 2013; Visser & Courtice, 2011) and K-12 school settings (Hargreaves & Fink, 2006). However, relatively few scholarly

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efforts have sought to define and study the nature and effects of sustainability leadership in universities (Sanchez-Carillo et al., 2021). The research questions guiding this review of research were as follows.

1. How is sustainability leadership conceptualized within the higher education literature?
2. What leadership roles and practices are enacted in order to initiate and support sustainability in higher education institutions?
3. What are the expected organizational outputs and outcomes of sustainability leadership within higher education?

This review paper extends the current literature by conducting a scoping review (Levac et al., 2010) of the current literature on sustainability leadership in higher education. The review yields a research-informed model of higher education leadership for sustainability that can be studied empirically in future research.

3.2 Method

The authors selected the scoping review method for this study of the literature due to its suitability of use in reviewing emerging topics that have yet to yield a large body of empirical research (Levac et al., 2010). The main steps in a scoping review include identifying the research question, selecting relevant studies, extracting data, analyzing concepts, and synthesizing findings (Levac et al., 2010).

The Scopus database was used in this review rather than the Web of Science due to its more extensive coverage of the education literature (Hallinger & Chatpinyakoop, 2019). Employing a keyword-based search strategy, the following keyword string was used to generate an initial document list: TITLE-ABS-KEY ("sustainability") AND TITLE-ABS-KEY ("leadership") AND TITLE-ABS-KEY ("higher education"). This search yielded 248 documents (see Figure 3.1). A supplementary Scopus search yielded an additional 41 documents.

Scopus filters were used to exclude 101 conference papers, book chapters, and notes, leaving 188 documents. The decision to limit the review to journal articles was based upon the greater consistency and rigor in peer review. In the next step,

documents in languages other than English, publications with no access to the full text paper, and publications not deemed directly relevant to sustainability leadership were excluded. At the conclusion of this filtering and screening process, 53 journal articles published between 1998 and 2021 remained for analysis in the scoping review.

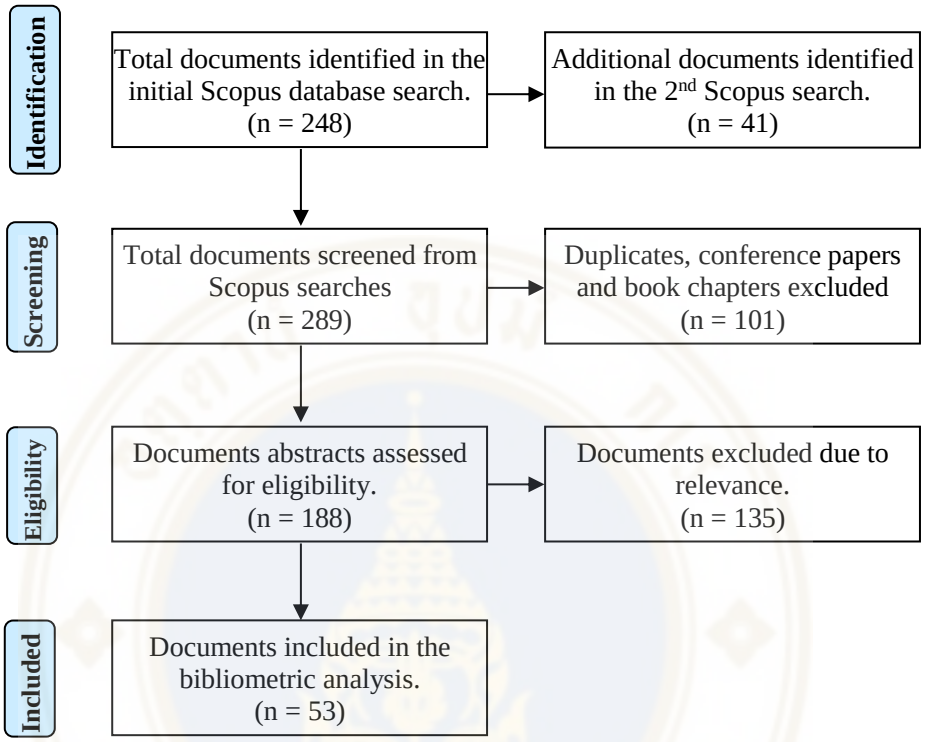

Figure 3.1 PRISMA diagram highlighting the process used in the identification of source documents for the bibliometric analysis of sustainability leadership in higher education

All of the articles were read and coded in line with the research questions. A grounded theory approach was used to analyze information extracted from the articles in order to derive a conceptual model (Corbin, 2021). Firstly, open coding was used to identify and label concepts (e.g. waste management, energy efficiency, sustainability curriculum) that emerged from the literature (see Table 3.1). In the next step, axial coding grouped the codes into broader concepts called subcategories (e.g. make campus greener, integrate sustainability into academia, engage with community), which were then aggregated into still broader categories (e.g. sustainability leadership practices). In the final step, selective coding was used to connect categories into one central theme called ‘sustainability leadership in higher education’. The relationships

and linkages among the broad concepts (i.e. subcategories and categories) and the central theme form the basis for an integrated model of sustainability leadership in higher education which represents the focal contribution of this scoping review.

Table 3.1 Example of the coding process

References	Open Coding	Axial Coding	Selective Coding	Central Theme
Dyer & Dyer, 2017; Lozano et al., 2015; Velazquez et al., 2006	greener facilities sustainable operations energy efficiency waste management	make campus greener	sustainability leadership practices	sustainability leadership in higher education
Alkaher & Avissar, 2018; Menon & Suresh, 2020; Lang et al., 2017	sustainability curriculum experiential learning innovative pedagogy transdisciplinary education	integrate sustainability into academia		
Farner, 2019; Freeman & Dmytriyev, 2017; Purcell et al., 2019	events and workshops local businesses sponsoring projects local sustainability issues	engage with community		

3.3 Results

3.3.1 Descriptive Analysis of the Documents

We began by classifying the documents using a four-type rubric that describes the types of research documents being produced on this topic. Documents were coded as 1) "empirical studies" that explicitly collected and analyzed data, 2) "conceptual papers" that proposed or critiqued a theoretical perspective, 3) "research reviews" that systematically analyzed a set of related documents, or 4) "commentaries" that reported on the experience of a single course, college, university or group of universities without explicit description of data collection and analysis procedures. The documents were comprised of 55% empirical studies, 30% conceptual papers, 11% reviews of research, and 4% commentaries.

Next, we classified the document set by research methods, and evaluated their research quality. The 29 empirical studies evidenced a preference for quantitative methods: 48% quantitative, 28% mixed methods, 24% qualitative. A five-point analytical rubric was then applied to evaluate the quality of the empirical studies. The

rubric focused on five key criteria including clarity of research goals, sampling, data collection, data analysis, potential for contributing new knowledge. The mean evaluation scores 3.1 for quantitative studies, 3.0 for qualitative studies, and 3.6 for mixed methods studies. The grand mean was 3.3, suggesting that current empirical research is only of moderate quality, with limited capacity for contributing to a broad understanding of the nature and effects of on sustainability leadership in higher education.

Several categories emerged from the core theme of sustainability leadership in higher education. These included 1) conceptualizations of sustainability leadership, 2) sustainability leadership practices, 3) sustainability outputs, and 4) sustainability outcomes. Each of these themes is defined and described below.

3.3.2 Conceptualizations of Sustainability Leadership in Higher Education

One of the earliest conceptions of sustainability leadership is found in 'Rhineland leadership' (Avery, 2005) (see Table 3.2). This European model departed from the shareholder value dominance of American capitalism, emphasizing long-term, corporate sustainability through explicit attention to brand reputation, social and environmental responsibility, ethical behavior, and broad stakeholder satisfaction (Kantabutra & Avery, 2011). While investigations of Rhineland leadership and its variants offered useful direction for this review, they are limited due to their exclusive focus on the corporate sector.

Another sustainability leadership model – the 'sufficiency economy philosophy' (SEP) --emerged from an indigenous development philosophy authored by the former King of Thailand, Bhumibol Adulyadej (Avery & Bergsteiner, 2020). The SEP model is a values-based conception of leadership grounded in the Buddhist philosophy of the 'middle way' (Avery & Bergsteiner, 2020; Kantabutra & Avery, 2011). Although, the SEP conception of leadership parallels Rhineland leadership in several respects (e.g., long-term orientation, balanced economic, social and environmental goals, stakeholder engagement), this model places greater emphasis on the underlying values (e.g., moderation, prudence, generosity) that guide sustainability

leadership behavior and foster organizational and societal resilience (Avery and Bergsteiner, 2020).

Table 3.2 Definitions of sustainability leadership

Name	Authors	Definitions	Context
Rhineland Leadership	Avery (2005)	Corporate sustainability is based on long-term sustainability, stakeholder interest, social justice, and cooperation.	Business
Sustainable Leadership	McCann & Holt (2010)	Creating current and future profits for an organization while improving the lives of all concerned.	Business
Cambridge Sustainability Model	Visser & Courtice (2011)	A sustainable leader is one who inspires and supports action toward a better world.	Business
Sustainable Leadership	Gerard et al. (2017)	A complex entity intertwined with sustainable culture with long-term perspective for all stakeholders	Business
Sustainable Leadership	Bendell et al. (2017)	Any ethical behavior that has the intention and effect of helping groups of people address shared dilemmas in significant ways not otherwise achieved.	Business
Sufficiency Economy Philosophy (SEP)	Avery & Bergsteiner (2020)	Balance the economic, societal, environmental, and cultural spheres by following a middle path characterized by moderation, reasonableness, and prudence.	Business
Sustainable Leadership	Hargreaves & Fink (2004)	Shared responsibility that perseveres without depleting human, environmental, or financial resources by taking an activist engagement with the educational environment.	K-12 Education
Sustainable Leadership	Davies (2007)	Long-term development of the school by building a leadership culture based on moral purpose which provides success that is accessible to all (p. 2).	K-12 Education
Sustainable Leadership	Lambert (2012)	Sustainable leadership as a tool for developing organizational capacity and leadership development.	Higher Education
Sustainability Leadership	Leal Filho et al. (2020)	Sustainability leadership entails the processes, which leaders, policymakers, and academics undertake in order to implement sustainable development policies and other initiatives within their organizations.	Higher Education

Conceptualizations of sustainability leadership in educational organizations first emerged during the 2000s (Davies, 2007; Hargreaves & Fink, 2006). Hargreaves and Fink (2006) defined ‘sustainable school leadership’, as a shared responsibility for educational and social development that perseveres without depleting human, environmental or financial resources. Davies (2007) defined sustainability

leadership as shared stakeholder responsibility for the long-term development of the school based on moral purpose. These conceptions of sustainability leadership were, however, grounded largely in literature aimed at understanding how to sustain change initiatives in primary and secondary schools (Bendell et al., 2017; Hallinger & Suriyankietkaew, 2018).

In the higher education context, Lambert (2011) developed a sustainability leadership model for further education colleges, based on the Hargreaves and Fink's (2006) and Davies' (2007) models. Lambert (2011) proposed six foci for sustainability leadership in HEIs. These included (1) enabling capacity building of staff, (2) strategic distribution of opportunities, (3) consolidation of curriculum to avoid duplication, (4) building long-term objectives from short-term goals, (5) encouraging diversity, and (6) conservation of resources. Consistent with its lineage, Lambert's (2011) framework focused somewhat more on the goal of sustaining performance than upon broader sustainability outcomes (e.g., social or environmental sustainability).

More recent scholarship on sustainability leadership in higher education is explicit in its concern for advancing toward sustainable development goals and impacting not only the school, but also society (Kolenick, 2017). This perspective is captured by Leal Filho et al. (2020) who defined sustainability leadership in higher education as, "the processes which leaders, policymakers, and academics undertake in order to implement sustainable development policies and other initiatives within their organizations" (p. 3761). According to Allen (2019), key aspects of sustainability leadership in higher education include embedding sustainability values in the university's core purpose, curriculum, teaching and learning, research, and organizational administration.

Leal Filho et al. (2020) further emphasized the 'distributed bottom-up nature of sustainability leadership', asserting that anyone in the university can become a 'sustainability leader' by taking on responsibility to promote sustainable conditions in the workplace. Thus, administrators, students, faculty members, and staff all have the potential to become "sustainability leaders" by focusing with intention on addressing sustainability challenges within the operation of the university. In this conception, sustainability leadership is not associated with a specific organizational role or limited to the purview of university administrators (e.g., president, vice

chancellor, dean). Consistent with this perspective, Allen (2019) highlighted the importance of engaging, empowering, and enabling students and staff in sustainability dialogue and practices.

Drawing upon these models of sustainability leadership, the authors suggest that sustainability leadership in higher education begins by clarifying and articulating the values which will guide the university's direction and decision-making. Second, sustainability leaders will develop an inspiring long-term vision and shorter-term goals that describe the university's desired social, environmental and economic impact. Third, sustainability leadership aligns the university's educational, research and management policies, programs, and practices with these goals (Buszard & Kolb, 2011). Finally, sustainability leadership expands and intensifies the engagement of internal and external stakeholders, as well as emphasizing capacity development as a foundation for change (Kantabutra & Saratun, 2013).

3.3.3 Sustainability Leadership Practices

The second research question inquires into the nature of leadership practices that contribute to or are associated with sustainable institutions of higher education. These practices are organized into several subcategories: leadership vision, transforming facilities and operations, integrating sustainability into research and educational programs, developing a sustainability culture, and fostering community engagement.

3.3.3.1 The Role of Leadership in Defining a Vision of Sustainability. In the absence of leadership, neither corporations nor universities will undertake the challenge of reorienting the organization's mission toward economic, social and environmental sustainability (Buszard & Kolb, 2011). Because the change for sustainability involves a major shift in institutional goals, sustainability leaders at the top of the university must assume responsibility for making value choices explicit (Thian et al., 2016). For example, will the university's administrators define key performance indicators that simply focus on driving up citation counts across faculties and departments, or will they prioritize research and development programs that address sustainability challenges? Will university administrators offer financial support for relevant institution-level research centers as a part of its sustainability strategy?

Responsible leadership articulates this value choice, encourages educative discourse among stakeholders, and prioritizes goals that reflect this orientation (Maak & Pless, 2006; Siegel, 2014). Velazquez et al. (2006) suggested that the first step in the strategic move toward integrating sustainability in higher education is creating a sustainability vision that offers a clear direction, provides stewardship, and enhances the affective commitment of stakeholders.

However, creating shared vision among stakeholders is a complex process that only unfolds over a period of years (Ferguson et al., 2015). Moreover, the challenges entailed in realigning the university's vision and mission with economic, social, and environmental sustainability should not be underestimated. While conceiving a new sustainability-oriented vision is rather straightforward, reconciling competition and contradictions among the three sustainability pillars is far more challenging in practice (Bendell et al., 2017). Indeed, the adoption of sustainability values in universities mirrors the challenge that corporations face as they try to move away from a single-minded focus on maximizing "shareholder value". In the absence of sustainability leadership, goals and strategies may be treated as value neutral, thereby reinforcing the status quo (Doh & Quigley, 2014; Siegel, 2014).

Thus, senior administrators in the university must consider the optimal strategy to employ in leading this change. While sustainability initiatives are often launched by top management in the corporate sector, a 'top-down' approach faces more obstacles in the "loosely-coupled organization" of universities. Traditions of autonomy and academic freedom, as well as fewer formal rewards and sanctions, reduce the ability of administrators at the top of universities to transform visions and goals into practices in faculties, departments, and classrooms. On the other hand, a 'bottom-up' approach to institutional transformation is unlikely to get off the ground without meaningful support from senior administrators and an organization-wide framework of sustainability goals (Levesque & Wake, 2021).

Both top-down and bottom-up leadership strategies are required to ignite a shared vision that aligns stakeholder practices both vertically and horizontally (Leal Filho et al., 2020). The task of developing and communicating a shared vision of sustainability is not limited to senior administrators. It requires collaboration with deans, faculty, staff, students, and even community leaders

(Kolenick, 2017; Maak & Pless, 2006). Pollock et al. (2009) offered an initiative at the University of Vermont that adapted Q methodology to collaboratively create a shared vision through community events and online surveys. This approach aimed to achieve a strong consensus around sustainability values, while managing the risk of divisiveness and polarization different stakeholder groups (Scott, 2015).

3.3.3.2 Transforming Facilities and Operations. Sustainability leadership in K-12 education has focused on "leadership" to the almost total exclusion of "management". In contrast, the higher education literature also highlights the managerial practices associated with "campus greening". Lozano, Beulemans, et al. (2015) conducted a global survey which identified numerous successful campus greening projects. These included initiatives related to energy (e.g., optimization of electricity, ventilation, and heating), waste management/recycling (e.g., recycling rain water, waste sorting), transportation (e.g., bicycle use, public transport), purchasing, technological uses and innovation, and social justice (e.g., equality and diversity policy, specific actions toward certain target groups). However, despite these examples of sustainability innovations in campus greening, few universities have achieved a systematic transformation of sustainable campus operations (Sharp, 2002).

Sustainability leadership at both the strategic and operational levels is required to support the transformation of facilities and operations (Mazon et al., 2020). Measurement in the form of both KPIs and operational standards is critical both as a means of stimulating and assessing progress toward a green campus. According to Dyer and Dyer (2017), successful institutionalization of sustainability in campus operations involves (1) interacting and collaborating with diverse stakeholders, (2) establishing a better understanding of the current institutional reality such as carbon footprints, greenhouse gas emissions and broader sustainability activities, (3) planning for long-term sustainability with holistic and integrated solutions, (4) financing and maintaining a healthy operational budget, and (5) prioritizing and implementing tactical actions in alignment with the strategic plan.

While supply chain management is perhaps the most powerful management practice used to support social, economic and environmental sustainability in the private sector (Seuring & Müller, 2008), it has received relatively little explicit attention in the higher education literature. Sustainable supply change

management impacts environmental, social, and economic practices and standards related to purchasing, transportation, and relationships with suppliers. As such, it represents a high leverage practice when driven by sustainability-oriented values.

3.3.3.3 Incorporating Sustainability into Education and Research. Teaching, learning, research, and service constitute the 'technical core processes' of universities. Dyer and Dyer (2017) argued that the core purpose of a university is to educate students and generate new knowledge that benefits society. Therefore, teaching, learning, and research represent additional leverage points for sustainability leadership (Kolenick, 2017; Menon & Suresh, 2020; Yue et al., 2021).

The literature recognizes the importance of promoting transdisciplinary teaching and learning (Cortese, 2003; Lang et al., 2017). Action projects that engage inter-disciplinary teams can yield meaningful, systemic solutions by broadening the knowledge resources that are brought to bear on a given issue (Cortese, 2003; Lang et al., 2017). Transdisciplinary projects, case studies, and problem-based projects represent means of bringing more broad-based knowledge to the analysis of sustainability issues (Menon & Suresh, 2020).

However, the literature also highlights how the organizational structure of universities tends to undermine collaboration across different academic units (Lozano, Beulemans, et al., 2015). Moreover, imposing mandates for engagement in sustainability initiatives clashes with the tradition and value of academic freedom. These features of university cultures further emphasize the need for leadership, engagement and discourse among stakeholders through the university before sustainable change can take place.

The literature also highlights potential for research conducted by faculty and students to uncover new ways of addressing unsustainable practices and disseminating innovations (Bolger, 2021). University administrators can support sustainability-related research through securing institution-level research funding (Bolger, 2021), establishing endowed chair professorships with a sustainability focus, offering incentives for sustainability-related research and publications, initiating university-private sector partnership projects, and through establishment of an interdisciplinary, university-wide research center on sustainability. While these

initiatives can be initiated by stakeholders at any level of the university, they usually require top-level administrative support for success.

One innovative development in sustainability research and development lies in 'living labs'. This is a user-centered, open-innovation, experimental educational approach that encourages faculty and students to engage in on-campus and off-campus collaborative research projects (Purcell et al., 2019). Living lab projects initiated at universities around the world have tackled a wide range of sustainability challenges including climate change, social equity, green energy, and sustainable economic growth (Purcell et al., 2019; Save et al., 2021).

3.3.3.4 Developing a Sustainability Culture. According to (Schein, 1987), culture is defined as a pattern of unwritten rules and tacit beliefs shared by members of an organization or social group. Culture operates at the levels of visible artifacts, espoused values, and invisible underlying assumptions. Culture plays a key role in shaping and changing unconscious assumptions, deeply ingrained beliefs, dominant values, and human behavior (Schein, 1987).

Sustainability leadership must target the institutional culture as a key leverage point in efforts to integrate sustainability as a social norm within the university. In a sustainability culture, relevant values (e.g., environmental and social justice, moderation, generosity, long-term perspective) become visible in the daily behaviors and practices of stakeholders, in the building and grounds, as well as in standard operating procedures used throughout the university (e.g., procurement, energy use, waste management, transportation, construction).

However, changing a university's culture is a complex process. The invisible layer of deeply ingrained beliefs and tacit assumptions that act as a stabilizing core for the organization also tend to resist change (Adams et al., 2018). Moreover, the 'invisible layer' of culture cannot be directly targeted. Instead, cultural transformation approaches tend to focus on changing the 'visible layers' such as university vision, mission, key performance indicators, policies, organizational structures, processes, incentives and rewards,. This reflects the assumption that moving the visible layers will slowly change the underlying assumptions (Adams et al., 2018). Thus, for example, Drucker (1954) observed that, "what gets measured gets done" and what gets rewarded gets repeated (p. 32).

Researchers have identified a range of leadership practices that can be used to cultivate a sustainability culture. Leaders can initiate and engage with stakeholders in an open platform for dialogue on sustainability issues that impact the university and society (Kolenick, 2017). A system of incentives and rewards can also be established for individuals and departments that foster sustainability on campus (Alkaher & Avissar, 2018). Additionally, expectations and model behaviors that are consistent with sustainability values can be articulated and modeled for and by middle level managers (Mazon et al., 2020). Leaders can make changes in one part of the university 'visible' to stakeholders in other colleges and departments (Pollock *et al.*, 2009). Lastly, barriers to innovation need to be addressed and assumptions need to be tested when behavioral change does not result from policy change (Argyris, 1977).

3.3.3.5 Fostering Community Engagement. Universities do not exist as an island. They have an ethical responsibility and moral obligation to support social, economic, and ecological development of their local, regional and global communities (Farner, 2019). Thus, a key role of sustainability leadership – at every level of the institution from the university council to students -- lies in strengthening the university's relationship with society (Kantabutra, 2019). This can be achieved through some of the strategies already discussed such as research and development, living labs, and service learning (Menon & Suresh, 2020).

This can create a model of two-way knowledge generation where sustainability students and faculties learn together 'with' and 'through' the community. Such co-generation of knowledge with and through the community also aligns with the stakeholder theory (Freeman & Dmytriyev, 2017). As argued by Kantabutra (2019), generating new knowledge by sharing knowledge with external stakeholders leads to business continuity and corporate sustainability. In a higher education context, leadership practices aimed at knowledge co-creation and sharing may lead to community development toward sustainability.

3.3.4 Sustainability Outputs and Outcomes

The final research question concerns the role leaders can play in supporting sustainable outputs and outcomes in higher education institutions. Bergsteiner and Dharmapiya (2016) defined outputs as concrete measurable sustainable results, and

outcomes as difficult to measure, less tangible, long-term idealistic indicators of sustainability.

3.3.4.1 Sustainable University. Sustainable universities are guided by sustainability values, and seek to achieve a balanced set of goals (Teay, 2019). All universities are already expected to strive for economic durability through wise spending, prudent expansion, and development of productive relationships with students, alumni, suppliers, and employees. However, a sustainable university also prioritizes environmental viability through management of energy consumption, waste management, recycling, and green purchasing, and managing the supply chain (Robinson & Pedersen, 2021; Saeudy, 2015). Increasingly, sustainability in universities is also being measured through its commitment to social and cultural diversity, not only internally but also in relationships with external stakeholders.

3.3.4.2 Sustainability Knowledge and Innovation. Scholarship and research on sustainability in higher education are heavily dominated by scholars in Western societies (Hallinger & Chatpinyakoop, 2019). There is an increasing awareness of the need to understand sustainability issues and solutions in different cultures and contexts in order for universities to become a viable change agent toward a sustainable future (Stephens et al., 2008). Examples of sustainability knowledge and innovation outputs of sustainability leadership include sustainability embedded curricula (SDG 4, 5), capacity building of students and staff to promote sustainability knowledge (SDG 8), transdisciplinary teaching, project-based learning (SDG 4), and sustainability research, publications and innovative solutions (SDG 11, 13, 14, 17) (Lozano, 2011).

3.3.4.5 Sustainability Mindset and Behaviors. Teay (2019) argued that “education should not only lead to knowledge but the creation of wisdom to make use of knowledge” (p. 385). Knowledge and skills, used in the absence of morality promotes short-term thinking, and prioritizes the self-interest of individuals and firms (Avery, 2005; Teay, 2019). This highlights the need for producing graduates with a sustainability mindset and behaviors. This links to SDG 4.7, which seeks to ensure that all learners acquire the knowledge and skills needed to promote sustainable development (UN General Assembly, 2015, p. 17).

3.3.4.6 Community development. Communities are among the key stakeholders of universities (Cortese, 2003). Through their stewardship of sustainability, universities have the potential to improve the quality of life in their communities, while also modeling pro-sustainability behaviors (Hallinger & Suriyankietkaew, 2018; Menon & Suresh, 2020). Universities can contribute to community development by providing scholarships and assistance packages to students living in poverty (SDG 1), delivering programs to enhance literacy in communities (SDG 4), hosting competitions for energy saving solutions (SDG 7), and modeling policies that reduce corruption and bribery (SDG 16) (SDSN, 2017).

3.3.4.7 Sustainability Outcomes. To date, there is very limited research on the 'sustainability outcomes' of higher education institutions. We wish to highlight two types of sustainability outcomes that seem pertinent to HEIs: institutional resilience and societal resilience (Amaral et al., 2015; Avery & Bergsteiner, 2020; Kantabutra & Saratun, 2013; Robinson & Pedersen, 2021). At the institutional level, a key outcome lies in the development of the university's capacity to withstand uncertainty and shocks from the external environment. The COVID-19 pandemic has challenged the resilience of universities. It should cause leaders to ask, 'what values and processes enable the university to respond productively and sustain in the face of unexpected financial, social and environmental challenges?'

Moreover, universities also have the possibility of contributing the resilience of the societies in which they are located (Lozano, Beulemans, et al., 2015). Thus, a broader sustainability outcome lies in the transformation or betterment of society (Dyer & Dyer, 2017; Leal Filho et al., 2020). Again, referencing the COVID-19 pandemic, universities contributed innovative solutions through the creation of vaccines, education of society concerning the disease, development of management information software and systems, and innovative supply chain solutions. More broadly, perhaps the longest-term outcome of a sustainable university is the 'production' of future citizens and leaders who will build businesses, organizations, societies, and communities that are resilient to internal and external threats (Amaral et al., 2015; Avery & Bergsteiner, 2020).

3.4 Discussion

This scoping review of research sought to document and synthesize findings drawn from conceptual and empirical research on sustainability leadership in higher education. Our content analysis of 53 documents suggests a reasonably well-balanced distribution across empirical, conceptual, commentary and review articles. The balance between empirical research (48%) and conceptual papers (30%), in particular, bodes well for the development of a theoretically-informed, empirically-tested literature. That said, the quality of research on sustainability leadership in HEIs remains constrained with few empirical studies studying the enactment of sustainability leadership and its effects across multiple institutions. Instead, most empirical studies were based on the analysis of a single class, course of study, curriculum, or institution. Thus, the current "knowledge base" is best characterized as "nascent". With this in mind, in this section of the article, the authors will propose a conceptual model of sustainability leadership for higher education, and discuss the implications of our broader findings.

3.4.1 A Proposed Model of Sustainability Leadership in Higher Education

Our proposed model of sustainability leadership in higher education is displayed in Figure 3.2. From left to right, the model starts with sustainability leadership which is a distributed form of leadership that aims to transform the university through sustainability integration (Leal Filho et al., 2020). Sustainability leadership promotes a shared vision among stakeholders which garners emotional commitment to the change for sustainability (Kantabutra, 2020).

Using a systems thinking approach (Senge, 1990), sustainability leadership seeks to align the university's vision and mission with the integration of sustainable policies and practices across campus facilities and operations, learning and research, organizational culture, and community engagement (Cebrián et al., 2013; Lozano et al., 2013; Menon & Suresh, 2020). Dimensions of both transformational (Bass & Riggio, 2006) and strategic leadership (Dyer & Dyer, 2017) have been identified as central to efforts to align campus facilities and operations with the sustainability vision (Amaral et al., 2015; Velazquez et al., 2006) through. Integration of sustainability values and

issues in learning promotes not only sustainability knowledge but also a mindset that shapes the future behavior of student citizens (Ceulemans & Severijns, 2019; Levesque & Wake, 2021). Additionally, studies show that when universities incentivize sustainability research, it leads to new knowledge and innovations that address sustainability challenges in society (Bolger, 2021; Menon & Suresh, 2020). Drawing on stakeholder theory (Freeman & Dmytriyev, 2017), sustainability leadership seeks to stimulate community development through active engagement with local communities to highlight and address sustainability issues (Doh & Quigley, 2014; Farner, 2019). Over time, the university will develop a "sustainability culture" in concert with changes in stakeholder mindset and behaviors (Adams et al., 2018; Schein, 1987; Senge, 1990). Catalyzed and supported by sustainability leadership, these internal changes in the university will become evident in key performance indicators associated with its outputs. Together these potential "effects" of sustainability leadership should cohere into the less easily measured resilience of the institution and society.

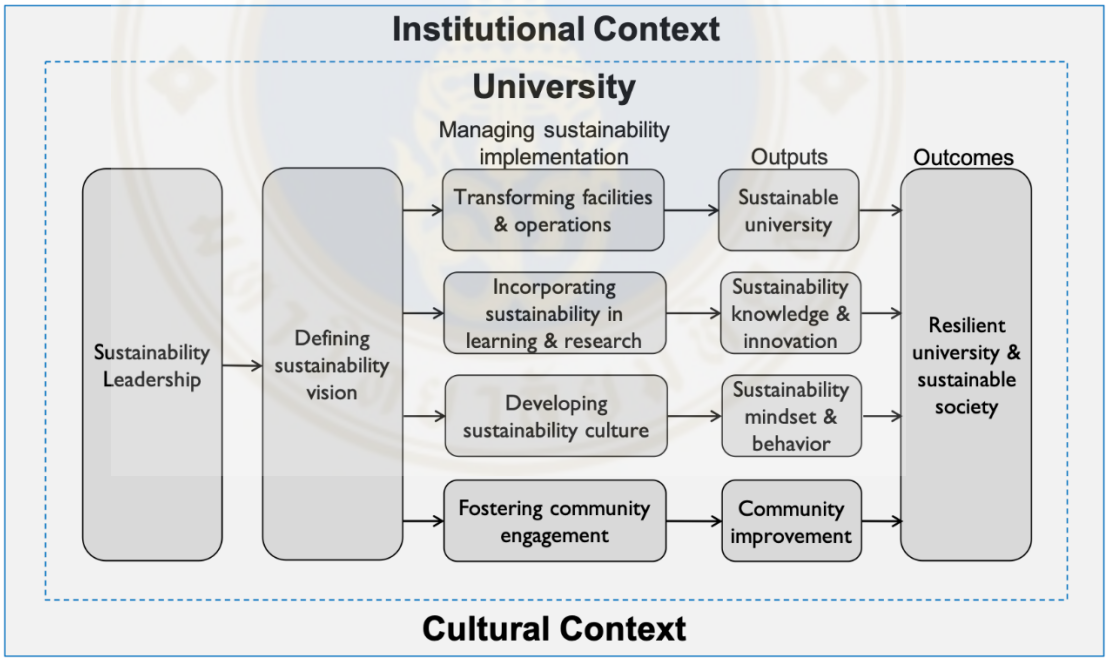

Figure 3.2 A proposed model of sustainable leadership in higher education

In this model, cross-level leadership is required to strategically anticipate and solve systemic issues associated with integrating sustainability into the implementation foci identified in Figure 2. It should also be noted that while the arrows

in Figure 2 suggest a causal chain, in practice, these sustainability dimensions develop concurrently and with some degree of reciprocity, rather than sequentially (Scott, 2015). For example, individuals and departments within a university may begin integrating sustainability issues into curriculum and research even before a "sustainability vision" has been articulated for the university (McNamara, 2010). However, the directionality implied in Figure 2 highlights the fact that the value and behavioral change required for "organizational transformation" (i.e., in Outputs and Outcomes) is often catalyzed by leadership (Doh & Quigley, 2014; Menon & Suresh, 2020).

The authors have also highlighted the role that responsible leadership can play by initiating conversations with internal and external stakeholders about the values that the university wishes to support (Doh & Quigley, 2014; Maak & Pless, 2006). This should be an educative conversation supported by leaders at every level of the university, not only at the top (Maak & Pless, 2006; Siegel, 2014). For instance, university-community partnered living labs can bring together internal and external stakeholders to work on local sustainability issues (Purcell et al., 2019; Save et al., 2021).

It should further be noted that this model places the university within "systems of higher education" that reflect the cultural norms of their societies. This acknowledges that while universities have the potential to influence their communities, they also respond to forces in the social environment. The actual dynamics of the transformation process that unfolds in a university are, to some extent, underemphasized by the linearity of our model.

3.4.2 Implications for Research and Practice

Findings from this review yield several implications for research and practice. With respect to research, the conceptual model presented above, offers a framework for research. Research can be conducted within a dimension (e.g., exploring the nature of sustainability leadership) or across dimensions (e.g., effects of vision on culture change). As suggested above, the model can also be used to assess the impact of leadership on the university's sustainability outputs. The steadily increasing adoption

of measurable sustainability KPIs by universities will facilitate longitudinal quantitative research on the effects of sustainability leadership on important outputs.

One critical focus for research concerns how sustainability leadership achieves a viable operational balance among competing goals of the university (i.e., economic, environmental, social). Equally relevant is understanding how sustainability leadership develops and creates consensus around new sustainability values and goals. For example, assumptions about sustainability issues, sustainable development goals, and their necessity must be tested and debated when seeking to gain consensus around a shared vision of change (Argyris, 1977; Cebrián et al., 2013). These research foci are best examined through qualitative and mixed methods research.

A second focus for research would aim to understand how sustainability leadership emerges and is distributed within a university. For example, what are the different leadership roles played by different stakeholder groups? What is the nature and balance of leadership enacted by university administrators and non-formal leaders? What types of leadership development prove most efficacious, and when during the transformation process?

A third focus lies in the understanding the role that leadership plays in the transformation of the university toward enhanced sustainability. What obstacles do leaders face in the sustainability transformation process? What strategies prove efficacious? What knowledge and capacities are needed to lead the change for sustainability in a university?

Finally, it should be recognized that universities exist in particular institutional (e.g., policy) and cultural contexts. This context shapes the perception of needs, the localized challenges, the resources, and the opportunities facing leaders who commit to sustainability transformation. For example, leaders seeking to enhance sustainability at a private, ivy league university in the USA operate in a very different context than at a public university in India or China. This highlights the need for contextualized research that is conducted in universities across different societies. By "contextualized research", the authors emphasize the need to make the context evident in the research process, not simply conduct the research across different societies.

In terms of practical implications, university administrators should recognize that leadership must grow by design and not by default (Leal Filho et al.,

2020; National College for School Leadership, 2007). Developmental opportunities should be provided for middle-level leaders, staff, faculty, and students with the goal of increasing the "density" of sustainability leadership throughout the university over time.

Through strategic programs and engagement with the community, university administrators and leaders need to set into motion positive social change for sustainability. For example, universities can set standards and requirements for their suppliers to comply with the social criteria such as human rights, ethical labor practices, and product responsibility (Lozano, 2011). When universities assume a more intentional stance toward creating social awareness of sustainability issues and take meaningful actions to improve people's lives, societal expectations of universities will change (Stephens et al., 2008).

Finally, this review highlighted "blank spot" within the scope of sustainability leadership. This lies in practices associated with sustainable supply chain management (Seuring & Müller, 2008). University administrators are routinely charged with managing supply chains, but research suggests that they do so largely without an awareness of the potential for reducing harmful effects on the environment, and promoting more positive social impact on external stakeholders. It seems ironic that universities are lagging so far behind the corporate sector in this respect. Thus, the authors urge university administrators to tap the sustainability potential that lies in adopting more intentional supply chain management processes.

CHAPTER IV
LEADING THE CHANGE TO SUSTAINABLE UNIVERSITIES: A QUALITATIVE STUDY

4.1 Introduction

The integration of sustainability into higher education has emerged as a critical area of focus in recent years, prompting an increasing number of universities worldwide to adopt initiatives aimed at enhancing their social, environmental, and economic sustainability (Aung & Hallinger, 2023; Menon & Suresh, 2020). Despite these efforts, there remains a significant gap in understanding the intricacies of the change process within these institutions. Leal Filho et al. (2020) highlighted a notable scarcity of research specifically addressing the role that leadership plays in implementing sustainability in higher education. Indeed, Mader et al. (2013) asserted that higher education institutions tend to prioritize discussions on the need for change over the practical implementation of these transformations, thus hindering the impactful realization of sustainability goals (Rieg et al., 2021).

These calls for focused empirical inquiry into the integration of sustainability into university policies and processes motivated this essay. More specifically, this essay has two main objectives. The first is to report the results of qualitative research into the change process experienced by universities that have demonstrated success in enhancing sustainability as measured by formalized assessments. The second objective is to generate information concerning the change process, obstacles, strategies, and activities that can be used to inform the design of the Leading Change for Sustainability in High Education (LCSHE) simulation. These objectives encompassed the following research questions.

1. What are key change stages, obstacles and activities experienced in universities during projects and programs designed to enhance their sustainability?

2. How do universities overcome obstacles to the implementation of sustainability values, programs, and practices?
3. How do internal and external factors influence the success of sustainability projects in universities?

This qualitative study is situated within the broader context of a larger research and development (R&D) process (see Chapter 1). Thus, the research described in this chapter represented a key step in the 'Information Collection' stage of the R & D process. More specifically, the results of this Chapter were also used to inform the development of a higher education version of the Leading Change for Sustainability computer simulation. Through this approach, the study aims both to contribute valuable insights to the field of sustainability in higher education and support the development of a tool that can be used to prepare higher education stakeholders more effectively to meet the challenges of sustainability.

4.2 Literature Review

4.2.1 Organizational Change

Change is a fundamental reality from which organisms or institutions can escape and universities are no exceptions. Due to the sheer force of political, economic, technological and socio-cultural pressures, organizations are constantly challenges to change and adapt (Elkin et al., 2008). This is why understanding how to bring about effective change is crucial for organizations to survive, grow and thrive (Bridges & Bridges, 2019; Fullan, 2007).

Undertaking a successful organizational change is not a natural process. It involves changing ingrained mindsets and behaviors of individuals and groups at multiple levels of the organization. Since universities are complex systems, looking at the process of change from one vantage point is insufficient (Buller, 2015). Multi-frame thinking proposed by Bolman and Deal (2017) provides a mental model for deciphering and capturing a more comprehensive picture of organizations. They proposed the use

of structural, human resource, political and symbolic frames, each of which offers its own perspective on the organizational reality (Bolman & Deal, 2017).

The structural or rational frame focuses on formal roles and responsibilities, hierarchical orientation of positions, vertical and lateral coordination, organizational goals, and policies (Bolman & Deal, 2017). The human resource frame focuses on the individual motivations, capacities, and needs of stakeholders (Buller, 2015). The political frame highlights, "the realistic process of making decisions and allocating resources in a context of scarcity and divergent interests" (Bolman & Deal, 2017, p. 183). Finally, the symbolic frame emphasizes the organization's culture and traditions which permeates through every layer of organizations (Buller, 2015). Viewing organizations through these multiple frames leads to a more multi-faceted understanding of problems, and enables leaders to develop alternative diagnoses and strategies to address them.

Waters and Grubb (2004) classified change into first-order and second-order changes. First-order change is a modification or adjustment of practices without altering prevailing values and norms in an existing paradigm (Waters & Grubb, 2004). In contrast, second-order change, "refers to major change exercises such as organizational restructuring, or fundamental shifts in goals, beliefs, values, cultures and procedures, entailing radical departures from usual practice" (Starr, 2003, p. 657). Second-order change is more complex and requires new knowledge and skills to step outside familiarity in order to solve persisting problems. However, the order of change is a perceived judgment of the stakeholders rather than the actual change itself (Waters & Grubb, 2004). Successful organizational change to sustainability clearly requires second-order change. The triple bottom-line orientation adopted toward sustainability in organizations (Elkington, 1998) envisions change in underlying values as well as in the observable practices of stakeholders and the organization. This orientation toward sustainability change in universities as a second-order, systemic change represents a fundamental conceptual basis for the current research.

4.2.2 Organizational Learning

Organizational learning is one of the organizational theories that centers on the human resource frame and enhances leaders' understanding of how change happens

in organizations (Brazer et al., 2014). Authors have defined organizational learning in different ways (Argyris, 1977; Cardno, 2012; Oldroyd, 2005; Sun & Scott, 2003). According to Argyris (1977), organizational learning is, "a process of detecting and correcting error. Error is for the purposes any feature of knowledge or knowing that inhibits learning" (p. 116). Taking a similar stance, Cardno (2012) described organizational learning as, "the ability to find out what is wrong when problems persist, and to learn from mistakes in order that long-term, recurring problems can be solved" (p. 42). In contrast, Sun and Scott (2003) asserted that organizational learning is the process of how individuals learn in the organization. Focusing on the outcome, Oldroyd (2005) defined organizational learning as, "the collective making of meaning for understanding and improving organizational life" (p. 203). Although these authors view organizational learning from different vantage points, they concur that organizational learning is a continuous, problem-oriented learning process carried out by people in an organization that aims not only to solve current problems, but also develop capacities for addressing future challenges.

Organizational learning processes occur in two ways: single-loop learning and double-loop learning (Argyris, 1977; Cardno, 2012; Sun & Scott, 2003). Single-loop learning takes place when an organization takes corrective action to solve an error without altering its present policies and objectives (Argyris, 1977). It means fixing organizational problems while maintaining the existing value orientation of the organization (Cardno, 2012). A limitation of single-loop learning is that it may lead to short-term fixes that fail to address the underlying forces that caused the problem to persist. In contrast, double-loop learning requires the reexamination of foundation values, underlying norms, policies and objectives (Argyris, 1977; Cardno, 2012). Argyris (1977) observed that while that single-loop learning tends to predominate in organizations, double-loop learning is necessary in order to organizations to make lasting changes for survival and growth. Thus, it is proposed that second-order change for sustainability in the complex environment of universities will require double-loop learning.

4.2.3 Process of Organizational Change

Numerous scholars have conceptualized change as a process comprised of different stages (Bridges & Bridges, 2019; Hall & Hord, 2006; Kotter, 1996; Lewin, 1951). One of the most widely recognized models of organizational change is Kotter's (1996) eight stage process of strategic change. Kotter (1996) proposed an eight-step approach to change management which are (1) creating a sense of urgency, (2) forming a coalition or guiding team, (3) developing a vision and strategy, (4) communicating the vision, (5) empowering action, (6) celebrating short-term wins, (7) consolidating change and (8) making the change stick. Kotter's (1996) transformation process aligns with Lewin's stages of unfreezing, introducing and refreezing new practices (Lewin, 1947).

Numerous scholars have examined the Kotter model in empirical studies (Gupta, 2011; Kang et al., 2022; Pollack & Pollack, 2014; Shah et al., 2023; Wentworth et al., 2020). Despite its popularity, Kotter's model has been criticized for several shortcomings. For example, there is disagreement about whether Kotter's eight stages constitute a planned process or an emergent process of change (Pollack & Pollack, 2014). Some have questioned the assumption that change is a linear, sequential procedure (Bucciarelli, 2015). Change management strategies must be flexible in order to account for an array of unpredictable issues that may arise during the course of change (Hughes, 2016). Finally, Kotter's model lacks detail on how to contextualize change strategies for different organizational situations, as well as the practices associated with the different stages (Pollack & Pollack, 2014).

Hall and Hord (2006) contributed several conceptual models to research on educational change. For example, their concerns-based adoption model (CBAM) highlights the personal dimension of the change process. The CBAM model views the change process in terms of the personal, management and impact concerns that people tend to experience during a change. Thus, for example, they noted that when confronted with organizational change, people tend to be concerned first with how the change will affect them personally (i.e., personal concerns), rather than how to do make the change work (i.e., management concerns), or how the change will benefit the organization (i.e., impact concerns).

Hall and colleagues' (1975) research into curriculum implementation highlighted the distinction between curriculum adoption and implementation. More specifically, they found that many so-called 'failed changes' were never actually implemented, and even fewer were institutionalized (Berman & McLaughlin, 1976; McLaughlin, 1990). This led Hall and colleagues (1975) to develop the 'levels of use of innovations framework'. This framework identified five measurable levels of use of innovations: information, interest, preparation, early use and routine use.

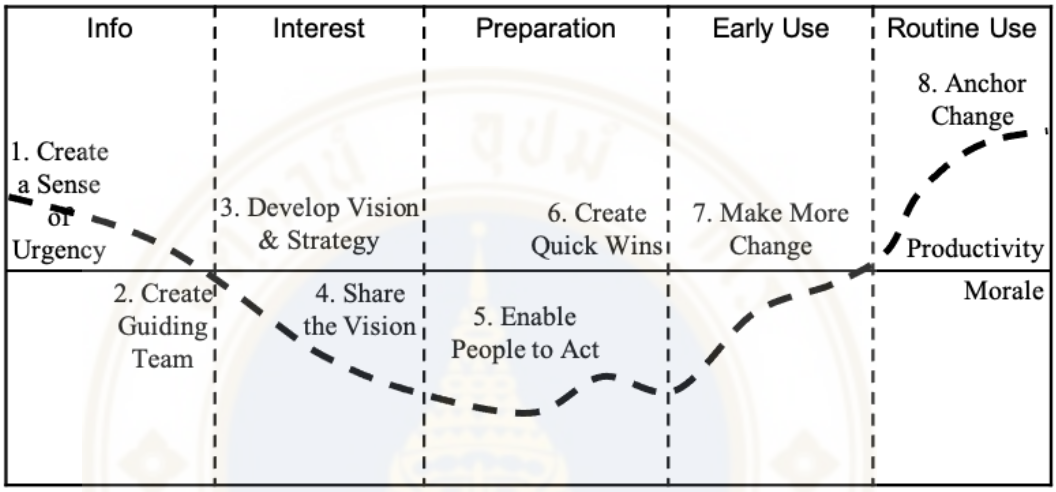

Figure 4.1 Integrated Model of the Change Process (Hallinger & Lee, 2011)

The integration of various change models is critical to understanding the multifaceted nature of organizational transformation in universities. Hallinger and Lee (2011) presented a synthesis of Kotter's eight-stage model within the continuum of Hall & Hord's 'levels of use of innovations framework', which includes stages such as Information, Interest, Preparation, Early Use, and Routine Use, offering a detailed view of change progression (see Figure 4.1). The figure illustrates how these models converge and diverge, offering a roadmap for effectively managing change in academic settings. This alignment underscores the complexity of change processes in educational institutions, highlighting the need for strategic planning and implementation at various stages.

These and other conceptual models are supported by empirical findings which indicate that the change process can be conceptualized in terms of fairly predictable 'stages' or 'phases'. Moreover, particular obstacles tend to be associated with different stages. For example, in the early stages of change, Kotter (1996)

highlighted comfort with the status quo as an obstacle, while Hall and Hord (2006) emphasized the lack of information (e.g., about the change, a need for change, benefits of the change) as a key obstacle. The identification of stages in the change process has also been useful with respect to identifying potential strategies that will yield greater benefits at different points in time, or with different groups of people. For example, Hall and Hord (2006) asserted that change activities must be aligned to meet the needs of people at any given point in time. For example, providing skill development (e.g., a workshop) to people when they lack knowledge and interest about the change is unlikely to achieve the desired effects. Thus, these stage-oriented change models have proven useful through the provision of change principles and guidelines.

4.2.4 Leading Change for sustainability in Universities

Jolović (2020) stated, that, "change management in higher education for the sake of achieving sustainability encompasses all processes, decisions, and activities that need to be undertaken within the educational institution for the sake of its transformation into an organization that supports the social, environmental and economic pillars of sustainable development" (p. 100). This broad conception of change leadership in universities frames the capacities needed by higher education sustainability leaders.

The first capacity needed by a leader is to understand the complexity of the change process so that they can manage fear and anxiety of stakeholders, and start preparing them for change (Buller, 2015). This entails understanding concepts such as double loop learning, second-order change, roles of change leaders, and stages in the change process.

Secondly, leaders need to be able to articulate why change is needed. The rationale for change needs to be communicated authentically and clearly to all stakeholders. This suggests that leaders need to truly believe in the need for enhancing sustainability in order to inspire other stakeholders. As Kotter (1996) asserted, the failure of organizational change can often be traced back to insufficient communication of purpose, roles, and processes.

Velazquez and colleagues (2006) proposed a four-step approach to sustainability transformation in universities. Their approach spans from strategic vision

to operational activities. They suggested to begin by developing a vision of sustainability that leads to reorientation of the organization's mission. This process should be carried out by a sustainability team that is charged with creating policies, objectives and targets, and implementation strategies (Velazquez et al., 2006).

Leaders also need to address challenges such as lack of understanding, interest and involvement from stakeholders, lack of leadership and commitment from senior and/or middle level administrators, and lack of skills. Other obstacles identified in the literature include seeing sustainability as a threat to academic freedom, questioning its relevance for certain courses or disciplines, and potential conflicts with other university goals (Cebrián et al., 2013; Leal Filho et al., 2020; Verhulst & Lambert, 2015). Other challenges that need to be addressed in the change process include the silo disciplinary structure of universities, a traditional focus on content-based learning, overcrowded curriculum, and a priority on short-term profit (Verhulst & Lambert, 2015).

Finally, it should be reemphasized that the implementation of sustainability has been cast as a systemic challenge rather than as a project, program, or curriculum. As conceptualized in the global literature, achieving social, environmental and economic sustainability requires organizational transformation (see Chapter III). Moreover, the loosely-coupled organizational structure of universities (Weick, 1976) may require quite different change strategies than those used in the private sector. These assumptions and challenges set the stage for the qualitative research proposed for this empirical study.

4.3 Method

This section describes the research design, participants in the study, and methods of data collection and analysis.

4.3.1 Research Design

This study adopted an interpretivist approach that used qualitative methods to understand the change experienced by universities that have traversed the journey toward sustainability. The purpose of the study was to an in-depth understanding of

how university leaders lead change for sustainability in higher education and make sense of participants' perspectives, their world view, and their experiences (Creswell & Poth, 2018). Qualitative studies, therefore, are often used to explore an emerging phenomenon and generate theoretical propositions, as opposed to testing the adequacy or application of theory in a particular setting.

It should be noted again that this qualitative study was carried out in the context of the larger R&D process. More specifically, this study comprises part of the 'Information Collection' stage of the R&D process (see next Chapter). Moreover, the qualitative research was also conceptualized as the first stage of an "exploratory sequential mixed methods study" (Creswell & Creswell, 2018), where the findings informed the redesign and evaluation of the LCSHE simulation for use in higher education settings.

4.3.2 Participants and Sampling

Participant selection occurred in a two-stage process. In the first stage, the research sought to identify relevant universities. In the second stage, the researcher vetted the sustainability coordinators for suitability. Purposive sampling was used to identify universities with a strong track record in sustainability and informants whose experience was relevant to the goals of the research (Cohen et al., 2018).

In stage one, the researcher identified universities that have made significant progress in implementing sustainable practices throughout the institution. The participating universities were identified through the Sustainability Tracking, Assessment, and Rating System™ (STARS) developed by the Association for the Advancement of Sustainability in Higher Education (AASHE, 2019). STARS is used worldwide by over 1,000 universities and colleges to report their sustainability progress. STARS produces four levels or ranks based upon performance-based assessments of university processes and outcomes: platinum, gold, silver, and bronze. An institution's ranking is based on the percentage of points earned by pursuing relevant credits across various organizational sub-systems: academics, engagement, operations, and planning and administration (AASHE, 2019). The criteria for the four levels are as follows.

- Platinum: achieve a minimum overall credit score of 85

- Gold: achieve a minimum overall credit score of 65
- Silver: achieve a minimum overall credit score of 45
- Bronze: achieve a minimum overall credit score of 25

The researcher identified universities that had achieved a platinum, gold, or silver ranking on the STARS system. This criterion ensured first that the university had achieved a comparatively high level of sustainability performance. In addition, it implied that the university had made significant progress on its 'journey of change' toward greater sustainability. Thus, the researcher would be able to gain a retrospective view on the process, obstacles, and change strategies of universities that had a base of successful experience accumulated over a period of years. This is consistent with the assumption from prior research that the change process takes multiple years to achieve successful change in behaviors and practices (Fullan, 2016).

When selecting the universities, the researcher sought a stratified sample to ensure that universities in both economically developed and developing countries were included in the study. Using this criterion ensured that the findings of the study would be more widely applicable. For example, universities in developing societies often operate with fewer financial resources than universities in the United States or Northern Europe. This contextual factor could shape the implementation of sustainability-related policies and practices. Thus, it seemed important that the study examine universities in a range of different societal contexts.

Universities that participate in STARS must identify a staff member as their 'sustainability coordinator'. In some universities this is an established staff role, while in others the responsibilities were accepted by an existing administrator. Once a list of possible participating universities was identified, the researcher contacted the sustainability coordinators to vet their suitability as potential informants for this research. Since the researcher sought to reconstruct a retrospective picture of the university's sustainability journey, it was essential that the sustainability coordinator had been in the current or a related position at the university for at least three years. This criterion was checked when the researcher contacted the universities to assess their willingness to participate in the study.

Sample size was an additional factor that was considered during participant selection. Creswell & Creswell (2018) maintained that qualitative research does not

prescribe a strict number of participants, however they suggested that anywhere from 10 to 50 participants may be adequate depending on the research type and questions at hand. Guest et al. (2006) recommended that 12 interviews are often enough for saturation. They stated that, "if the goal is to describe a shared perception, belief, or behavior among a relatively homogeneous group, then a sample of twelve will likely be sufficient" (p. 76).

In this qualitative study, the sample included 12 sustainability coordinators from universities with gold, platinum, and silver sustainability rankings. This selection was intentionally made to aid in uncovering prevalent themes across various contexts, which will be instrumental in the redesign of a computer simulation (see Chapter V). The uniformity in participants' role as sustainability coordinators ensured a generally homogeneous group - essential for maintaining thematic consistency - while their differing institutional rankings introduce slight heterogeneity. This variation enriched the dataset with a diverse spectrum of professional experiences, enhancing the qualitative insights for simulation development. The approach captured a broad array of sustainability practices essential for a realistic educational tool and aligned well with the research objectives to gather detailed, context-specific insights.

Using these criteria, the researcher began by developing an initial list of platinum, gold, and silver STARS-rated universities. Next, the list was organized in terms of developed/developing nation status in order to develop a diverse sample. Perusal of the STARS list of platinum/goal/silver universities suggested that it would not be possible have a balanced sample on this criterion since the majority of qualifying universities were located in developed nations. Thus, the final list was weighted toward developed societies. At this stage the researcher compiled a longer list of possible universities in anticipation that some would decline to participate in the research, or prove ill-suited for other reasons (see Appendix C).

Once the list of qualifying universities had been compiled, the researcher moved to the stage of identifying the eligibility of the sustainability coordinators at these universities. Reports in the STARS database disclosed the sustainability coordinators who were responsible for overseeing and monitoring their universities' sustainability efforts programs. During the recruitment process, potential participants were contacted by an initial email to discuss the research project and find out if the

coordinator has been there for at least three years. A recruitment letter was attached which contained information detailing the research project (see Appendix A). The letter outlined the researcher's role, their role as potential participants, the researcher's contact details, research aims, an invitation to interview using ZOOM platform, outline of the interview procedure, and informed consent for recording, transcript verification, voluntary participation, assurance of anonymity, and the right to withdraw at any point during or after the data collection stage. An online letter of consent to participate in the research was also made available for signature by the coordinators as representatives of their universities (see Appendix B).

Initial contact was made with a total of 53 universities, comprising 36 from Anglo-American countries and 17 from emerging regions. Contacts continued to be initiated until 12 coordinators at qualified universities agreed to participate in the research. The participating universities included 7 from Anglo-American countries and 5 from emerging regions (see Table 4.1).

Table 4.1 below provides detailed information about these universities, including their country, current STARS rating, the year they joined STARS, their rating duration, participation count, ratings received, and university demographics. As indicated in Table 4.1, despite the effort to gain access to universities in emerging regions, in the end only the universities located in Ecuador and Mexico can be considered developing nations. It's noteworthy that no universities from African nations were included, as none participated in the STARS rating system during the period of this research. Additionally, despite reaching out to all relevant universities in the United Kingdom, none responded to the recruitment email.

Table 4.1 University Information

Code Name	Nation	STARS Rating 2022	STARS Joining Year	Current Rating Years	STARS Partici-pation Count	STARS Ratings Received	University Demographics
U1	USA	Platinum	2011	2022-2026	6	2 Platinum 4 Gold	110952 Students 12039 Staff 1600.2 Acres
U2	CAN	Platinum	2011	2022-2025	4	2 Platinum 1 Gold 1 Silver	26660 Students 1816 Staff 335 Acres

Table 4.1 University Information (cont.)

Code Name	Nation	STARS Rating 2022	STARS Joining Year	Current Rating Years	STARS Partici-pation Count	STARS Ratings Received	University Demographics
U3	USA	Platinum	2011	2022-2026	6	4 Platinum 2 Gold	37806 Students 7720 Staff 8811 Acres
U4	TAI	Gold	2022	2022-2025	1	1 Gold	15920 Students 3343 Staff 55.25 Hectares
U5	CAN	Gold	2015	2022-2025	3	2 Gold 1 Silver	31037 Students 9090 Staff 2104.80 Acres
U6	TAI	Gold	2022	2021-2024	1	1 Gold	16917 Students 3284 Staff 296.80 Acres
U7	USA	Gold	2011	2022-2025	5	3 Gold 2 Silver	21776 Students 7822 Staff 716 Hectares
U8	USA	Gold	2011	2022-2025	4	2 Gold 2 Silver	50,000 Students 13,000 Staff 52,000 Acres
U9	ECU	Gold	2013	2022-2025	3	1 Gold 1 Silver 1 Reporter	9823 Students 930 Staff 9.27 Hectares
U10	AUST	Gold	2020	2022-2025	2	1 Gold 1 Silver	37265 Students 4407 Staff 654.26 Hectares
U11	MEX	Silver	2012	2021-2025	4	2 Silver 1 Bronze 1 Reporter	11418 Students 2580 Staff 53.37 Hectares
U12	UAE	Silver	2018	2021-2024	2	1 Silver 1 Bronze	13197 Students 1853 Staff 499.91 Acres

4.3.3 Data Collection

Given the constraints of accessing data on processes from universities throughout the world, the researcher opted to use interviews with key staff as the

primary method of data collection. Qualitative interviews provide opportunities for mutual reflection, explanation, and understanding of the social phenomenon (Tracy, 2020). The advantages of the interview include not only gaining research-relevant information in a greater depth, but also countering any misunderstandings of the researcher (Cohen et al., 2018). Moreover, the interview allows participants to clarify their answers and gives opportunities for further elaboration with sound contextual basis (Ary et al., 2010). As a distinctive research method, the interview can be used as the principal means of gathering information or used in conjunction with other methods (Cohen et al., 2018). The role of the researcher as the interviewer is to construct and interpret the reality articulated by the interviewee with a critical lens (Lichtman, 2013).

Limitations of interviews include information filtering by interviewees, bias response due to the presence of the researcher, differences in ability to articulate information, and limitations of experience of the interviewee based on his/her organizational role and tenure (Creswell & Creswell, 2018). Therefore, it is important for the researcher to understand the strengths and weaknesses of a research method in order to provide a more accurate analysis and presentation of the data.

A semi-structured interview is an exploratory interview that is flexible and organic nature as it, "allows for discovery, with space to follow topical trajectories as the conversation unfolds" (Magaldi & Berler, 2020, p. 4825). Semi-structured interviews are often used to obtain in-depth understanding of a particular topic and to allow participants to reflect on his or her experiences. This interview method is useful for gaining insight into the experience and perceptions of participants who have knowledge, skill, and expertise on the phenomenon of interest (Tracy, 2020).

Semi-structured interview were selected as the optimal method for this study due to its goal to explore the change process experienced by the university as it moved toward sustainability. In contrast with unstructured interviews, the semi-structured interview enabled the researcher to employ existing change frameworks as guides, while allowing the informants to detour in a variety of unanticipated directions.

The principles and practice of collecting and analyzing semi-structured interviews include seven stages: thematizing, designing, interviewing, transcribing, verifying, analyzing and reporting (Cohen et al., 2018). The research topic, aims and questions informed the themes of the interview by setting detailed and specific

objectives concerning the kind of data to be collected. Next, an interview protocol was constructed based on the research objectives. Open-ended interview questions were used. These have the advantage of being flexible, allowing for greater more depth, clearing up misunderstandings, testing the limits of participant's knowledge, and encouraging cooperation (Ary et al., 2010).

4.3.3.1 Interview Questions. According to Tracy (2020), qualitative interview questions are formulated according to the themes of interest framed around the research questions, objectives, and relevant literature. Firstly, the following research questions of this study were used to establish the themes of interest.

1. What are key change stages, obstacles and activities experienced in universities during projects and programs designed to enhance their sustainability?
2. How do universities overcome obstacles to the implementation of sustainability values, programs, and practices?
3. How do internal and external factors influence the success of sustainability projects in universities?

Secondly, interview questions under each theme of interest were developed by drawing on three theoretical frameworks: Kotter's (1996) eight-step approach to change management, Bolman and Deal's (2017) four-frames model, and Argyris's (1977) organizational learning theory. Lastly, the interview questions were refined in order to minimize redundancy and maximize the logical flow.

The first research question has three key themes consisting of key stages in the change process, change activities and events, and challenges encountered during the implementation process. When creating the questions related to key stages and activities of implementation, Kotter's (1996) eight-step approach to change management was used (see Table 4.2).

Interview questions related to the first step of Kotter's change management theory involved how the university created a sense of urgency, how the idea of change for sustainability began and how it was introduced to stakeholders. The second set of questions related to formation of a guiding team and identification of the main players in the change process. The third and fourth steps related to sustainability vision. Relevant interview questions concerned the university's sustainability goals, how they

goals and by whom, and how they were communicated and accepted by stakeholders. The fifth step inquired into empowering actions and activities used to achieve the sustainability goals. The final three steps examined through questions that deal with the quick wins to provide momentum to the change process, monitoring and celebrating progress and success along the way, and how the university embedded change in its culture and policy structures. In addition to using Kotter's (1996) eight-step model, interview questions related to challenges and obstacles of change were created with the guidance of the first research question.

Table 4.2 Kotter's (1996) Eight-step model as a framework for generating interview questions

Kotter's (1996) Stages	Interview Questions
(1) creating a sense of urgency	How was the idea of change for sustainability introduced at your university, how and when did the change start? What was the initial response of people at that time?
(2) forming coalition	Who were the main players in the change?
(3) create a vision	What were the goals of initiated change?
(4) communicating the vision	Were these goals understood by members of the university?
(5) empowering actions	What main steps and what activities did the university use to achieve sustainability goals?
(6) celebrating short-term wins	What were some of the quick wins that gave more momentum to the change process?
(7) consolidating change	How was the progress and success of sustainability implementation monitored and measured?
(8) embedding change in the organizational culture	How is the university different today compared to five years ago?

Another theme of interest in the interview concerned the role of leaders at different organizational levels in leading and managing change for sustainability in universities. In order to formulate interview questions for this theme, Bolman and Deal's (2017) four-frame model was used as a guiding framework (see Table 4.3). Interview questions related to the structural frame include the role and responsibilities of leaders in the change process. The human resources frame was used to formulate questions such as the creation of the leadership team and the distribution of leadership

to other stakeholders. The political frame elicited questions concerning the relationships and cooperation among stakeholders, and their reaction and resistance toward change. Lastly, interview questions guided by the symbolic frame included how leaders inspired other members of the university, gained commitment, and celebrated success.

Table 4.3 Bolman and Deal's (2017) four-frames model as a framework for generating interview questions

Bolman and Deal's (2017) Four Frames	Interview Questions
1. Structural Frame	What is your role in leading change for sustainability at your university?
	What are the key responsibilities?
	Where does leadership come from?
	Is there a team responsible?
2. Human resources Frame	How is leadership distributed?
	How has ownership transferred to other stakeholders?
	Have they assumed leadership?
	How would you describe the relationship and cooperation among members of university in the process of change?
3. Political Frame	How did the other members of the university react to the proposed changes?
	How would you describe their level of resistance to the changes?
	How did the leadership inspire and get commitment from other members of the university to implement this change?
4. Symbolic Frame	What were some of the biggest success celebrated?

The last theme of interest examines how obstacles are overcome in universities to be more sustainable. For this theme of interest, Argyris's (1977) organizational learning theory, specifically single-loop learning and double-loop learning, was used as a conceptual framework when formulating interview questions (see Table 4.4). The interview questions related to single-loop learning includes how leaders generally solve issues and obstacles and what corrective actions were used. The double-loop learning theory informs questions such as the causes of the underlying reasons for the obstacles, critical reflection on actions taken, and how leaders learn when their behavior doesn't lead to the resolution of the problem.

Table 4.4 Argyris' (1977) organizational learning theory as a framework for generating interview questions

Argyris (1977) Organizational Learning	Interview Questions
(1) single-loop learning	How did the leadership address those obstacles, what methods were used in leading change?
	Looking back now, what were some root causes of the obstacles?
	What were some of the actions taken to address the obstacles?
(2) double-loop learning	What was done when the challenge was not resolved?
	What steps have been taken to make this change sustainable for the long-term?

Table 4.5 illustrates the integrated questions that were used during the in-depth qualitative interviews. With the guiding frames of the research questions and theoretical frameworks, the interview questions were developed in order to elicit the change process, leadership, perceptions, challenges, and lived realities of sustainability transformation in universities.

Table 4.5 Integrated interview questions

#	Interview Questions	Theory
1	Could you give an overview of your university's engagement with sustainability?	Kotter (1996)
2	Can you please give an overview of your relationship with the university, including years involved and primary responsibilities held?	Bolman and Deal (2017)
3	What is your role in leading change for sustainability at your university? • What are the key responsibilities?	Bolman and Deal (2017)
4	How was the idea of change for sustainability introduced at your university, how did the change start? • Who were the main players in the change?	Kotter (1996) Bolman and Deal (2017)
5	What were the goals of initiated change? • How were the goals communicated to the stakeholders?	Kotter (1996)
6	Where does leadership come from? • Is there a team responsible? • How is leadership distributed?	Kotter (1996) Bolman and Deal (2017)
7	What main steps and what activities did the university use to achieve sustainability goals?	Kotter (1996)
8	How did the leadership team inspire and get commitment from other members of the university to implement this change? • What specific approaches worked well and in which situation? • What specific approaches did not work well and in which situation?	Bolman and Deal (2017)
9	How is the university different today compared to five years ago? • Can you give specific examples of the progress for social, economic, and environmental factors?	Kotter (1996)
10	Were there any quick wins along the way that gave more momentum to the change process?	Kotter (1996)

Table 4.6 Integrated interview questions (cont.)

#	Interview Questions	Theory
11	In your opinion, what were the main obstacles and limitations encountered in the change process for sustainability?	Argyris (1977)
12	How did the university address those obstacles, what methods were used in the work on leading change?	Argyris (1977)
13	How was the progress of sustainability implementation processes monitored and measured? • What were the key indicators?	Kotter (1996)

4.3.4 Conducting the Interviews

Setting up and conducting the interview was the next stage of the procedure. This included getting informed consent, recording and establishing rapport with the participant with careful consideration to probing and active listening (Wellington, 2015). Notably, the context for the interviews was not face-to-face. Instead, they were conducted via Zoom platform. While this complicated certain aspects such as rapport-building, it also had some advantages. For example, use of the online video platform meant that the researcher could easily interview participants without regard to time or geography. In addition, Zoom has a built-in recording function, meaning that the researcher would have a permanent recording of the interview for subsequent re-analysis. This feature also meant that the researcher was freed from having to keep extensive notes or become distracted during the interview.

Establishing rapport started from the first point of contact during the recruitment stage. I sent out a recruitment email (see Appendix A) to each participant to introduce myself as a researcher and to provide information including my identity, current studies, doctoral research project, research questions and objectives. This email also included information about interviews as a data collection method, an invitation to participate, the conduct of interview via ZOOM, kinds of data intended to collect, their role as an important contributor for this research. Finally, the recipient was given instructions on how to accept or decline the interview request, and return the signed consent form.

The interview protocol (see Appendix D) and consent form (see Appendix B) were attached to the email. The interview protocol contained the interview process and the semi-structured interview questions. The consent form contained information about the identity of the researcher and institution, research aims, level of participation,

interview duration, assurance of confidentiality, right for withdrawal at any time, and contact information of the researcher and the institution.

Willing participants returned the signed consent form, well as their preferred date and time for the interview. A follow-up email thanked the coordinators for agreeing to participate together with the information of ZOOM meeting link, meeting ID and passcode. For the participants who did not respond after seven days, a follow-up email was sent out as a reminder.

As noted above, the participating universities were located the USA, Canada, Taiwan, Ecuador, Australia, Mexico, and the UAE. All of the universities held STARS ratings from Silver to Platinum. Notably, the participants' roles were spread across different types of sustainability offices. Some worked in dedicated sustainability offices, while others were located in broader administrative units. As detailed in Table 4.6, the coordinators held various job titles ranging from Assistant Directors to Chief Sustainability Officers. Their tenure in the sustainability role varied from 3.5 years to as long as 23 years. This variety in job titles and experience levels yielded varied insights into the sustainability initiatives at these institutions.

Table 4.7 Participant information

Code Name	Gender	Job Title	Years in Role	Office	Nation	STARS Rating
P1	M	Assistant Director	3.5	Sustainability Office	USA	Plat
P2	M	Manager of Sustainability Programs	10	Sustainability Office	CAN	Plat
P3	F	Director of Communications and Sustainability	20	No Sustainability Office	USA	Plat
P4	M	Director of Center of Sustainability	23	Sustainability Office	TAI	Gold
P5	F	Director	5	Sustainability Office	CAN	Gold
P6	M	Processor and Chief Sustainability Officer	19	Sustainability Office	TAI	Gold
P7	M	Assistant to Provost for Sustainability Initiatives	14	No Sustainability Office	USA	Gold
P8	F	Sustainability coordinator	4	Sustainability Office	USA	Gold
P9	F	Sustainability and Innovation Officer	4	Sustainability Office	ECU	Gold

Table 4.8 Participant information (cont.)

Code Name	Gen-der	Job Title	Years in Role	Office	Nation	STARS Rating
P10	M	Chief Sustainability Officer	12	No Sustainability Office	AUS	Gold
P11	M	Coordinator of Strategic Projects in Sustainability	10	Sustainability Office	MEX	Silv
P12	F	Head of Sustainability	5	Sustainability Office	UAE	Silv

USA = United States of America; CAN = Canada; TAI = Taiwan; ECU = Ecuador; AUS = Australia; MEX = Mexico; UAE = United Arab Emirates ; Plat=platinum, Silv=silver

When an interview commenced, the researcher spent the first five minutes establishing rapport through some open-ended questions that prompted the respondent to speak openly and offer opportunities to establish common ground. After introducing myself, the researcher provided an overview of the interview questions, set the duration of the interview, and reminded the participant that the ZOOM meeting would be recorded (see Appendix D). The interviews averaged 60 minutes and resulted in approximately 10 pages of transcript, formatted in Times New Roman with single spacing.

During the interview, the researcher ensured that the following interview strategies were followed in order to create a meaningful social interaction and elicit rich, specific, and relevant answers. The first strategy was to always engage in active listening and show interest by observing when to give verbal and non-verbal feedback and when to keep silent (Cohen et al., 2018). The second strategy was to give respondents enough time to answer, and use follow-up probes to encourage the participants to expand on the initial responses with examples, stories, or other types of illustrations. The next strategy was to verify and check my understanding and interpretation of respondent's answers during the interview. The fourth strategy was to avoid showing signs of judgement during the interview and maintaining an awareness of my own assumptions to avoid any influencing the participant. The fifth strategy was to stick to the semi-structured interview and steer the participants politely if they went off topic. The sixth strategy was to avoid interruptions and minizine distractions due to technical and non-technical factors. The last strategy was to avoid asking long

compound questions. Instead, the researcher tended to ask shorter questions that addressed one item at a time.

Data recording is an important process that needs to be prepared in advance before conducting field research. In this study, an interview protocol was developed in order to assist the researcher in asking questions and recording the interview. According to Creswell and Creswell (2018), an interview protocol should contain introduction and opening questions, content questions with probes, closing remarks, space for note-taking. The primary data recording was done through ZOOM meeting recording function. As noted above, the recording function through ZOOM meeting did not constrain the respondent because it was not as obstructive as a physical audiotape player or videotape recorder. Since notetaking can take the attention away from the participant's responses and may even be off-putting for some respondents (Cohen et al., 2018), the researcher limited notes to points to ask in follow-up and probing questions.

4.3.5 Data Analysis

Creswell and Creswell (2018) described a five-step approach for use in analyzing qualitative data obtained from interviews. The first stage is organizing and preparing the data which involves transcribing interviews, visually scanning the data, and sorting them so that they can be easily searched and identified. Transcribing is a crucial step in interviewing because it takes considerable amount of time and has the potential for data loss, distortion, translation error and reduction of complexity (Lichtman, 2013). That is why interview transcripts must be verified for accuracy and validity.

Once the interview has been transcribed and verified, the next step involves coding, counting frequencies of occurrence, clustering, building logical chains of evidence and making conceptual connections (Ary et al., 2010). Finally, the interview data will be reported through a combination of direct quotations, commentary and interpretation while preserving the original context and authenticity (Cohen et al., 2018).

Computer-aided qualitative data analysis software or CAQDAS are computer packages that facilitate data analysis. According to Tracy (2020), the software

provides options for coding, sorting, organizing, managing, reconfiguring, querying, and retrieving qualitative data. In this study, the Text Analysis Markup System (TAMS) Analyzer (Weinstein, 2002-2012) was selected from a range of available CAQDAS options. The choice was influenced by its status as an open-source software, as well as its compatibility with Macintosh computers, which aligns with the technology used by the researcher (see Figure 4.2).

The choice of TAMS software over other qualitative analysis tools such as MAXQDA, QDA Miner, and NVivo was deliberate and informed by several factors. Firstly, TAMS offers a user-friendly interface and intuitive features that align well with the needs of this study. Its simplicity allows for efficient coding and analysis, particularly suited for a project of this scope. Additionally, TAMS is a free and open-source software, making it easily accessible without the need for costly licenses. Furthermore, TAMS has demonstrated reliability and stability, with a track record of being widely used in academic research (Hart, 2011; Weinstein, 2006). Overall, the selection of TAMS was based on its suitability, accessibility, and reliability for facilitating the qualitative analysis required for this study.

The interview transcripts were uploaded into the TAMS Analyzer software for comprehensive review. This process allowed for a holistic understanding and reflection on the interviewees' responses. Utilizing TAMS Analyzer, data coding involved labeling segments or paragraphs of the transcripts with representative words or phrases. Tracy (2020, p. 213) defined coding as "the active process of identifying data as belonging to, or representing, some type of phenomenon." In this research, a grounded theory approach (Corbin, 2021; Corbin & Strauss, 1990) guided the coding and analysis of the interview data. Grounded theory, as defined by Corbin and Strauss (1990), is an approach that develops a theory through the systematic gathering and analysis of data pertaining to a phenomenon. This method was chosen for its ability to generate rich, detailed theories grounded in empirical data. It allowed the research to evolve inductively from the specific experiences and perspectives of the participants, ensuring that the findings were closely aligned with the data itself, thus enhancing the authenticity and applicability of the research conclusions.

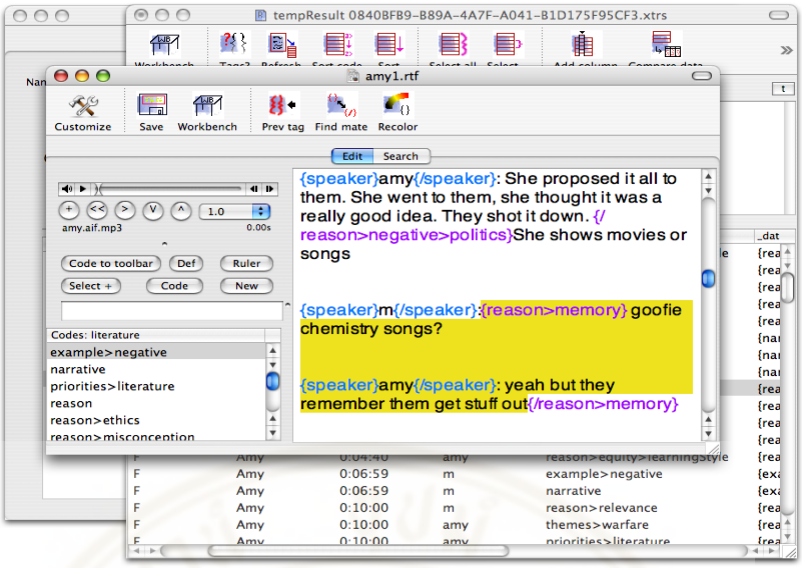

Figure 4.2 Sample of coding and retrieving in TAMS Analyzer

The initial step in the grounded theory approach is open coding, which involves identifying, naming, and categorizing phenomena found in the interview transcripts. In open coding, the data are broken down into discrete parts, closely examined, and compared for similarities and differences. This process was performed using TAMS Analyzer, followed by exporting the raw open codes to an Excel file. This step ensured that the codes accurately corresponded to the highlighted verbatim quotes and maintained internal consistency.

The next step, axial coding, involves reassembling the data fractured during open coding to form new ways of understanding the data. Axial coding relates categories to their subcategories, linking them in a way that creates a new level of abstraction. Using Excel, logical thinking and the researcher's judgement were applied to review the list of open codes. Related codes were then combined to form categories and sub-categories (see Table 4.7). For example, discrete codes like 'Demographics>EmployeePopulation' and 'Demographics>Facilities' identified in open coding were logically grouped into broader sub-categories such as 'University Profile' during axial coding. These sub-categories such as 'University Profile' and 'Implementation Structure' were then synthesized into more comprehensive categories, such as 'University Context'.

Table 4.9 An example of the coding process and data analysis

Quotes	Codes	Subcate-gories	Cate-gories	Theme
"Roughly 13,000 employees" "We do have a lot of property. We have Dairy farm, all this stuff." "Our campus here in East Lansing is 52,000 acres. It's essentially a city, and of itself." "we've got over 50,000 students"	Demographics> EmployeePopulation Demographics> Facilities Demographics>Size Demographics> StudentPopulation	University Profile	University Context	The Context of Change
"The Dean appoint there Associate Dean as the CSO for a corresponding college. Of course implementation, maybe, Deputy Director for correspondent and administration become a CSO, so they got an administrative position." "I think they're there is a benefit of being so decentralized where it like I kind of see it more our role to embed sustainability throughout these different divisions, throughout these different units, making sustainability part of just what we do." "It's a little bit of both. It's a little bit of both honestly because our Vice President for strategy is still the lead. So, she develops the plan with her team and then she's also implementing the plan so that part is centralized."	Structure> Centralization Structure> Decentralization Structure> Decentralization> Cons Structure> Decentralization> Pros Structure> Hybrid	Implem-entation Structure		
"We got the funding from the government. We built an ecological roof up the whole building" "There are a lot of environmental regulations, but I think more of these external factors have been like local." "But our President decided to sign on to… back then it was called the American College University President's Climate commitment. It's now called the carbon commitment."	ExternalFactors> Culture ExternalFactors> Funding ExternalFactors> Government ExternalFactors> Trend Sustainability> Commitment	External Influ-ences		
"From the University perspective, we have to engage the in the process of the University ranking like the STARS or the THE." "Sometimes I feel like STARS takes entirely too much time to measure and then you're like oh but we could be working on this program as we were." "The Times Higher Education Impact ranking. So again, that's where it's this newer ranking, looking at how universities are addressing the UN sustainable development goals."	Ranking>STARS Ranking>STARS> Weakness Ranking>THE	External Recog-nition	External Context	

The next phase, selective coding, built upon this categorization. It involved integrating these categories into broader themes, further refining the data's interpretation. In this step, categories like 'University Context' and 'External Context' were synthesized to form overarching themes, such as 'The Context of Change'. This final phase of selective coding was crucial for developing a cohesive theoretical framework, as it involves systematically relating core categories to each other, validating these relationships, and identifying areas that require further refinement and development.

This process was enriched with detailed descriptions, diverse participant perspectives, varied quotations, and specific evidence, as suggested by Creswell & Creswell (2018). The final stage entailed interpreting and representing these themes. This involved summarizing the overall findings, incorporating the researcher's personal interpretation, drawing comparisons with existing literature, and visually presenting the data (Cohen et al., 2018).

4.3.6 Data Synthesis

In the Data Synthesis stage of this research, the researcher focused on extracting verbatim quotes related to specific codes such as 'ExternalFactors>Government' and 'Sustainability Policies' from each university. This extraction was facilitated by TAMS Analyzer software, with the data subsequently organized in an Excel database file. The quotes were not only categorized by their relevance to specific codes but also tagged with participant identifiers, creating a clear distinction of perspectives across different universities (see Figure 4.3).

The synthesis of data followed a methodical approach, drawing upon the thematic analysis framework as suggested by (Braun & Clarke, 2006). This process entailed an iterative cycle of thoroughly examining the verbatim quotes associated with each code. During this examination, the focus was on discerning patterns in activities, practices, challenges, and strategies expressed in the narratives from various universities. This meticulous comparison highlighted both commonalities and distinctions among the narratives, facilitating the transition from individual university stories to a more comprehensive perspective on sustainability in higher education globally.

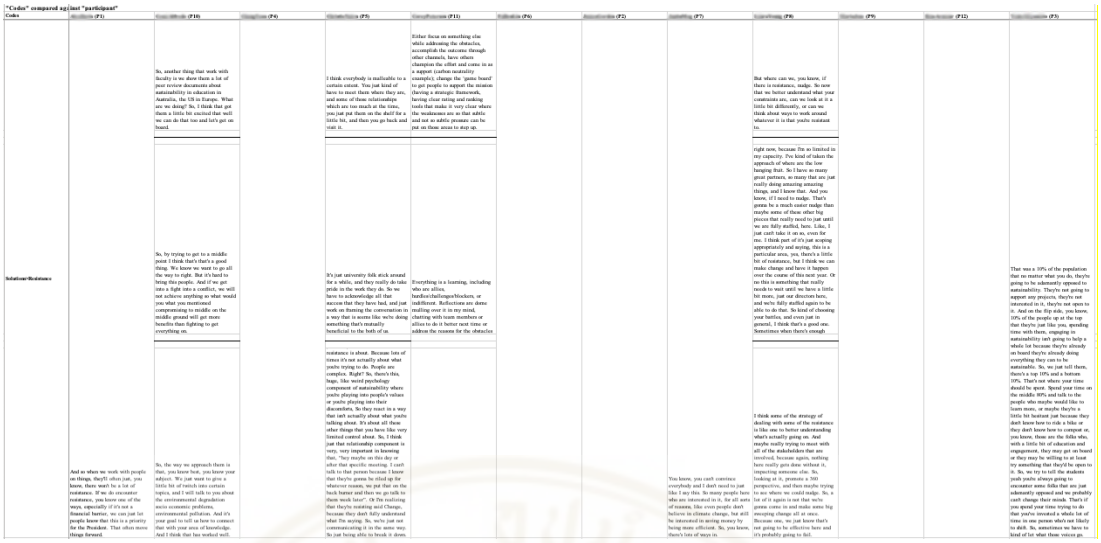

Figure 4.3 Screenshot of excel database layout (quotes categorized by codes and participants)

For example, when analyzing the verbatim quotes related to ‘Sustainability Policies’, commonalities emerged across different universities. Both emerging region and Anglo-American universities, such as U11, U4, U2, and U7, consistently emphasized the influence of external factors like government policies and global sustainability trends in shaping their strategies. Despite these common influences, differences were also evident; emerging region universities often faced challenges due to resource constraints, contrasting with the more resource-rich environments of their Anglo-American counterparts.

In summary, the data synthesis in this qualitative study is a critical stage that follows the grounded theory methodology, encompassing open, axial, and selective coding. This phase involved the thematic analysis of each code, effectively bridging individual university narratives to form a cohesive understanding of sustainability in higher education. Grounded theory provided the framework for organizing and presenting findings, while data synthesis integrated these insights to highlight the diverse approaches to sustainability across different institutions. This process illuminated key patterns and trends in sustainability within academia, offering a clear perspective on how universities are navigating and leading the shift toward a sustainable future.

4.3.7 Validating the Findings of Individual Interviews

In qualitative research, validity refers to the authenticity of the findings from the standpoint of the researcher, the participant, or the readers. It is important for the researcher to pay careful attention to qualitative validity during data collection and data analysis to ensure that the research approach is effective and findings are credible.

According to Creswell and Creswell (2018), a number of strategies can be used to improve the validity of qualitative research. The most common strategy to enhance validity is triangulation which is defined as, "the use of two or more methods of data collection in the study of some aspect of human behaviour" (Cohen et al., 2011, p. 141). In this study, although the primary data is collected from in-depth interviews with the sustainability coordinators, data triangulation was accomplished by examining secondary data contained in a university's sustainability reports accessible in the STARS database.

Another approach to increase validity is to clarify bias and subjectivity of the researcher when collecting, analyzing, and presenting the data and findings. According to Ary et al. (2010), bias can occur when the researcher's beliefs, values, attitudes, and backgrounds influence the interpretation of the findings. Therefore, it is important for researchers to engage in self-reflection in order to minimize bias and declare clarification in an honest and open manner when writing the research findings and discussion (Cohen et al., 2018). In this study, careful attention was paid to how interview questions were phrased to ensure that researcher bias did not influence participants responses. Additionally, interview transcripts were sent to the participants for verification to ensure that the data were accurate from their perspectives.

Possibly the strongest threat to the validity of the data arose from a natural inclination on the part of the sustainability coordinators to present their universities in the best light and highlight their successes. Therefore, it was important for the researcher to address the tendency for interviewees to present either a 'revisionist history' or 'greenwashed story" of change in their universities. The first strategy was to ensure that the interview guide contained a balanced set of questions that not only focused on the achievement of the university in striving for sustainability, but also contained explicit questions concerning the challenges they had faced, how the university addressed the problems, and probes for specific examples. As a second

strategy, the author thoroughly checked the sustainability reports of each university on the STARS database prior to the interview (STARS Participants and Reports, 2023). In this way, the researcher could formulate – in advance - probes regarding areas in which the university was still lagging behind and needed further work.

4.3.8 Ethical Issues

According to Tracy (2020), key ethical issues in qualitative research include informed consent, confidentiality, voluntary participation, transparency, and researcher relationship to the participants. This study had received approval from the ethics board, Mahidol Institutional Review Board (IRB), and the Certificate of Approval (COA No. 2022/06-152) from Mahidol IRB is included in Appendix I to ensure adherence to ethical guidelines.

Informed consent involves obtaining permission from the individuals who can grant authorization to access the site and conduct research (Ary et al., 2010). In this study, participant permission was sought prior to the field work. As discussed earlier, participants were required to sign an informed consent form (see Appendix B).

Confidentiality is about respecting privacy and safeguarding the participants from possible harm due to their participation in the research (Tracy, 2020). This study ensured that the identities of the participants were not disclosed to any person or in the research reports of any publications of the study. Additionally, only pseudonyms were used when writing field notes, memos, transcription, and coding. The interview recordings and transcripts will be stored for a limited time period of five years in a secure password protected computer which can only be accessed by the researcher.

Voluntary participation is about deciding to participate at free will and having the right to withdraw at any point during the research project (Tracy, 2020). In this study, participants were requested to participate voluntarily via email. None were pressured to participate or sign the consent form. During the recruitment process, participants were also made aware that they could decide not to participate in the study and withdraw from the study at any point. It is to ensure that participants' wishes were respected and the information they provided were accurate and not extorted in any form (Ary et al., 2010).

Transparency is to ensure that participants are fully aware of the research process and the role they play as contributors of the research (Tracy, 2020). This study ensured that participants were provided with accurate and truthful information of the research project during the recruitment stage in an open and honest manner so that participants were not deceived or misled in any way.

Researcher relationship to the site is also an important consideration so that potential harm to the participants and disruptions to the site can be minimized (Creswell & Creswell, 2018). In this study, participants chose the interview date and time that fitted their schedule so that their flow of activities were not disrupted. Since the interviews were conducted through an online platform, participants attended the meeting from a suitable location that was convenient and comfortable for them.

Moreover, the researcher needs to anticipate and respect any cultural, religious, gender, or other social norms expected at the site of study (Creswell & Creswell, 2018). This study ensured that interview questions were phrased in a respectful manner, courteous language and tone of voice were used, and appropriate dress code and mannerism of the researcher were maintained during the interview. Lastly, participant contributions needed to be reciprocated by sharing the findings and benefits of the study or providing a small token of appreciation to those who provided time and valuable data into the study (Cohen et al., 2018).

4.4 Findings

4.4.1 Introduction

This section reports the findings derived from the 12 qualitative interviews conducted with sustainability coordinators in the participating universities. These findings responded to the three research questions posited in the introductory phase of this research. The questions explored the multifaceted aspects of sustainability initiatives, focusing on the progression, challenges, and strategies involved in such endeavors. The specific research questions were as follows:

1. What are key change stages, obstacles and activities experienced in universities during projects and programs designed to enhance their sustainability?
2. How do universities overcome obstacles to the implementation of sustainability values, programs, and practices?
3. How do internal and external factors influence the success of sustainability projects in universities?

The findings are organized systematically under headings that reflect the various stages and elements influencing the sustainability journey of the universities. Research questions 1 and 2 were combined and discussed under the heading The Process of Change. This section focused on the stages of change, change activities, the challenges encountered, and the strategies employed by universities to overcome these obstacles to enhancing sustainability within universities. Moreover, the research delved into understanding the internal and external factors that play a critical role in shaping the sustainability projects in universities.

Overall, the findings section aims to provide a detailed understanding of the processes, challenges, and strategies involved in advancing sustainability in the university context, aligning with the research objectives and questions posed at the outset of this study. These insights also supported the design of the LCSHE simulation, a training tool for future sustainability leaders in university settings.

4.4.2 The Process of Change

The theoretical frameworks discussed earlier provided valuable insights into the multifaceted nature of the change process. As seen in Table 4.8, the complexity of leading change for sustainability in higher education involves various stages including awareness, interest, preparation, practice, and institutionalization stages, supported by theoretical frameworks.

Table 4.8 draws on Hall and Hord's (2006) model as a means of highlighting the purpose and activities that are typically associated with stages in the change process. The awareness stage is the starting point, focusing on building recognition of the need for change. This includes creating awareness, initiating the change process, identifying key areas needing change, and forming a guiding team.

Table 4.10 Stages of change management

Change Stage	Key Activities	Purpose and Function	Relevant Theories
Awareness Stage	Initiating the Change Process	Recognizing the need for change, typically involving a sense of urgency.	Kotter: Urgency Lewin: Unfreezing
	Beginning Focus	Identifying the primary areas or issues that need change.	Lewin: Unfreezing
	Creating Awareness	Building understanding and recognition of the need for change.	Lewin: Unfreezing Hall & Hord: Orientation
	Creating the Guiding Team	Forming a coalition or group to lead the change efforts.	Kotter: Coalition Building
Interest Stage	Creating Interest	Generating enthusiasm and support for the change.	Lewin: Movement Hall & Hord: Orientation
	Creating Vision and Goals	Developing a clear vision and objectives for the change.	Kotter: Create Vision
Preparation Stage	Strategic Planning	Outlining a roadmap or strategy for achieving the change vision.	Hall & Hord: Integration
	Providing Training	Equipping people with the necessary skills and knowledge for the change.	Hall & Hord: Preparation
Practice Stage	Communicating and Coordinating Efforts	Ensuring everyone understands and aligns with the vision and strategy.	Kotter: Vision Communication Hall & Hord: Routine
	Collaboration	Encouraging cooperation across departments and teams for effective change.	Hall & Hord: Integration
	Incentivizing People	Motivating stakeholders to embrace and support the change through rewards.	Lewin: Movement
	Creating Quick Wins	Recognizing and rewarding early signs of progress to build momentum.	Kotter: Short-Term Wins
Routine Use Stage	Creating Sustainability Policies	Establishing policies and practices to ensure the change is lasting and embedded.	Kotter: Anchoring Lewin: Refreezing
	Evaluating and Reporting Progress	Monitoring the effectiveness of the change process and reporting on progress.	Kotter: Consolidation Hall & Hord: Routine Use/Renewal

The interest stage is when stakeholders must become engaged and motivated to the join the change initiative. The preparation stage involves actions that empower individuals, reduce barriers to change, and provide training, underpinning the

transition toward action. The practice stage focuses on practical implementation, emphasizing collaborative action and creating quick wins. Finally, the routine use stage, essential for sustaining change, involves creating policies that embed the change in the organization's structure, and evaluating progress.

4.4.3 Awareness Stage

4.4.3.1 Initiating the Change Process. In both Anglo-American and emerging regions, leadership plays a crucial role in driving sustainability. For instance, at one university (U1), an interviewee recounted the significant shift around 2002, highlighting the University President's impactful leadership: "Our university president is a very strong leader and a lot of people really respect what he asks for." This statement underscored the pivotal role that leadership could play in driving sustainability initiatives. Similarly, an interviewee from U10 shared a critical moment in 2011, saying, "and in 2011, they were wondering, are we accomplishing the vision... So, they created this sustainability office to track what they were doing to reach the vision." This reflection highlighted the role of university leadership in not only setting sustainability goals but also in establishing mechanisms to track and fulfill these objectives.

Economic factors also emerged as a common motivator. As an interviewee from U7 recalled, the 2008 financial crisis spurred the creation of the "Green Budget rescue team," showcasing how universities adapted to economic pressures by integrating sustainability into their fiscal strategies. At another university (U2), the establishment of a sustainability office in 2009 was a critical decision influenced by the board of governors in response to the global financial crisis.

Interest in environmental programs also served as a starting point for broader sustainability initiatives in universities. An interviewee from U4 described the evolution of such programs, beginning with activities like energy saving and water conservation since 2000. These efforts, initially not labeled as sustainability, gradually became part of a larger strategy. Highlighting this progression, another interviewee from U3 remarked, "So, I was working on educating students about how to recycle and we were just starting to get some sustainability initiative started on campus." This reflected the early stages of sustainability initiatives, where efforts like

recycling education served as foundational steps toward a more comprehensive sustainability strategy.

4.4.3.2 Beginning Focus. Notably, the initial focus for most of the universities, such as U1, U3, U5, and U7, was on environmental issues such as recycling, waste reduction, water and energy (see Table 4.9). For example, an interviewee from U1 mentioned, "recycling several decades back," illustrating a long-standing commitment to sustainability. Over time, these efforts expanded to encompass a broader spectrum of sustainability challenges. This progression signified not only an increasing awareness of environmental issues but also a commitment to deeper, more comprehensive sustainability stewardship.

Table 4.11 Summary of initial foci for sustainability efforts of the universities

Univ-ersity	Initial Focus	Approach & Evolution
U1	Early engagement in environmental programs, recycling	Long-standing, evolving from basic initiatives to broader sustainability
U2	Main focus on improving the university's energy system	Continuous and focused approach on energy efficiency
U3	Started with recycling and basic initiatives	Progression from accessible initiatives to complex sustainability efforts
U4	Energy, water, recycling, and campus biodiversity from the beginning	Practical, focusing on tangible sustainability projects
U5	Initially general environmental stewardship, evolving to specific commitments	Maturation from broad environmental focus to targeted sustainability efforts
U7	Commitment to reducing emissions, forming the 'Green Budget rescue team'	Evolving from waste management to significant climate commitments
U8	More heavily focused on the operational side, later transitioned to energy focus	Early focus on operational aspects, shifting to energy sustainability
U9	Began with research interests, focusing on environmental performance metrics	Applied research, 'living lab' approach, focus on environmental sustainability
U10	Grew from finding allies to understanding holistic sustainability	Holistic approach, including socio-cultural and financial aspects
U11	Using STARS framework for planning	Recent strategic approach, emphasis on plan creation

Another notable aspect of these universities' sustainability efforts was their focus on specific areas. For instance, U2's concentration on improving the university's energy system represented a targeted approach to a crucial aspect of sustainability. Similarly, U4's attention to energy, water, recycling, and campus biodiversity from the outset demonstrated a practical, project-based focus on tangible sustainability goals. U7's commitment to reducing emissions and forming a specialized

‘Green Budget rescue team’ further underscored a strategic approach to specific environmental challenges.

Some universities have shown a shift in their sustainability focus over time. U8, for example, initially emphasized operational aspects but later transitioned to an energy focus. U9 began with research interests, particularly focusing on environmental performance metrics, and then adopted an applied research approach with a ‘living lab’ concept. These shifts suggested a dynamic and responsive approach to sustainability, where priorities were adjusted in response to emerging insights and evolving environmental challenges.

4.4.3.3 Creating Awareness. Universities in both regions adopted varied and innovative approaches to creating awareness for sustainability (see Table 4.10). Anglo-American universities like U3, U5, and U8 demonstrated a systemic and resource-rich approach. These include interactive and high-visibility activities such as luncheon learns, town halls, and innovative projects like Bio digestors and solar car ports, as seen in universities like U5 and U8, reflecting a higher level of institutional commitment and resources.

In contrast, universities in emerging regions adopted more direct and grassroots approaches. For example, U4 engaged students in sustainable practices through practical initiatives like distributing reusable cups to new students, while U6 focused on showcasing sustainability research and student engagement through competitions and exhibitions. Similarly, U11 and U12 emphasized hands-on methods such as short sustainability workshops and peer-to-peer education. These diverse approaches, whether resource-intensive or hands-on, signified a movement toward integrating sustainability into the fabric of higher education.

The challenges faced by these universities when creating awareness for sustainability also varied. Anglo-American universities like U2 and U3 often struggled with integrating sustainability into a comprehensive institutional agenda. Despite their resource richness, there was a challenge in maintaining consistent engagement and commitment across all levels of the university community.

Table 4.12 Challenges for awareness stage

Challenges	Examples	Strategies	Activities/Events
Limited awareness and engagement	Students and faculty are not fully aware of sustainability issues or initiatives.	Increase visibility of sustainability initiatives.	- Annual Sustainability Week with presentations and exhibits (U6). - Information booths in busy areas like cafeterias (U5). - Engaging social media campaigns and virtual conferences (U5).
Lack of institutional commitment	The university leadership does not prioritize sustainability in their agenda.	Gain support from university leadership.	- Presentations and reports to the board of governors (U2). - Drafting and endorsing a sustainability plan (U2). - Organizing luncheon learns and town halls with university leaders (U5).
Insufficient resources	Limited budget or manpower to run extensive sustainability programs.	Optimize resource use and seek external funding.	- Volunteer-driven Eco Reps program (U12). - Applying for grants and forming partnerships with eco-friendly organizations (U5). - Utilizing student volunteers for sustainability initiatives (U12).
Cultural and behavioral resistance	Faculty and students resist changing their habits to more sustainable practices.	Education and behavior change campaigns.	- Workshops on sustainable living (U11). - Initiatives like free reusable cups for new students (U4). - Peer-to-peer education campaigns through Eco Reps (U12).
Ineffective communication	Sustainability messages are not reaching the intended audience effectively.	Improve communication channels and messaging.	- Regular newsletters and email updates (U5). - Engaging storytelling and updates on social media platforms (U5). - Interactive webinars and virtual conferences on sustainability topics (U5).

For example, U10's large-scale surveys and engagement programs indicated efforts to understand and improve community attitudes to sustainability, but they also hinted at challenges in achieving widespread and deep-rooted change. Similarly, U5's reliance on varied communication strategies, including newsletters, social media, and interactive events, suggested ongoing efforts to penetrate different segments of the university population: "we rely heavily on social media... Instagram is their best friend on getting the student population involved" (P5).

In contrast, universities in emerging regions faced challenges rooted primarily in limited resources and initial stages of awareness. Universities like U11 and U12 demonstrated this through their focus on basic workshops and peer-to-

peer education programs. These institutions were not just tasked with raising awareness but also with building it from a more foundational level. Limited resources further compounded these challenges, as seen in the reliance on volunteer-driven programs and the need for external funding in U12. These universities often had to balance the need to raise awareness with the practical realities of budget constraints and limited manpower.

4.4.3.4 Creating the Guiding Team. Creating a guiding team for sustainability initiatives in universities across Anglo-American and emerging regions ranged from top-down leadership-driven models to grassroots efforts led by faculty and students (see Table 4.11). For instance, several institutions (e.g., U1, U3, U8, U11, U12) exhibited strong leadership-driven approaches, where sustainability was prioritized at the highest levels of university administration. U1 exemplified this approach, with the university president making sustainability a key academic and operational pillar, and U12's Chief Operating Officer took the lead in establishing a standalone sustainability office in 2017.

Table 4.13 Approaches to creating the guiding team

University	Approach to Creating Guiding Team	Description
U1	Leadership-Driven	The university president prioritized sustainability, making it a key academic and operational pillar.
U2	Structured Team Building	Established a sustainability office with a director, an energy manager, and a coordinator.
U3	Leadership-Driven	Director of Communications and Sustainability co-chairs the President Sustainability Commission, combining leadership and collaborative efforts.
U5	Faculty-Led	A faculty member, passionate about sustainability, initiated a sustainability committee and plan.
U7	Faculty-Led	Faculty formed the "Green Budget rescue team" in response to financial crunch.
U8	Leadership-Driven	Executive leaders convened a steering group for sustainability, with diverse operational members.
U9	Faculty-Driven	Two professors interested in sustainability drove the initiative, beginning as sustainability officers.
U10	Staff-Driven	Initiated by academic and professional staff; led to the appointment of a casual sustainability project officer and a sustainability manager.
U11	Leadership-Driven	A group of influential university members created the vision and mission for sustainability.
U12	Leadership-Driven	COO with a background in sustainable finance created a standalone sustainability office.

Further illustrating this trend, U2 established a sustainability office in 2009, appointing dedicated staff like a director and an energy manager, thereby setting a precedent for structured team building in sustainability. This approach was mirrored by U11, where the sustainability vision and mission were crafted by influential university members. Similarly, U8 engaged executive leaders in sustainability discussions, culminating in the formation of a steering group. U3, on the other hand, adopted a more collaborative model, with the Director of Communications and Sustainability co-chairing the President's Sustainability Commission, blending leadership with broad-based involvement.

Concurrently, faculty and staff-led initiatives were also notably present, as seen in universities like U5, U7, U9, and U10. These instances underscored the role of individual passion and commitment in driving sustainability, with initiatives often starting on a smaller scale before receiving institutional support. For example, U9 saw its sustainability officer role develop from an initiative by two professors, indicating a grassroots approach. Similarly, U10's sustainability efforts were initiated by academic and professional staff, leading to the appointments of a casual sustainability project officer and a sustainability manager. At U5, a faculty member's passion for sustainability led to the formation of a committee and a formalized plan, while U7's faculty organized a "Green Budget rescue team" in response to financial constraints.

One notable difference was that Anglo-American universities often relied on a combination of strong leadership and collaborative models to form their guiding teams, while universities in emerging regions tended to vary in their approach, with many favoring faculty and staff-led grassroots movements.

4.4.4 Interest Stage

4.4.4.1 Creating Interest. As seen in Table 4.12, universities across different regions employed diverse strategies to create interest in sustainability, which was also accompanied by challenges.

Both Anglo-American and emerging region universities faced the challenge of engaging their diverse campus communities to garner interest in

sustainability. For example, universities such as U2, U5, and U7 implemented volunteer and ambassador programs, formed departmental partnerships, and hosted various events to foster engagement. U2, specifically, emphasized involving students, staff, and faculty in sustainability initiatives through these programs. Similarly, U7 focused on making sustainability appealing by leveraging its high ranking in sustainability as a motivational factor, using campus tours and events to do so.

Table 4.14 Challenges for interest stage

Challenges	Examples	Strategies	Activities/Events
Engaging diverse campus community	Difficulty in reaching and involving various groups within the university.	Implementing programs that encourage active participation across different campus groups.	- Volunteer and ambassador programs, partnerships with departments (U5, U2). - Hosting diverse events to attract different campus communities (U7).
Lack of internal expertise in sustainability	Limited knowledge or resources within the university to effectively drive sustainability initiatives.	Bringing in external knowledge and expertise to fill gaps.	- Inviting international experts for talks and workshops (U11, U9). - Communication and public relations campaigns to enhance understanding and engagement (U9).
Gradual introduction of sustainability concepts	Challenge of integrating sustainability into university culture and curriculum.	Using strategic discussions and activities to slowly integrate sustainability into the university environment.	- Socializing sustainability concepts through strategic discussions (U8). - Promoting remote work and other sustainable practices (U3).
Cultural integration of sustainability	Integrating sustainability into the local and cultural context of the university.	Tailoring sustainability efforts to align with local culture and interests.	- Hosting local culture-based events and movie nights (U6). - Incorporating sustainability themes into local contexts and activities (U12).
Making sustainability appealing	Sustainability seen as uninteresting or irrelevant by the campus community.	Utilizing the university's prestige and creating engaging events.	- Campus tours focusing on sustainability efforts (U7). - Organizing sustainability nights and events that leverage the university's ranking (U10).

U1 had focused on student-to-student outreach, utilizing social media and direct engagement in residence halls to spark interest in sustainability. An interviewee from U1 had mentioned, "We are trying to start, what's called an Eco Reps program," focusing on peer-to-peer interaction. U5, on the other hand, had engaged with student unions and various campus groups, organizing open houses and town halls for participative decision-making. These town hall meetings allowed for collective

goal-setting, aligning with U5's strategy of facilitating dialogues and workshops to bring together diverse interests.

U8 and U3 adopted a gradual approach to introducing sustainability concepts. They involved strategic discussions, socialized these concepts across the campus, and integrated them into operations, including remote work. U8 had taken an academic approach to sustainability, encouraging faculty engagement with the SDGs to spark interest: "Many of them actually really associate or identify with the SDGs. When we ask the faculty how they are engaging in these concepts, they were really excited to learn more, and be recognized for what they were doing. It helped us engage with folks on the academic side."

In emerging regions, universities like U6 and U12 organized local culture-based events and movie nights, emphasizing the importance of contextualizing sustainability within the local culture. This approach was complemented by U9 and U12's efforts in effective campus communication. They utilized PR campaigns and waste campaigns to engage students more effectively, recognizing the need to tailor their strategies to their specific campus environments and cultural contexts.

The lack of internal expertise in sustainability was another common challenge especially for emerging region universities such as U9 and U11. They addressed this by inviting international experts and implementing communication and PR campaigns to inspire their community, as seen in U11's strategy of inviting renowned figures to influence top management and campus community. As the participant U11 stated, "bringing or making your top management, hear it from someone from the outside someone else someone who has a big name in this subject."

Despite some regional differences, a common theme that emerged across these institutions was the growing interest in sustainability among students. Universities such as U5 and U12 had recognized the importance of measuring participation in sustainability-related events as an indicator of this increasing interest. This student-centric approach became a unifying factor across diverse geographical and cultural contexts, highlighting a universal shift in student engagement with sustainability issues.

4.4.4.2 Creating Vision and Goals. The establishment of clear sustainability vision and goals was crucial in capturing the attention and interest of the university community. It set a direction for future actions and initiatives, serving as a catalyst for developing a deeper commitment and understanding of sustainability, ensuring that sustainability is not just an additional agenda but a core aspect of the institution's identity.

Table 4.15 Sustainability visions and goals

University	Vision	Goals
U1	Key pillar in academics and operations.	Climate positive, Waste reduction, Water optimization, Personal and community engagement, Resilience and regeneration, Sustainable food choices.
U2	Sustainability as a core theme with strategic focus.	Low Carbon Energy System, Cross-level involvement, Sustainability strategy assessment.
U3	Global perspective on sustainability.	On-campus and global focus, Food system stability, Energy sourcing and solar arrays.
U5	Reflect national and international sustainability.	Reusable items promotion, Plastic container regulation, Climate action and emission focus, Global sustainability information, Educational quality improvement.
U7	Environmental stewardship and engagement.	Metric-driven goals, Community involvement, Sustainable investment policies.
U8	Promote SDGs and evaluate annually.	Annual sustainability reports, Carbon-neutral path for 2050, SDG-related projects, Local economic collaboration.
U9	Sustainability in ethos and operations.	Collaborative goal setting, Environmental and social projects.
U10	Sustainability integral to strategic plan.	100% renewable energy transition, Emission reductions, Adaptation to strategic goals.
U11	Regional leadership in sustainability.	Eliminate single-use plastics, Data-driven decision making, Campus sustainability leadership.
U12	Sustainability in strategic planning.	Environmental management, Sustainable design, Event guidelines, Sustainability policy.

A common thread among all universities was that sustainability is not just an add-on but a fundamental aspect of their identity (see Table 4.13). These institutions had integrated sustainability deeply into their strategic plans and operations linking them to the triple bottom line outputs. STARS sustainability reports further supported this finding, indicating that all participating universities have sought to integrate sustainability across all facets, including vision, operations, facilities,

curriculum, strategic planning, and university administration (STARS Participants and Reports, 2023). For instance, U4 and U5 had positioned sustainability as a core aspect of their institutional ethos, aligning their strategic plans with environmental, social, and economic sustainability. For instance, the participant from U4 noted that "it's a kind of balancing… not just on the economic development. We need the development of the human being. And we need to care about the human, care about the issue of justice and environment, and care about diversity." U6 and U8 also demonstrated this trend, with U8 notably aligning its goals with the Sustainable Development Goals (SDGs), showcasing a holistic approach to sustainability that permeates their academic and operational practices.

The commitment to diverse sustainability goals was evident across the board, with universities adopting a range of initiatives aligned with the triple bottom line. For example, U10's strategic plan stated: "Future planning, design and management of the facilities will be guided by a vision of sustainability seeking to reduce environmental impacts, achieve economic efficiency, demonstrate social responsibility, and enhance student experience." These goals were often backed by significant resources, institutional support, and a culture of innovation, enabling ambitious projects like U1's resilience and regeneration programs and U2's advanced energy systems: "once it's finished, the engineering company say that it will be one of the most advanced energy systems in the world."

One notable difference was that universities in emerging regions such as U4, U11, and U12 displayed a more adaptive approach. These institutions often modified existing models to fit their unique contexts, focusing on achievable and immediate goals. For example, U11's adaptation of the STARS tool to the Mexican context was a prime example of this pragmatic approach: "We use STARS from AASHE. So, what we did we merged what we had with STARS and started creating a new plan for the institution."

4.4.5 Preparation Stage

4.4.5.1 Strategic Planning. Integrating sustainability into the university's strategic plan was a crucial step in ensuring long-term commitment for the

university to have an impact on social, environmental, and economic sustainability also known as the triple bottom line (see Table 4.14).

Universities, irrespective of their region, demonstrated a commitment to integrating sustainability into their strategic planning. This process involved setting clear long-term visions and goals, stakeholder involvement, consensus-building, and balancing environmental aspirations with practical and financial considerations. For instance, U1 outlined eight sustainability goals including "climate positivity" and "optimized water usage," showing a balance between ambitious environmental goals and financial pragmatism. Similarly, U12 from an emerging region focused on embedding sustainability in the curriculum, highlighting a broad effort to foster a culture of sustainability.

Table 4.16 Approaches and challenges to strategic planning

University	Approach & Strategic Planning	Key Challenges & Adaptations
U1	8 goals for sustainability; climate positive; circular resources; optimized water usage.	Balancing environmental goals with financial considerations; stakeholder engagement.
U2	STARS framework; 5-year campus strategic sustainability plan; stakeholder involvement.	Balancing STARS framework with additional institutional goals; wide stakeholder involvement.
U3	Top-down climate action plan; public review phase; presidential sustainability commission.	Complexities of public review and approval process; multiple stakeholder representation.
U4	Assessment of previous strategy; focus on campus life, research, and operations.	Continual adaptation of sustainability goals; alignment with operational efficiencies.
U5	Sustainability strategy and climate action plan; engagement with student unions and facility teams.	Updating and aligning sustainability strategy with broader institutional goals.
U6	Consensus-building for carbon-neutral pathway; major goal achievement focus.	Building consensus in decision-making; focusing on long-term environmental goals.
U7	University-wide strategic planning initiatives; sustainability council with practical priorities.	Balancing university-wide efforts with practical sustainability council initiatives.
U8	Integrating sustainability into strategic plan; focus on research and stewardship.	Incorporating sustainability in strategic conversation; obtaining executive support.
U9	Defining main areas and projects; focus on smart campus initiatives.	Aligning sustainability efforts with institutional goals; managing resources.
U10	Integrating sustainability into strategic plan; focus on Sustainable Development Goals (SDGs).	Aligning sustainability with strategic directions; engagement with internal and external stakeholders.

Sustainability planning often followed established frameworks like STARS, as seen in the practices of both Anglo-American and emerging region universities (STARS Participants and Reports, 2023). These frameworks provided a structured approach, ensuring that various aspects of sustainability such as triple bottom line targets are addressed comprehensively. However, the adaptation of these frameworks to fit local contexts, as seen in emerging regions, highlighted the dynamic nature of sustainability planning. U11 from emerging region discussed adapting the STARS tool to fit their local context, emphasizing the need for cultural relevance: "we adapt to the plan, because the STARS is really American focus." This adaptation, coupled with practical negotiations like achieving a gold LEED certification, underscored the complexities and resourceful adaptability required in different economic and cultural settings.

However, these strategic efforts were not without challenges. Common issues faced by these institutions, like U6's consensus-building for a carbon-neutral pathway and U7's balancing of university-wide efforts, highlighted the complexity of implementing sustainability initiatives. Challenges such as aligning sustainability with broader institutional goals (U8 and U9) and engaging a wide range of stakeholders (U3 and U10) were recurrent themes. These challenges showcased the need for continual adaptation, effective resource management, and broad-based support, both internally and externally, to realize the sustainability goals set forth in their strategic plans.

Additionally, incorporating sustainability into strategic plans was a continuous effort across universities, regardless of their ratings. For instance, a representative from U7 expressed frustration over sustainability being initially overlooked in their strategic planning. Likewise, an interviewee from U8 described a similar challenge, which was resolved with the President's support, emphasizing the importance of leadership in prioritizing sustainability. These examples underscored the need for persistent advocacy and strong leadership to ensure sustainability is a key component in university strategic plans.

Overall, while Anglo-American universities often leveraged more resources and established systems for comprehensive sustainability strategies, universities in emerging regions, despite sharing similar ambitions, navigated

additional challenges like adapting global standards to local contexts and managing limited resources.

4.4.5.2 Providing Training. In the realm of professional development training for sustainability, both the Anglo-American and emerging region demonstrated unique and effective approaches, each tailored to their specific contexts and needs (see Table 4.15).

Table 4.17 Sustainability training

Univ-ersity	Sustainability Training Approaches
U2	- Continuous re-education on sustainability for students, staff, and faculty
U3	- Access to AASHE global conference - Grant process for creating or integrating sustainability into courses - Professional development opportunities in sustainability
U4	- Lectures for employees - Workshops on sustainable practices (e.g., avoiding plastic containers)
U5	- Educating and fostering relationships with appointed personnel - Sustainability change leadership courses in higher education
U6	- Training and project initiatives for student body on sustainability
U7	- Annual 'Green Threads Sustainability' faculty workshop - Strategies for incorporating sustainability into various disciplines
U9	- Academic programs and funds for sustainability research and training
U11	- Access to sustainability conferences for leaders ($150 each) - Workshops for incorporating sustainability into academic curriculum aligned with SDGs
U12	- Outreach and workshops on climate change - Empowering various university departments (e.g., HR, IT) to consider sustainability in their operations

Universities across both Anglo-American and emerging regions demonstrated a commitment to sustainability training, encompassing a variety of approaches tailored to their specific contexts. For instance, U2 and U3 highlighted a comprehensive approach with continuous sustainability education for all university members and involvement in global sustainability conferences like AASHE. Similarly, U11 facilitated access to sustainability conferences specifically for leaders, while U12 emphasized outreach and workshops on climate change, involving various departments.

Moreover, other universities, irrespective of their region, adopted diverse methods for sustainability training. For example, U5 focused on leadership courses in higher education, advocating for change leadership and relationship building. On the other hand, Universities U4 and U6 from emerging regions emphasized practical aspects, like workshops on sustainable practices and lectures. This reflected a pragmatic approach, more focused on immediate, applicable solutions.

While methods varied, with Anglo-American institutions typically adopting more structured and extensive approaches like grants and professional development opportunities, emerging region universities often concentrated on workshops and practical knowledge dissemination. This illustrated the diverse yet unified commitment to sustainability education in higher learning institutions.

4.4.6 Practice Stage

4.4.6.1 Communicating and Coordinating Efforts. During the practice stage, effective communication ensured that all stakeholders were informed and engaged with the sustainability initiatives whereas coordination ensured that these efforts were synchronized across different departments and groups, maximizing their impact.

The challenges and strategies of communication and coordination in sustainability efforts across various universities revealed several common themes (see Table 4.16). A primary challenge faced by many institutions, such as U1, U3, and U8, was the large scale and decentralized nature of their operations. This often lead to communication gaps and difficulties in effectively tracking progress and coordinating efforts across different departments, as seen in U1. “The university is so big that I’m not sure that they would know what the goals were,” exemplified the challenge at U1. Additionally, universities like U3 and U10 grappled with the issue of information overload, which hampered their ability to maintain widespread awareness of sustainability goals and activities among staff, faculty, and students.

Table 4.18 Communication and coordination challenges and strategies

Univ-ersity	Communication and Coordination Challenges	Communication and Coordination Strategies
U1	Large size leading to lack of awareness about goals; difficulty in tracking activities and progress.	Online annual reports; contextualizing meetings and presentations within goals; leveraging ranking scores for visibility.
U3	Decentralization causing communication gaps; overwhelming amount of information and goals.	RSS feed for sustainability news; listservs; strategic planning with broad participation; President's Sustainability Commission for idea sharing.
U4	Need to enhance visibility and impact of sustainability efforts.	Emphasis on visible sustainability initiatives (e.g., building a center); participation in sustainability rankings.
U5	Trust issues with central administration; difficulty reaching all staff and faculty; over-communication; absence of a dedicated communications position.	Switch to virtual events (e.g., Sustainability Day); extensive review process for reports; reliance on social media for student engagement.
U6	Need for effective bilingual communication and student engagement.	Bilingual website; student ambassador program; regular communication through a committee.
U7	Engaging broader community in sustainability initiatives.	Involving students in data gathering and reporting; use of website, social media, and newsletters for communication.
U8	Decentralization leading to communication difficulties; engagement challenges; complexity in coordinating sustainability across multiple departments.	Green Office Certification program; top-down communication initiatives; exploration of more effective communication methods.
U9	Difficulty in effectively showcasing work and activities; coordination with other university areas working on sustainability.	Regular meetings with deans; establishment of Smart Campus group; investment in communication and public relations; sustainability dashboard development.
U10	Information overload; lack of awareness about university's sustainability efforts.	Biennial Travel Behaviour Survey; stakeholder forums; utilization of various communication channels.
U11	Resistance to sustainable building standards; negotiation challenges.	Active discussions and compromise on sustainability standards (e.g., LEED certification level).
U12	Generation-specific communication preferences; inefficiency of email for broad communication.	Use of different social media platforms for different audiences; newsletters; use of bulletin boards and traditional communication channels.

Another significant theme was the need to enhance the engagement and visibility of sustainability efforts. Universities such as U4, U6, U7, and U9 focused on making their sustainability initiatives more visible and engaging for

the broader community, including students. This was often achieved through the development of clear and impactful projects, such as building a dedicated sustainability center or creating student ambassador programs. These efforts were crucial in fostering a culture of sustainability and ensuring that these initiatives received the attention and participation they deserved.

The strategies employed to overcome these challenges were diverse and innovative. Many universities relied on online tools and social media for disseminating information and engaging with their audiences, as seen with U1's online annual reports and U3's RSS feeds. Inclusive planning and regular meetings, like those implemented by U3 and U9, ensured broad participation and effective communication among stakeholders. Additionally, initiatives like the Green Office Certification program by U8 and various communication channels utilized by U10, highlighted the importance of tailored approaches to coordinate and increase participation in sustainability efforts.

Lastly, some universities faced unique challenges such as trust issues with central administration and generation-specific communication preferences, as noted by U5 and U12. These challenges necessitated the development of specific communication strategies that were sensitive to the needs and preferences of different groups within the university community. For instance, U12's use of different social media platforms for varied audiences and U6's bilingual website catered to a diverse demographic. In cases like U11, where resistance to sustainable building standards posed a challenge, active discussions and compromises were key in aligning the interests of different stakeholders. Overall, these themes highlighted the necessity for effective, inclusive, and adaptable communication strategies in advancing sustainability initiatives in university settings.

4.4.6.2 Collaboration. Collaboration involved bringing together diverse groups such as faculty, students, external partners, and community members to work on sustainability projects. This collaborative approach not only pooled resources and expertise but also fostered a sense of shared responsibility and community engagement in sustainability efforts.

Table 4.19 Key collaboration strategies

Univ-ersity	Key Collaboration Strategies
U1	- Emphasis on partnerships and collaboration through events and volunteering. - Collaboration with a wide range of partners, including facilities and sustainability groups.
U2	- Volunteer and ambassador programs for sustainability. - Collaboration with different departments and student groups on sustainability projects.
U3	- Creation of a presidential commission for idea sharing. - Decentralized model dependent on collaboration. - Involvement of diverse groups, from students to vice presidents.
U4	- Strong team formation across research, teaching, and service. - Active collaboration on important projects.
U6	- Development of urban-rural collaborative projects. - Integration of local community with faculty, students, and staff.
U7	- Grassroots approach to sustainability. - Role in supporting collaborative work and convening groups. - University-wide sustainability council involvement.
U8	- Working with strong partners and key advocates. - Challenges with staffing and resource allocation.
U10	- Positive reception to sustainability initiatives. - Efforts to align university activities with broader sustainability missions.
U11	- Involvement of faculty, students, and sustainability office. - Co-creation of sustainability initiatives. - Emphasis on building relationships across different university sectors.

The participating universities demonstrated a strong emphasis on partnerships and collaboration in their sustainability efforts (see Table 4.17). Key strategies included engaging a variety of partners, from facilities and sustainability groups to local communities and strong external partners. For instance, U1 and U6 focused on integrating the local community with faculty, students, and staff, while U7 and U8 concentrated on grassroots approaches and working with key advocates. As the participant from U1 noted, “We are pretty big so we also work closely with a lot of partners in the facilities group - parking and transit etc. There’s a long list.” Moreover, universities like U2 and U4 had adopted volunteer and ambassador programs, as well as cross-departmental collaboration, to foster a comprehensive approach to sustainability.

Collaboration with diverse groups across the university spectrum was another common theme among these institutions. Universities such as U3, U7, and U11 emphasized the role of various stakeholders, from students and faculty to high-level administrators like vice presidents, in their sustainability efforts. U3's creation of a presidential commission for idea sharing and U7's involvement in a university-wide sustainability council exemplified structured approaches to incorporating diverse perspectives. U3 described their strategy: "So, creating the presidential commission was so that everyone was around one table and they could share ideas."

Operational strategies and challenges also emerged as notable themes. Universities like U4 and U10 focused on aligning their various activities, including research, teaching, and service, with broader sustainability missions, indicating a holistic approach to embedding sustainability in all aspects of university life. P4 highlighted, "We kind of form a very strong team. And we work together. And through the research, teaching, and also service." However, challenges in implementation were also acknowledged, as seen in U8's mention of staffing and resource allocation hurdles. This reflected the complexities universities face in operationalizing sustainability initiatives, necessitating a balance between ambitious goals and practical constraints.

Overall, these universities showcased a multi-faceted and participatory approach to sustainability, emphasizing partnerships, diverse involvement, and strategic alignment with broader sustainability goals.

4.4.6.3 Incentivizing People. Providing incentives to stakeholders played a critical role in motivating and encouraging active participation in sustainability initiatives within universities.

Both regions exhibited a mix of financial and non-financial incentives, indicating an understanding that motivation in academia is multi-faceted. For instance, universities in both regions offered financial rewards, such as grants and stipends, with a notable difference in scale. Anglo-American universities tended to provide larger incentives, like the $100,000 sustainability grant at U2, whereas Emerging Region universities often offered smaller grants. Additionally, there was a

focus on non-monetary recognition, like the President's Award at U1, emphasizing the value of acclaim and visibility alongside financial rewards.

Another common thread across these universities was the emphasis on sustainability and research, reflecting a global academic trend. Universities, irrespective of their geographic or economic context, were incentivizing activities in these areas. This is evident in U2, U4, U9, and U11 in the provision of research grants, sustainability funds, and support for course development. Moreover, the involvement of national bodies in emerging regions, as seen with U4's support from the National Scientific Council, highlighted a collaborative approach between academia and government.

Overall, Anglo-American universities provided more substantial financial resources and emphasized recognition and large-scale grant funding. In contrast, universities in emerging regions navigated resource limitations with a mix of modest financial incentives, recognition, and strategic support for collaboration and research.

4.4.6.4 Creating Quick Wins. Creating quick wins for sustainability was vital in sustaining momentum and building support for longer-term sustainability initiatives within universities.

A predominant theme across universities was the emphasis on achieving high ratings in sustainability assessments such as the STARS (STARS Participants and Reports, 2023) and other environmental rankings (e.g., Sierra Club, THE Impact ranking). Institutions like U1, U5, U10, and U3, among others, had strived to achieve high rankings, serving as a tangible and measurable indicator of their commitment and progress in sustainability. U1, for instance, boasted, "So we get No. 1 in the Sierra Club's coolest schools ranking. That was very exciting for people." This focus not only provided a benchmark for their efforts but also served as a public recognition of their achievements, thus contributing to the momentum in their change process.

Another significant theme was the integration of sustainability into academic curriculums, as seen in universities like U1, U6, and U7. This approach effectively delivered immediate results by embedding environmental consciousness into the educational journey of students. Additionally, some universities had chosen to

specialize in specific sustainability areas or research, such as U5's focus on Arctic research and U7's development of comprehensive sustainability academic programs. Such targeted efforts lead to immediate recognition and credibility, acting as a catalyst for further sustainability initiatives and driving momentum in their broader change processes.

Visible changes in infrastructure and campus practices also played a crucial role in creating quick wins. Initiatives like the development of recycling stations by U12, enhancing infrastructure for accessibility at U11, and U7's recognition as a bike-friendly university, were tangible, visible markers of commitment to sustainability. These immediate changes not only improved the campus environment but also served as a daily reminder of the institution's dedication to sustainable practices. Furthermore, the engagement of the university community, especially through student-led initiatives as seen in U3, indicated a bottom-up approach where the change was driven actively by the stakeholders themselves. This engagement was crucial for sustaining long-term momentum in the change process.

There are also noticeable differences in the approaches between universities in emerging regions and those in the Anglo-American region. Universities in emerging regions, such as U11, U6, and U9, often placed a greater emphasis on diversity and inclusion, and infrastructure improvements that were directly impactful and visible to their communities. In contrast, Anglo-American universities tended to focus more on achieving high sustainability rankings and integrating sustainability into research and academic programs. This difference could be due to the varying levels of resources available and the distinct educational and environmental policies in these regions.

4.4.7 Institutionalization stage

4.4.7.1 Creating Sustainability Policies. Policies were crucial in embedding sustainability into institutional frameworks.

A primary aspect involved in creating sustainability policies was stakeholder involvement and community input, as seen in universities like U3, U6, and U9. These institutions prioritized engaging the community through open houses, town halls, and public review phases. This approach ensured that sustainability policies

were not only comprehensive but also reflective of the broader community's needs and aspirations. Institutional structures dedicated to sustainability, such as U7's committee-focused approach and U8's university-wide sustainability council, also played a significant role. These structures were instrumental in ensuring that sustainability was integrated into the institutional fabric and that there was a dedicated body overseeing the implementation and progress of these policies.

Another critical theme was the focus on comprehensive sustainability planning. As disclosed in the STARS reports, universities such as U3, U9, U10, and U11 were examples of this, showcasing a trend toward the development of detailed, multi-year sustainability plans that encompass various triple bottom line aspects, from energy transition and infrastructure growth to transport strategies (STARS Participants and Reports, 2023). Policies like U4's Environmentally and Socially Responsible Purchasing Policy, U5's Reusable Cup Policy, and U8's ESG Investment Policy demonstrated a trend of setting specific, measurable goals.

Another common aspect in sustainability policy development was the use of established frameworks and standards. The adoption of frameworks like STARS by U3 and U9, and LEED standards by U12, was indicative of a reliance on recognized guidelines to shape, implement, and measure sustainability efforts. Alongside this, the financial strategies and funding aspects were also pivotal. Universities like U1, which needed CFO approval for projects with a clear financial return, and U4, which emphasized feasible projects with available funding, illustrated the balance between sustainability objectives and financial viability. This balance was crucial in ensuring the practicality and long-term sustainability of these policies.

Finally, there were also notable differences. Universities in emerging regions, often constrained by resources, focused on optimizing resources, local environmental priorities, and community awareness and capacity in their sustainability policies. Conversely, Anglo-American institutions, benefiting from more resources and established sustainability infrastructure, pursued advanced initiatives like comprehensive carbon neutrality and broader institutional sustainability integration. This underscored the need for tailoring sustainability policies to the unique needs and contexts of different regions.

4.4.7.2 Evaluating and Reporting Progress. Evaluating and reporting progress on sustainability initiatives was a crucial aspect for institutions in both the Anglo-American and Emerging Region, each employing distinct methods and tools for this purpose (see Table 4.18).

Table 4.20 Key performance indicators and reporting

Univ-ersity	Key Performance Indicators (KPIs)	Reporting Methods
U1	LEED metrics, greenhouse gas emissions, waste management, energy efficiency, water efficiency, indoor air quality, transportation support, use of natural materials.	Year-on-year change analysis, data metrics, LEED certification.
U3	Campus-wide sustainability across various sectors, such as energy, food, transportation, waste, water, etc.	STARS reporting, focus on continuous improvement.
U4	Focus on specific areas relevant to the institution (e.g., agriculture, urban issues), greenhouse gas emissions.	STARS for benchmarking and data collection, strategic planning, annual greenhouse gas inventory.
U5	Sustainability literacy of students.	THE and STARS ratings, surveys.
U6	Sustainability literacy, utility and emissions data, waste data.	Reporting to Low Carbon Government Office, STARS reporting, social media polls, surveys.
U7	STARS index adherence, sustainability integration in university operations.	Annual sustainability reporting, data collection system, benchmarking with THE or STARS.
U8	Progress in various sustainability areas, comparison with other schools.	Regular STARS evaluations, reporting of sustainability efforts, student participation in data gathering.
U9	Holistic sustainability assessment, continuous improvement in sustainability.	STARS assessment, Times Higher Ed Impact rankings, reporting on university goals.
U10	Carbon footprint, energy consumption, water usage, waste management, academic sustainability research.	STARS accreditation, focus on data-driven decision making, performance monitoring.
U11	Carbon emissions, sustainability in strategic plans, academic involvement.	STARS, Times Higher Education Impact ranking, NGERS reporting, Sustainability Survey of staff and students.
U12	Waste segregation, energy consumption per student/square meter, academic courses with sustainability, water usage, greenhouse gas emissions, public outreach impact.	Sustainability events, GRI reporting, greenhouse gas protocol.

The reporting methods employed by these universities were diverse yet centered around a few key tools. STARS (Sustainability Tracking, Assessment & Rating System) emerged as a prominent tool, extensively utilized by

universities like U3, U6, U7, and U9 for benchmarking and continuous improvement (STARS Participants and Reports, 2023). This emphasis on data-driven analysis extended to methods like year-on-year change analysis and the use of sustainability indices, employed by universities like U1 and U7. Certifications and rankings, including LEED and the Times Higher Education (THE) rankings, were also instrumental, as seen in the practices of U5 and U11. Additionally, methods like surveys and social media polls, as adopted by U6, reflected an engagement with the broader university community in evaluating sustainability literacy and impact.

Sustainability outputs and outcomes significantly influence university policies and practices. As U9 noted, "So, in the past 3 years, the funds for sustainability have more than tripled... The new authorities have sustainability in their core." This substantial increase in funding reflects the growing importance of sustainability on campus. Once the university achieved notable sustainability outcomes, top leadership fully embraced and integrated it into the university's core values. U3's Platinum STARS status further illustrates this dedication: "We've been Platinum since 2015... We use that as a benchmarking tool to assess our progress and identify areas for improvement." Such recognitions not only acknowledge achievements but also provide benchmarks for directing sustainability efforts, strategies and policies. U7's comment on goal setting echoes this sentiment: "So, we set this 20% goal, and now we can surpass that. Recently, we've set more ambitious targets," highlighting the university's evolving and more ambitious sustainability goals based on measurable outputs.

The primary Key Performance Indicators (KPIs) hinged on triple bottom line metrics such as greenhouse gas emissions, social outreach initiatives, sustainable supply chain management, energy and water efficiency, and waste management. Notably, universities like U1, U10, and U12 emphasized adherence to standards like LEED and closely monitor their carbon footprint and utility data (STARS Participants and Reports, 2023). Simultaneously, there was a notable trend in integrating sustainability across various sectors, particularly evident in institutions like U3, which assesses campus-wide sustainability in energy, food, and transportation. Furthermore, specific institutions, like U4, tailored their focus to areas uniquely relevant to their context, such as urban issues or agriculture, while U5 and U6

emphasized sustainability literacy among students and staff, underlining the educational aspect of sustainability.

Despite the progress made by these universities, implementing sustainability initiatives has been fraught with challenges. U9 reflected on their struggle with achieving emission-free status, stating, “Other last challenge big challenge that one we still have to think about is how we are going to be emission free... we installed a car-pooling program which wasn’t very successful.” U3 attested to the difficulty of prioritization and balance in implementation, noting, “it’s hard to prioritize. And so, sometimes that’s hard because you’re taking time away from implementing new projects to look back and measure what you just did.” U12 highlighted the financial and temporal constraints, saying, “if we can turn everything to green energy... that would be fantastic but that’s simply not going to happen.” The participant from U7’s frustration with the exclusion of sustainability in strategic planning was evident, “This last round of process, though, is very frustrating for me, because it ended up not being incorporated.” These accounts shed light on the multifaceted challenges of sustainability leadership and the complexities of implementing change, even in institutions making significant strides towards sustainability.

The approaches to sustainability between emerging regions and Anglo-American regions revealed certain differences. Universities in emerging regions often prioritized immediate environmental and social impacts over global sustainability standards. In contrast, Anglo-American universities typically have more resources and established infrastructures, enabling a broader and more systematic implementation of sustainability practices. They often lead in adopting international standards like LEED and are more likely to engage in global sustainability networks and rankings.

4.4.8 Internal Factors

The demographics of universities can provide crucial context when considering strategies for leading change for sustainability (see Table 4.1 in Method section). For the Anglo-American universities, the student population varied considerably, ranging from sizable institutions with over 110,000 students to moderately sized ones with around 26,000 students (STARS Participants and Reports, 2023). Similarly, the land of these universities’ campuses spanned a broad range from

a massive 52,000 acres to more compact settings of 335 acres (STARS Participants and Reports, 2023). Additionally, the staff population in these institutions showed significant variation, suggesting a diverse administrative and academic framework.

On the other hand, universities in emerging regions presented a different picture. These institutions tended to be smaller, both in terms of student population and physical size. The student population ranged between approximately 9,800 to almost 17,000 students (STARS Participants and Reports, 2023). The campuses, whether measured in hectares or acres, were notably smaller than their Anglo-American counterparts. Interestingly, despite their smaller student populations, the staff size in some of these universities was comparable to the larger Anglo-American institutions, indicating a potentially higher staff-to-student ratio.

Universities, especially large Anglo American universities, tended to adopt a decentralized structure partly due to the size of the university and the pre-existing norms. One interviewee from an Anglo-American university which had 50,000 students with 13,000 employees over 52,000 acres of campus (STARS Participants and Reports, 2023) stated that "We're so big, we're so decentralized. But it's just learning like who's who, and I think, especially on the academic side again. That's a little bit bigger of a challenge, because we are just so large, I mean 17 colleges." (P8). Another interviewee commented that the university followed a decentralized structure with various work groups implementing sustainability in the university. The interviewee stated, "So yeah we are a little bit complicated because we're we have a decentralized model where we have multiple teams embedded within colleges and division to work on sustainability and so they each have a slightly different goals and focus." (P3).

The universities that used centralized structure were primarily from emerging regions. One university had implemented a leadership structure at both the school and executive office levels. Deans appointed Associate Deans as Chief Sustainability Officers (CSOs), and administration personnel were given administrative positions to support campaign promotion and data collection efforts. The interviewee stated, "We have school level leadership. And then we have executive office to do pushing or some kind of a move. We have leadership in the corresponding unit. Right now in a school actually a beginning the president actually encouraged or suggest the Dean to appoint their Associate Dean as the CSO for a corresponding college." (P6).

Another university from emerging region used centralized structure of implementation for integrating sustainability in the curriculum by mandating that every course needed to incorporate at least one SDGs or linkage to two of the triple bottom line. The interviewee explained that "It's more of a mandatory thing. So, a month ago we work with the engineering school, and it was no option. Everyone should include the SGDs in their syllabus. And it's mandatory. So, you don't get the say on that." (P10).

In conclusion, internal dynamics crucially shape sustainability implementation in universities. Large, decentralized Anglo-American institutions required innovative strategies for effective coordination and clear communication. Conversely, universities in emerging regions often adopt centralized approaches, embedding sustainability into curricula and strategy.

4.4.9 External Factors

External factors significantly influenced the implementation of sustainability initiatives in universities across both Anglo-American and emerging regions, with funding and financial incentives being a primary driver. In the Anglo-American context, the importance of grants was underscored by a respondent's statement, "Most of the collaboration with industry is through like grants" (P3), highlighting the reliance on external funding for sustainable projects. Additionally, the use of state bonds was notable, as another interviewee mentioned, "With that guarantee, we were able to get a bond from the State Government... We ended up investing 50 million dollars" (P7). Conversely, in emerging regions, the approach to funding was intertwined with sustainability track records and reputation, as evidenced by the comment, "It's been easier to collaborate with industry partners that are definitely involved in sustainability" (P9), and the competitive advantage in securing research funds, "if the University has some sort of sustainability scheme" (P9).

Government and policy directives also played a critical role. In the Anglo-American realm, the influence of local ambitions was clear, with a respondent from an Anglo-American university referring to their city's goal: "The city of Vancouver... wants to be the greenest city in the world" (P2). This is accompanied by accountability measures such as, "Every year [Our] University... has to submit a Climate Action Plan

report to the government" (P2). In emerging regions, the direct response to governmental policies was evident, with one participant explaining, "There was a directive from the Ministry of Education, that all students in higher education had to have a class, at least one... required course on sustainability" (P6), and another highlighting the broader national impact: "for the nation to hit that goal [of net zero by 2050]... it's going to impact every company, every organization in the country" (P12).

Broader social movements and global trends were also mirrored in universities' operations and objectives. The push for gender equality in Taiwan, as one interviewee outlined, had institutional ramifications: "The college and university must follow the policy of the government, to make sure the gender equality had been implemented in the University" (P6). Additionally, one interviewee noted, "Many of them have seen that... you have to be talking about sustainability and show sustainability, because if not, we're gonna be left behind" (P9).

In conclusion, universities across both Anglo-American and emerging regions were increasingly recognizing and responding to the multifaceted dimensions of sustainability, driven by a blend of funding opportunities, policy mandates, global trends, and social movements.

4.5 Discussion

This study embarked on a qualitative exploration of the dynamics involved in integrating sustainability into the framework of higher education, focusing on universities that have demonstrated notable advancements in sustainability. Through in-depth interviews, grounded theory and thematic analysis, this research shed light on valuable insights into the complexities, challenges, and successes associated with leading change for sustainability in academic institutions, contributing to both theoretical and practical understandings of sustainability in higher education (Rieg et al., 2021; Shah et al., 2023).

Our study's exploration of sustainability integration in universities aligned with the growing consensus on the importance of sustainability in higher education (Hallinger & Chatpinyakoop, 2019; Kang et al., 2022; Menon & Suresh, 2020) while

revealing unique insights. Particularly, universities in Anglo-American regions had shown a robust commitment to sustainability, implementing comprehensive strategies that embraced the triple bottom line (Elkington, 1998) by going beyond the conventional environmental focus to encompass broader social and economic dimensions (Leal Filho et al., 2020; Sanchez-Carillo et al., 2021).

Our research revealed a significant trend of grassroots initiatives in sustainability within universities. This evolution from top-down directives to bottom-up, community-driven approaches reflects a transformative shift in the ethos of sustainability in higher education (Robinson & Pedersen, 2021; Taşçi & Titrek, 2020). Such initiatives, often faculty-led, student-led or originating from individual departments, signify an increased engagement at all levels of the university, fostering a more inclusive and participatory approach to sustainability.

The emergence of student leadership in sustainability, particularly noted at universities U1 and U5, exemplified this shift toward grassroots initiatives. This change challenges traditional university governance structures, placing students at the forefront of sustainability efforts. This student-led model is not just about participation; it's about empowering students to be the primary drivers of change, reflecting a deeper engagement and commitment to sustainability at the student level.

Additionally, the role of leadership in driving sustainability transformations remained critical, as highlighted by the findings, especially at universities like U7 and U8. Leaders must navigate the complexities of the change process, manage stakeholder anxieties, and effectively communicate the need and vision for sustainability (Aung & Hallinger, 2023; Leal Filho et al., 2020). This finding highlights the pivotal role of leadership in steering organizational change for sustainability, aligning with the perspective of Kotter (1996) on the importance of visionary leadership in change management.

The challenges of implementing sustainability initiatives were also evident in the study. Universities like U2 and U4 faced obstacles ranging from individual-level resistance to change to complexities in inter-departmental coordination. These challenges underscored the need for strategic planning and stakeholder engagement (Kang et al., 2022; Rieg et al., 2021). the findings demonstrated that overcoming these barriers necessitated a blend of commitment and persistence from leaders, strategic

planning, and inclusive participation, resonating with the insights of Mader et al. (2013) and Verhulst and Lambert (2015).

The implementation of sustainability initiatives in higher education institutions proved to be a multifaceted process fraught with challenges. While projects were carried out successfully by participating universities, the complexities involved could not be overlooked. Universities grappled with issues such as limited manpower, resistance, funding constraints, unexpected disruptions like the COVID-19 pandemic, communication overload, failed sustainability initiatives, and competing priorities that overshadowed sustainability efforts. However, the presence of strong leadership in these universities enabled perseverance (Al-Zawahreh et al., 2019; Aung & Hallinger, 2023). These leaders consistently advocated for sustainability, urging top university leadership to prioritize sustainability and empowering champions within the institution (Leal Filho et al., 2020). Such sustained advocacy and empowerment were crucial for navigating the intricate landscape of sustainability implementation in higher education.

Moreover, the research also highlighted a clear contrast in the sustainability trajectories between Anglo-American universities and their counterparts in emerging regions. For example, Anglo-American institutions typically benefited from the use of more established sustainability frameworks and greater resources. The universities in emerging regions faced somewhat different institutional and cultural challenges, and often had to proceed with more pronounced resource constraints. This divergence not only illustrated the disparity in global sustainability efforts among universities, but also highlighted the universal need for flexible, context-sensitive approaches to sustainability implementation (Leal Filho, 2015; Sanchez-Carillo et al., 2021).

The triple bottom line framework (Elkington, 1998), which emphasizes economic viability, social equity, and environmental responsibility, has also profoundly influenced university sustainability policies and activities. The participating universities showcased diverse yet cohesive approaches to sustainability, aligning with the principles of the triple bottom line and championing holistic sustainable development in their policies and practices (Menon & Suresh, 2020). This evolution underscores how sustainability has transitioned from mere environmental conservation to a comprehensive approach that cares for people, profit, and the planet (Amaral et al., 2015; Macgregor, 2015).

This study also contributes to the body of knowledge on sustainability in higher education by providing qualitative evidence concerning the processes and challenges of embedding sustainability into the core functions of universities. For example, effective practices for successful sustainability implementation, as illustrated by universities like U5 and U6, included the development of clear sustainability goals, creating quick wins, active stakeholder engagement, and continuous monitoring and adaptation. The research provided detailed examples of these strategies in action, thus validating and expanding upon the theoretical frameworks proposed in earlier studies (Velazquez et al., 2006).

Additionally, This study significantly contributes to the understanding of organizational change within complex and loosely coupled organizations like universities (Weick, 1976). Drawing upon established frameworks such as Kotter's change management model (Kotter, 1996) and Bolman and Deal's multi-frame theory (Bolman & Deal, 2017), the findings highlight how universities successfully navigate the complexities of transforming into sustainable institutions. Specifically, the hybrid model of sustainability leadership observed - combining transformational and distributed leadership - offers a novel integration of leadership styles that is particularly effective in academic settings where authority is often decentralized and the buy-in from a wide range of stakeholders is crucial.

Moreover, the application of the triple bottom line approach within these universities illustrates a practical implementation of Elkington's (1998) concept in a sector not traditionally associated with this business model. The holistic incorporation of social, economic, and environmental goals highlights a shift towards sustainability that encompasses not just infrastructural or policy changes but a fundamental rethinking of university operations and values. This approach aligns with the organizational learning theories proposed by Argyris and Schön (1978), particularly the concept of double-loop learning where underlying assumptions are challenged and revised. The findings from this study highlighted the importance of such learning processes in achieving deep organizational change and provided a valuable framework for other educational institutions aiming to integrate sustainability into their core operations.

In the accompanying diagram (see Figure 4.4), the conceptual model is visualized as a circular framework encapsulating the iterative and interconnected stages

of the change process for sustainability within universities. At the core is the 'Change Process for Sustainability in Universities,' surrounded by a looped arrow indicating the flow from Awareness to Institutionalization, with both 'Internal Influence' and 'External Influence.' This model captures the cyclical and systemic nature of sustainability initiatives, acknowledging the external and internal factors that interact with and inform each stage of the process.

The conceptual model illustrates a dynamic, interconnected process whereby universities transition toward sustainability, emphasizing not only sequential stages such as Awareness, Interest, Preparation, Practice, Institutionalization - but also the cyclical nature of these phases, enabled by feedback loops. Significantly, the Institutionalization Stage, where sustainability becomes embedded within policies and culture, feeds back into the Awareness Stage, fostering a continuous process of renewal and heightened consciousness regarding sustainability.

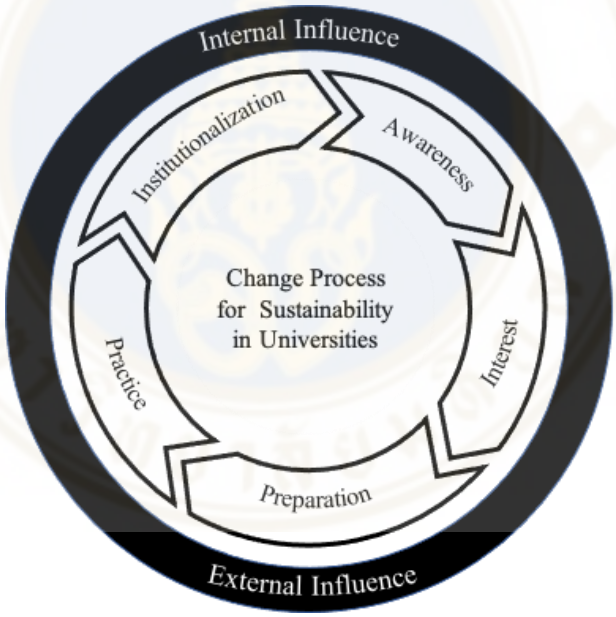

Figure 4.4 Conceptual model of the change process for sustainability in universities (Aung, 2024)

For instance, U5's engagement in Arctic research not only exemplified institutionalization but also raised awareness about global sustainability challenges within the academic community. Similarly, U7's development of comprehensive sustainability academic programs institutionalized sustainability in curricula, which in

turn fostered ongoing awareness among students and faculty. This cyclical feedback mechanism ensures that sustainability remains a vibrant and evolving component of university life, adapting to new challenges and opportunities.

Leadership is pivotal throughout this process, acting as both a catalyst from the very inception (i.e., Awareness Stage) and "glue" throughout the process. As gleaned from the interviews, leadership vision from varied sources inspired commitment, and facilitated the mobilization of resources. The latter "management" function of formal leaders which was essential in setting performance targets, managing information and resources, and coordinating the efforts of diverse stakeholders and university departments and units. reinforces Kotter's (2008) assertion that successful change requires both leadership and management.

Leaders not only championed the cause but also embodied the values of sustainability, creating a culture that supports iterative learning and adaptation. For example, at U1, the significant shift around 2002 under the university president's leadership marked the beginning of a focused sustainability journey, emphasizing the central role of leadership in driving sustainability. Similarly, U12's Chief Operating Officer spearheaded the creation of a standalone sustainability office in 2017, demonstrating how leadership not only champions the cause but also embodies the values of sustainability. This interconnected model illustrates how leadership, coupled with the feedback loops, propels universities to adopt a deeper, more integrated approach to sustainability.

Our findings also resonated with the model of sustainability leadership in higher education proposed by Aung and Hallinger (2023), which emphasized the transformative role of sustainability leadership in integrating sustainable policies and practices across various dimensions of university operations. Similarly, the stories told by the sustainability coordinators frequently surfaced leadership capacities that are often associated with transformational and distributed leadership. Transformational leadership was visible in leadership behaviors and practices including vision articulation, creating shared goals, modeling of values, high expectations, individualized support, and rewards (Leithwood et al., 1996). Distributed leadership was evident in the multi-layered roles and responsibilities assumed by both formal administrators and informal leaders during the change process (Harris et al., 2007).

Both of these leadership models responded to the contingencies that come into play in the loosely coupled organization of universities (Burke, 2014; Weick, 1976).

Findings from the study also highlighted the pivotal role of both top-down and bottom-up approaches in driving the integration of sustainability within universities. However, Aung and Hallinger's (2023) emphasis was on the contents of change, such as the areas where universities should focus, including operations, curriculum and education, research, culture, and community engagement. In contrast, the model focused more on the sequential loop nature of the process of change. This aligns with Argyris's (1977) double-loop learning model, suggesting that for sustainability integration to be truly effective, universities must not only implement these changes (single-loop learning) but also reflect and fundamentally question their underlying policies and objectives (double-loop learning), fostering a deeper, systemic transformation in their approach to sustainability.

4.5.1 Implications

At the policy level, the findings advocated for the development of clear, comprehensive policies that reinforce the integration of sustainability across all aspects of university operations such as using established frameworks like STARS in strategic planning and policy making processes (AASHE, 2019; Purcell et al., 2019). Policymakers could also consider mechanisms for incentivizing sustainability initiatives and integrating sustainability criteria into accreditation and ranking systems, thereby fostering a culture of sustainability within the higher education sector (Leal Filho et al., 2020; Sanchez-Carillo et al., 2021).

The practical implications of the research extended beyond academic discourse, offering tangible strategies for universities pursuing sustainability. Universities like U1, U2, and U3, which demonstrated successful sustainability integration, served as exemplars for others. The creation of sustainability-focused positions, committees, and offices emphasized the need for dedicated resources and personnel to drive sustainability initiatives (Kang et al., 2022; Sharp, 2002). The emphasis on stakeholder engagement and the allocation of dedicated resources served as critical considerations for university administrators and sustainability officers aiming to lead change. Additionally, the findings highlighted the necessity of embedding

sustainability into the curriculum, research, and operational practices, suggesting a holistic approach to sustainability in higher education (Leal Filho et al., 2020; Robinson & Pedersen, 2021).

The need for leaders to possess not only a clear vision but also the ability to inspire and engage various stakeholders illustrates another crucial practical implication. This advocates for the incorporation of sustainability leadership and change management components within training and development programs for university leaders, highlighting the importance of equipping them with the skills to navigate and drive sustainability initiatives effectively (Waas et al., 2010).

The results also highlight the need to bring "management" back into conversations about the role played by formal and informal leaders in bringing about change for sustainability universities. This emphasizes not only the importance of leadership in initiating sustainability efforts but also the critical role of effective management practices in sustaining these initiatives over time (Al-Zawahreh et al., 2019; Mader et al., 2013). By integrating management principles with leadership vision (Drucker, 1954), universities can develop a more structured approach to implementing and maintaining sustainability projects, ensuring they are not just launched but are also effectively integrated into the institutional fabric and culture.

Furthermore, the insights gleaned from this qualitative study have been instrumental in the redesign of the LCSHE simulation, exemplifying the practical application of academic insights into educational tools (see Appendix H). This simulation serves as a dynamic platform for university stakeholders to navigate the journey toward sustainability across five stages of change: Awareness, Interest, Preparation, Practice, and Sustainability (Hallinger et al., 2020).

Central to this redesign is the strategic incorporation of activities that mirror the real-world actions identified as crucial in the research. These activities ranging from 'Create Shared Vision' and 'Assess Sustainable Practices' to 'Share Sustainability Success' and 'Policy Revision' were designed to reflect the multifaceted approach needed to embed sustainability in higher education contexts (Nguyen & Hallinger, 2020). These activities within the simulation can potentially provide a hands-on experience in managing and overcoming the complexities associated with sustainability initiatives.

Additionally, the feedback cards, which are triggered upon the selection of specific activities mentioned above, depict varied responses from the university to sustainability efforts. For example, the activity 'Strengthen Sustainability Mindset' might reveal feedback cards showing the practical implications of sustainability actions, like the installation of solar farms or the promotion of electric vehicle use on campus. These feedback scenarios were directly informed by the successes and strategies uncovered in the research, providing participants with contextual examples of how sustainability can be advanced within their institutions. This focused application of research findings to the simulation's redesign not only enhances its educational value but also bridges the gap between theoretical research and practical application.

4.5.2 Limitations

Our study, while providing valuable insights into sustainability in higher education, was not without limitations. One such limitation was the reliance on qualitative data from a limited number of universities, which may not fully represent the diversity of global higher education institutions. Additionally, the subjective nature of qualitative analysis could introduce bias, despite efforts to mitigate it through reflection, formulating a balanced set of interview questions that covers both success stories and challenges.

Future research should aim to address the limitations noted above by incorporating a more diverse set of universities, including those from different geographic and socio-economic contexts. Quantitative studies or mixed-method approaches could complement the qualitative findings, as advocated by (Creswell & Creswell, 2018). Additionally, longitudinal studies could provide insights into the long-term sustainability of the initiatives identified. Exploring the role of student activism in driving sustainability changes, a topic not extensively covered in this study, could also yield valuable insights.

4.5.3 Conclusion

In conclusion, this study contributed to a deeper understanding of the journey toward sustainability in higher education, highlighting the pivotal roles of top-down and bottom-up leadership, stakeholder engagement, strategic planning, and

dedicated resources. The incorporation of these findings into the redesign of the ‘Leading Change for Sustainability - Higher Education’ simulation was also promising in equipping future leaders with the knowledge and skills necessary to champion sustainability in their institutions, fostering a more sustainable future for all. By addressing the limitations and building on the implications for research, policy, and practice, this work laid the groundwork for future endeavors in the quest for sustainable universities (Leal Filho et al., 2020; Robinson & Pedersen, 2021; Sanchez-Carillo et al., 2021).

CHAPTER V
DESIGN AND EVALUATION OF A COMPUTER SIMULATION ON LEADING CHANGE FOR SUSTAINABILITY IN HIGHER EDUCATION (MYANMAR CONTEXT)

5.1 Introduction

The quote, "leadership must grow by design, not by default" (Gallagher, 2018), holds true for sustainability leadership. We cannot assume that just because people are passionate about sustainability does not mean that they will do a good job at leading change for sustainability in higher education. Knowledge, skills and a mindset associated with change leadership and sustainability needs to be developed and refined.

The literature on leadership development for sustainability in higher education focuses on broader competencies related to sustainability, environmental preservation, business ethics, organizational change, and social innovation (Holdsworth et al., 2008; Kaza et al., 2016; Prabhu et al., 2020). But there is less attention to the means by which we can develop leaders with these dispositions and skills needed to transform universities toward sustainability.

Therefore, there is a gap in literature concerning how stakeholders in higher education can develop the knowledge, skills, and mindset to lead the change for sustainability in their universities. In addition, educators have called for research on the use of more powerful learning methods capable of changing attitudes, and developing knowledge and skills in the domain of sustainability (Figueiró & Raufflet, 2015; Hallinger et al., 2020). This is an important area of both practical and research interest because many universities globally are still falling behind in implementing sustainability.

Simulations provide experiential learning opportunities for tackling complex and dynamic issues such as sustainability and organizational change management (Hallinger et al., 2020; Moon, 2015). In the management literature,

simulations have been used by educators as a means for developing knowledge and skills for corporate social responsibility (Gatti et al., 2018), operations management (Pasin & Giroux, 2011), sustainable tourism (McGrath et al., 2021) and leading change for sustainability in business organizations (Hallinger et al., 2020). Therefore, simulation is one of a number of promising pedagogies being used in leadership development for sustainability in higher education. Yet, research on the effectiveness of simulations in educating for sustainability remains limited (Gatti et al., 2018; Nguyen & Hallinger, 2020).

This chapter describes the development, use, and evaluation of an online computer simulation, 'Leading Change for Sustainability in Higher Education' (LCSHE). Using a research and development method (R&D), the author adapted an existing simulation, 'Leading Change for Sustainability (LCS) in Business', for use in a higher education context. The LCSHE simulation was initially developed in English as a generic version for application in any university setting. Subsequently, this version was translated into the Myanmar language, creating a LCSHE-M variant. This Myanmar language version was then subject to testing and evaluation within a higher education professional development context. The research resulted in the production and dissemination of a new tool for training relevant stakeholders in universities that are just starting out to become more sustainable or for training new staff joining universities at mature stages of sustainability implementation. Additionally, the simulation holds potential for use in courses or workshops focusing on change management.

The aim of this study was to describe the adaptation, design and evaluation of the efficacy of the LCSHE-M computer simulation. Specifically, this study addressed the following research questions.

1. How can the content of an existing business simulation be revised to make it realistic and meaningful for the higher education context in Myanmar?
2. To what extent are students engaged while learning to solve a higher education sustainability challenge with the LCSHE-M simulation?

3. What are the effects of learning to solve a higher education sustainability challenge with the LCSHE-M simulation on students' skills in leading change for sustainability in higher education?
4. What are the effects of learning to solve a higher education sustainability challenge with the LCSHE-M simulation on the ability of students to apply knowledge of change leadership concepts?

5.2 Literature Review

5.2.1 Sustainability

Since the release of the Brundtland Report (World Commission on Environment and Development, 1987) in 1987, the term 'sustainable development' has gradually gained traction throughout the world. This term encompasses diverse social dilemmas such as poverty, climate change, inequality, social unrest, and unemployment. Although the terms 'sustainability' and 'sustainability development' have been used interchangeably in the literature (Bendell et al., 2017), some scholars maintained that they differ (Kagawa, 2007; Mochizuki & Fadeeva, 2010). For instance, sustainability is the preservation of humanity and its natural environment whereas sustainable development is about growth and prosperity in a manner that does not jeopardize future generations.

Sufficiency economy philosophy (SEP) is a sustainability concept from Thailand based on the Buddhist beliefs and practical wisdom of the King Bhumibol Adulyadej (Avery & Bergsteiner, 2020). SEP is defined as a balance in the economic, societal, environmental, and cultural spheres by following a middle path characterized by moderation, reasonableness, and prudence. SEP proposes three pillars of 'wise' attitudes: moderation, reasonableness, and prudence, which engender wise decision-making in both professional and personal life (Avery & Bergsteiner, 2020).

The theoretical foundation of sufficiency thinking or SEP mindset (see Table 2) can guide the decision-making processes of sustainability implementation in universities (Avery & Bergsteiner, 2020). For instance, moderation and reasonableness

can be key values in shaping decisions about energy consumption, resource allocation, and waste production, whereas prudence can be critical for planning and innovation of campus facilities. With sustainability values and knowledge, sustainable leadership can apply a sufficiency mindset to transform the university for sustainability through changing university policies and practices to focus on saving energy, purchasing decisions, recycling, managing waste, reducing carbon footprint, and campus greening (Velazquez et al., 2006).

5.2.2 Sustainability in Higher Education

Universities, just like any other organization, utilize natural resources, create wastes, and impact the environment (Grecu & Ipiña, 2014). In recent years, universities, through their evolution and to a certain extent, are driven by corporatist values and profit-seeking agenda (Clair, 2020). However, universities and colleges worldwide have already started pledging for a sustainable future by signing The Talloires Declaration, a ten-point tactical strategy for integrating sustainability into all aspects of universities (Grecu & Ipiña, 2014). Between 1990 and 2009, more than 14 initiatives, declarations, and charters have been issued with the aim of guiding universities toward the adoption of policies and processes designed to enhance their sustainability (Lozano et al., 2013). Moreover, the United Nations adopted a Sustainable Development Goals (SDGs) which is a global agreement to aim the world toward a more sustainable future by 2030 (SDSN, 2017; UN General Assembly, 2015). However, despite the growing number of global initiatives, universities have remained quite traditional in holding onto their reductionist and mechanistic paradigms (Lozano et al., 2013). In many instances, there is an intention to move forward with sustainability initiatives, but a lack of tools to available to make the change happen.

These sustainability challenges situate higher education in a unique strategic position. For centuries, higher education has been instrumental in fostering innovation and educating future decision-makers, entrepreneurs, and leaders (Lozano et al., 2013). Higher education can play a part in developing a sustainable world by designing and helping societies to implement social, environmental, economic, and technological solutions (Leal Filho, 2015). However, at this stage, the enactment of sustainable leadership in higher education remains has yet to achieve a critical mass.

This frames the current challenge facing sustainable leadership in higher education. How can higher education leaders realize this potential for catalyzing universities to assume the role of transforming communities and societies to educate new generations of citizens, scientists, engineers, and business leaders with sustainability knowledge, skills, and mindset (Grecu & Ipiña, 2014).

5.2.3 Leading Change

In the process of change, steps are actions that can be taken whereas stages describe the key milestones crossed during the change process. According to Kotter (1996), the eight steps to leading change involves (1) establishing a sense of urgency, (2) forming a powerful guiding team, (3) creating a shared vision, (4) communication the vision, (5) empowering stakeholders to act on the vision, (6) creating short-term wins, (7) consolidate improvements to produce more change, and (8) institutionalizing new approaches.

The appeal of Kotter's eight-step approach lies in its combination of theoretical clarity and practical leverage analyzing the context of change in an organization. However, Buller (2015) argued that change in universities require more than the fixed path that Kotter's (1996) stages offer. For instance, universities are made up of disciplines and departments and therefore, do not have a single control center. Additionally, university deans and lecturers have a strong sense of ownership of the curriculum and programs they have created. Thus, they tend to strongly resist externally imposed changes that pose a serious threat to the sense of ownership (Buller, 2015).

Change in organizations go through several key stages. According to Kaminski (2011), the five stages of change process are awareness, interest, decision, implementation, and adoption stages. During the awareness, interest, and decision stages, the performance and satisfaction may decrease as individuals and teams start to get exposed to change, anticipate future situation, and decide on actions on how to get the desired stage. As the organization reaches the implementation and adoption stages, the performance and satisfaction will rise as the teams start to experience quick wins, make use of innovations, reinforce new ideas, and celebrate the new success.

During the change process, it is natural for the individuals in the organization to also go through predictable stages that are characterized by different

cognitive and emotional states (Buller, 2015; Pollack & Pollack, 2014; Starr, 2003). Negative emotions such as fear, stress, anger, confusion, frustration, resistance, uncertainty, and chaos are frequently encountered, especially during the early and middle stages of the implementation process (Bridges & Bridges, 2019; Fullan, 2007; Hall & Hord, 2006). However, when managed effectively, disruption of the status quo can also inspire positivity resulting in emotions such as creativity, innovation, hope, energy, enthusiasm, and acceptance. It is up to change leaders to understand the natural responses and assist the team in navigating the difficult stages of the change process.

5.2.4 Leadership Development

Effective leadership is of great importance for universities in transformation toward sustainability. Cebrián et al. (2013) highlighted training and leadership development as a key role in successful change process. That is why developing effective leaders is of crucial importance as sustainability leaders can make a difference to social, environmental, and economic impact through higher education.

Leadership development means the expansion of the organizational capacity to carry out leadership and management functions through the development of the individual leaders. This view is supported by Van Velsor and McCauley (2004) who map out the vertical alignment between leader development at individual level and leadership development at organizational level. They define leader development as, "expansion of a person's capacity to be effective in leadership roles and processes" (p. 2). Leadership development also intersects with organizational development by strengthening connections and relationships between individuals around shared organizational goals to boost organizational capacity (Van Velsor & McCauley, 2004). Regardless, leadership development must start from individual leader development.

Leadership must be developed to ensure its own sustainability. As argued by Hargreaves and Fink (2006), sustainable leadership is enacted in a context that continues to support and reinvigorate the leaders themselves. Living labs in higher education can provide informal learning environments where skills and competencies of sustainability leadership can be developed alongside subject-specific sustainability knowledge (Bourgault, 2012). Through the empowerment of both internal and external stakeholders, key leadership competencies such as long-term planning, visioning,

collaborating, interdisciplinary work, empathy, compassion, critical reflection, and transcultural understanding can be developed (Barth et al., 2007).

Although the role of leadership development is widely accepted, the activities that constitute appropriate leadership preparation still need answers. According to Cardno (2012) management and leadership development involves training, education and support. This gives individuals opportunities to learn theoretical and practical knowledge while being able to apply and learn from developmental experiences (Van Velsor & McCauley, 2004). Bush (2010) gives more comprehensive methods ranging from personalized learning such as facilitation, mentoring and coaching of potential candidates by senior leaders, as well as group learning through action learning, networking and portfolios. All in all, leadership development needs a balance between theory and practice.

Since these activities need to take place in a conducive environment, the role of leaders in professional development is not only to exemplify professional learning by participating in leadership development (Robinson et al., 2009) but also to create and maintain learning culture where professional development is both valued and fostered (Armstrong, 2006). Moreover, Timperley et al. (2007) endorse that adult learning is informal and usually occurs outside professional development training or workshops. Although pre-arranged meetings can lay a foundation, it is the on-going informal interactions and relationships among staffs that strengthen learning.

To conclude, if senior and middle leaders in higher education are to transform their universities toward sustainability, they themselves need to rise to the occasion of leadership development. Their own training and development cannot be ignored.

5.2.5 Simulation-based Learning

Simulation is defined as, “the technique of imitating the behavior of some situation or process (whether economic, military, mechanical, etc.) by means of a suitably analogous situation or apparatus, especially for the purpose of study or personnel training” (Oxford English Dictionary). Simulations can be enacted in a live setting such as the use of simulated patients in medical education, or through technologies that provide virtual contexts for decision-making (Hallinger & Wang,

2020). In both instances, simulations provide learners with a simplified version of reality in which they engage in making decision aimed at solving a real-world challenge (Pasin & Giroux, 2011).

The use of simulation can be traced back to military usage and strategic war simulation in terms of board games. Later on, simulations were used in other fields such as medicine, engineering, aeronautics, and management. The first management simulation known as 'The Top Management Decision Simulation' was developed by the American Management Association in 1956. Since then, an increasing number of simulations have been used for education and training by universities and businesses (Pasin & Giroux, 2011).

Simulation is a very powerful that has multiple purpose and functions. (Moon, 2015, p. 2) highlighted several uses of simulation These include: (i) to develop a better understanding and gain insights of a system, (ii) to compare various plans and scenarios before implementation, (iii) to predict behaviors of a system, (iv) to aid decision-making processes, (v) to develop new tools for investigation, and (vi) for training (Moon, 2015, p. 2).

Pasin and Giroux (2011) argued that simulations are a powerful means of acquiring not only knowledge but also skills. According to Chien (1995), there are three types of knowledge that can be gained through computer simulated learning: declarative, procedural, and strategic knowledge. Chien's (1995) classification of knowledge for simulation-based learning can be compared to the range of cognitive levels encompassed in Bloom's Taxonomy (Bloom, 1956). Bloom proposed six levels of cognition running from lower-order to higher-order thinking skills: recall, understand, apply, analyze, evaluate, create.

Declarative knowledge refers to the ability to remember and understand the meaning of facts, events, concepts and principles (Granlund et al., 2000). In this study, declarative knowledge relates to understanding the structure, different domains, and stakeholders of the university. Procedural knowledge refers to actions or conditions under which different actions can be taken (Granlund et al., 2000). The process of leading change for sustainability in higher education such as how and when to set up a guiding team and how to achieve quick wins are examples of procedural knowledge relevant to this study. Lastly, strategic knowledge describes higher-order thinking and

problem-solving strategies (Granlund et al., 2000). Strategic knowledge has also been termed as conditional knowledge in other frameworks (Pintrich, 2010).

Simulations can also cultivate skills which refer to actions either in intellectual or physical forms (Granlund et al., 2000). Skills differ from knowledge in that one may understand a procedure but lack the skill to actually perform the action. For example, medical students learn how to apply diagnostic skills through opportunities to work with simulated patients (Good, 2003). In this study, skills refer to decisions made by learners that bring about successful change for sustainability in a university.

The rise in popularity of simulations can be attributed to its demonstrated benefits and advantages for both creating student engagement and developing knowledge and skills (Farashahi et al., 2018; Warren et al., 2016). Chi (2000) stated that simulation provides a cheaper, faster, and easier way to study sustainability and complex ecological systems. In their review of the use of simulations for learning about sustainability, Hallinger and colleagues (2020) found a common belief among scholars that simulations and games offer great potential due to their ability to develop systemic and holistic thinking.

The literature also addresses several limitations of simulations when used in a learning context. For instance, developing and testing a simulation can be costly and may require a substantial amount of time (Pasin & Giroux, 2011). In the case of computer simulations, trainers must be well prepared to assist any technical difficulties, both trainers and learners must have computer literacy, and sufficient computers must be made available if learners do possess their own (Pasin & Giroux, 2011). Furthermore, simulation can take up significant amount of class time and additional hours outside of classroom may be required for learners to get the most out of simulations (Pasin & Giroux, 2011). Finally, in order for learners to gain the full benefits of simulation-based learning, the instructor must not only have a deep understanding of the simulation, but also skills in leading the debriefing of learning at key points during the learning process (Fanning & Gaba, 2007; Paige et al., 2015).

There has been a recent increase in interest among educators in the use of simulations in sustainability and education for sustainable development (Nguyen & Hallinger, 2020). The literature suggests that simulations are well-suited for developing

skills and knowledge required to tackle the complex problems such as those associated with sustainability (Gatti et al., 2018; Hallinger et al., 2020). Although there are empirical studies that use simulation in educating for sustainable development (Hallinger & Kantamara, 2001; Hallinger et al., 2020; McGrath et al., 2021), the empirical research conducted in this area remains limited (Gatti et al., 2018). This represents the research gap addressed in this research and development study which aimed to develop and evaluate the use of a computer simulation that can be used in the training of sustainability leaders for higher education, both in Myanmar and other countries.

5.2.6 Student Engagement

Bond et al. (2020) provided a comprehensive definition of student engagement, emphasizing its manifestation through behavioral, cognitive, or affective indicators within a learning community. This engagement is not only a result of the energy and effort students invest but also reflects the complex interplay of relationships, learning activities, and the environment. Similarly, Wong and Liem (2021) highlighted engagement as a psychological state that energizes students, enabling them to exert effort and immerse themselves in learning activities. Kuh (2009) also contributed to the conceptualization of student engagement by focusing on participation in practices that yield measurable outcomes, thereby reinforcing the multifaceted nature of engagement in the educational process.

Wong and Liem (2021) delved into the complexity of the engagement construct, noting its broad use across various stakeholders in education. Despite its apparent straightforwardness, engagement encompasses a wide range of interpretations, reflecting its intricate nature (Wong & Liem, 2021). This complexity emphasized the need for a nuanced understanding of engagement that goes beyond simplistic definitions, acknowledging its depth and breadth across different educational contexts.

The three dimensions of student engagement of affective, cognitive, and behavioral engagement are widely recognized in the literature (Fredricks et al., 2004; Wong & Liem, 2021). Affective engagement involves students' emotional investment in learning activities, while behavioral engagement focuses on the intentional efforts

students make during these activities, including time on task and persistence (Bond et al., 2020). Cognitive engagement, on the other hand, pertains to the depth of students' absorption in learning activities (Wong & Liem, 2021).

The significance of student engagement extends to various educational outcomes, such as improved achievement, persistence, and retention (Finn & Zimmer, 2012; Kuh, 2009). Conversely, disengagement negatively impacts learning outcomes and cognitive development, potentially leading to dropout (Finn & Zimmer, 2012). The construct of student engagement is multifaceted, with some scholars describing it as a 'meta-construct' due to its encompassing nature (Fredricks et al., 2004).

The relationship between educational technologies and student engagement has also been explored. Technologies such as online discussion boards, learning management systems, games, and videos have been found to impact student engagement positively across its dimensions (Bond et al., 2020). Furthermore, Bedenlier et al. (2020) and Phillips et al. (2014) highlighted the role of educational technology, including multimedia tools, games and mobile technology, in fostering student engagement, with behavioral engagement being the most influenced dimension.

5.3 Research Method

5.3.1 Research Design

In this study, the LCSHE-M computer simulation was developed and evaluated through the research and development method (Borg & Gall, 1983). The study involved two main phases. Stage one involved the development of the simulation. Stage two encompassed e research study in which the researcher used a quasi-experimental design to field test and evaluate the effectiveness of the new simulation (see Figure 5.1).

Research and development is defined as, "the systematic study of design, development and evaluation processes with the aim of establishing an empirical basis for the creation of instructional and non-instructional products and tools and new or enhanced models that govern their development" (Richey & Klein, 2008, p. 748).

Therefore, research and development is a type of research method that combined elements of design, creativity, implementation, and assessment.

Figure 5.1 Two phases of the research design

The purpose of research and development is to create new products and services or improve existing ones by institutions and corporations (Borg & Gall, 1983). It has been used extensively in businesses, industries, health sectors, schools, universities, and government agencies (Richey & Klein, 2008). Adapted from Borg and Gall (1983) and Plomp (1997), this study used a five-stage model design of research and development. The stages included investigation, simulation design, simulation construction, simulation testing and revision, and implementation.

Experimental designs are used to determine the causal relationship between an independent (i.e. the use of simulation for leadership development training) and dependent variable (i.e. student knowledge, attitude, and behavior) (Rogers & Révész, 2020). There are several kinds of experimental study such as the 'true' experiment, quasi-experiment, natural experiment, and retrospective experiment (Cohen et al., 2018). A 'true' experiment is a laboratory experiment where test subjects are randomly assigned and the variables are isolated, controlled and manipulated (Rogers & Révész, 2020). On the other hand, quasi-experiments do not have random assignments of groups and are usually conducted in natural settings (Rogers & Révész, 2020). A natural experiment is used when it is not possible to control and manipulate variables and the retrospective experiment is used to find the likely cause of an observed effect (Cohen et al., 2018).

Cohen et al. (2018) argued that 'true' experimental designs are seldom appropriate in study education research due to the inability to randomly select participants and assign to alternative treatments. A quasi-experimental design was used for this study because it could be done in a natural setting (i.e. a voluntary professional development workshop in a university), with non-randomized assignment of groups (i.e. a class of students are chosen for the suitability and relevancy), and without a control group (Cohen et al., 2018).

In this study, a single-group quasi-experimental design ($O_0\ X\ O_1\ X\ O_2\ X\ O_3\ X\ O_4$) was used. This design involved the use of the simulation as the experimental treatment (X), to assess if there were significant differences in leadership skills and knowledge application scores across different time points. These time points included Baseline (O_0), Week 1 (O_1), Week 2 (O_2), Week 3 (O_3), and the Final Test (O_4).

5.3.2 Description of the LCS Simulation

This study redesigned the existing LCS business simulation (Hallinger, 2019) which deals with bringing about corporate sustainability changes in a company (see Figure 5.2). The player is part of the team which will implement the 'One Future' initiative in the company. The goal of the 'One Future' initiative is to holistically incorporate sustainability in the company and become a sustainable organization which cares for social, economic, and environmental factors. The team has three years to set the company on the steady course to achieve its sustainability goals.

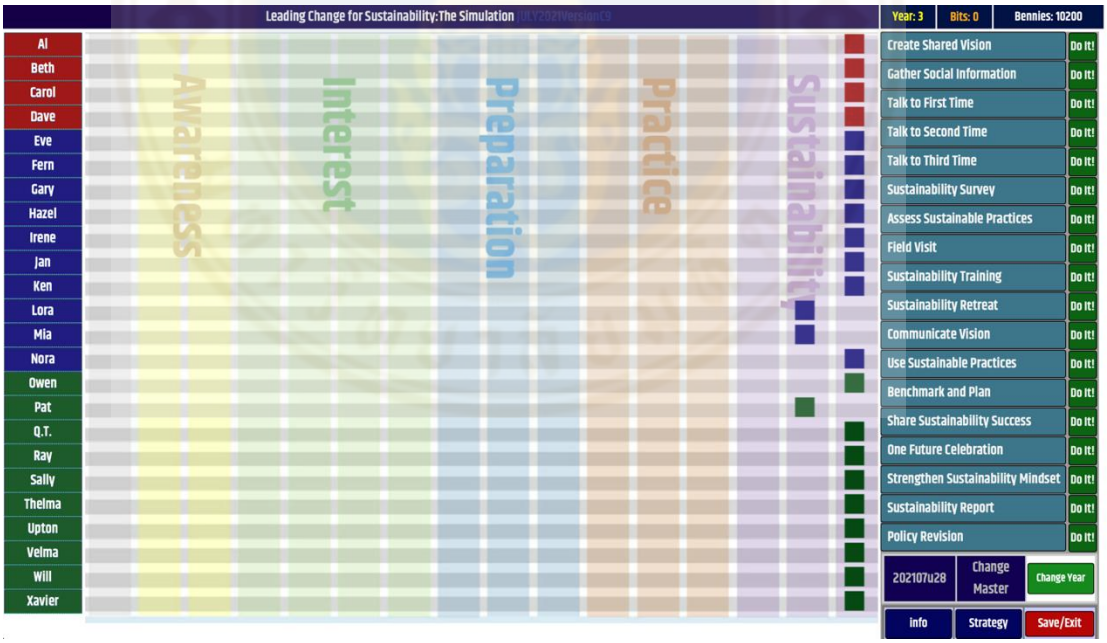

Figure 5.2 Interface model of the simulation

During the simulation, the player makes a continuous set of decisions to enact activities designed to bring about change in the mindset and practices of the university's stakeholders. The activities include talking to stakeholders, creating and

sharing vision, and visiting other companies that have been successful at implementing sustainability. Each activity costs a different amount of 'bits' ranging from 1 bit to 8 bits depending on the complexity of the activity chosen. Each player obtains 30 bits in the first year, 25 bits in the second year, and 20 bits in the third, which is the final year. The player may also gain some bits by doing certain activities in the simulation. The player can track their progress through five key indicators that are displayed on the computer dashboard:

1. Number of people moving through different stages of adopting sustainability,
2. Bennies which are measures of triple bottom-line benefits that result from successful change,
3. Sequence of activities already implemented is shown in a "strategy record",
4. Number of Kotter's change principles enacted in the user's change strategy,
5. The player's change leadership proficiency level, ranging from Apprentice (level one) to Change Master (level six), which is a composite score based on the effectiveness of moving stakeholders through the change process and accruing Bennies.

In the higher education version of the simulation, adapting to higher education context involved changing several elements of the business simulation. These included developing a new case description, revising job roles for the stakeholders, conceptualizing a different organizational structure, and revising the activities to be consistent with a university context. Following these fundamental changes to the simulation context, the researcher had to revise the 750 feedback dialogue boxes that convey "what happened" in response to the activities implemented by the learners. These revisions had to not only be changed to reflect the university setting. For example, the participants are positioned as members of the One Future Project team, tasked with leading the pilot implementation of the One Future initiative at the university that wishes to build a sustainable university. This will require the university to adjust key processes such as teaching and learning, research, operations, facilities and community outreach toward sustainable development.

Learning goals are an important component of an instructional design. Simulation-based learning provides students with not only knowledge but also skills to execute a concept. In this study, the learning goals of the LCSHE-M simulation was to understand and explain what sustainability means in higher education, to understand different domains of university where sustainability is implemented, to be able to lead and implement change for sustainability in universities.

5.3.3 R&D Process

This study involved adapting an existing business simulation, *Leading Change for Sustainability*, for the higher education context. Therefore, the research and development (R&D) method was used in conjunction with quasi-experimental study in order to adapt the simulation. The method of this study follows the following stages: research on information, plan, develop the preliminary product, test for usability, perform product revision, test for educational effectiveness, data collection, data analysis (see Figure 5.3).

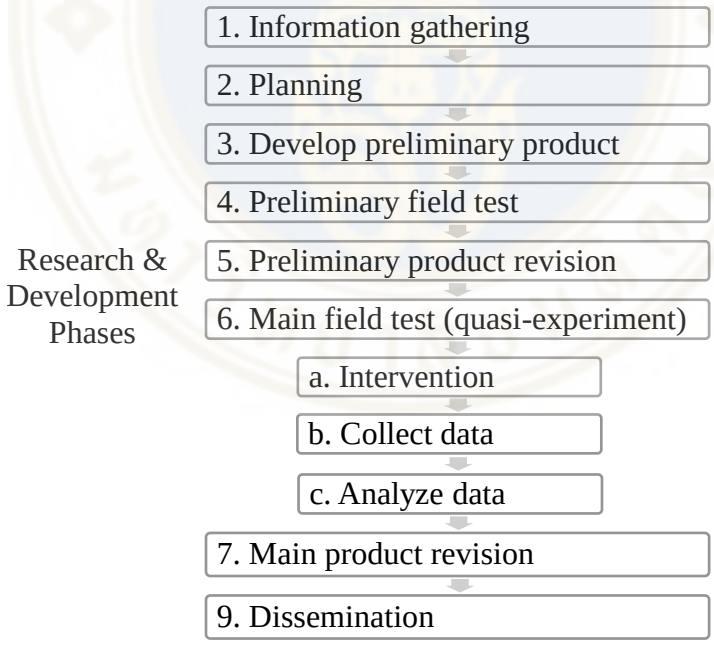

Figure 5.3 Stages of the research & development process

5.3.3.1 Information Gathering. During the information gathering stage, an integrated literature review comprising bibliometric review and scoping

review was conducted to gain insight into the knowledge and understanding of the literature on sustainability leadership in higher education. The detailed results of this study were reported in Chapter 2 and 3. Secondly, a qualitative study was carried out to explore the change process and how successful transformation for sustainability was led in highly ranked universities in the STARS rating system. The detailed findings of the qualitative study were reported in Chapter 4. Therefore, knowledge and understanding gleamed from the literature review and the qualitative study provided the researcher with adequate information to develop the 'Leading Change for Sustainability in Higher Education' (LCSHE) simulation.

5.3.3.2 Planning. During the planning stage, several components of the simulation such as the problem, context description, people, actions, feedback, and decision rules were checked, compared with the information gained from the literature and qualitative study, and revised to fit the higher education context. For instance, prior studies that adapted this simulation for K-12 education contexts went through a similar simulation redesign (Hallinger & Kantamara, 2001; Hallinger et al., 2017).

Insights gleaned from the Bibliometric study (Chapter 2), scoping review (Chapter 3), and qualitative exploration (Chapter 4) were instrumental in reshaping the LCS-B simulation to align with its new educational context. The adaptation of the Leading Change for Sustainability in Business (LCS-B) simulation to its higher education counterpart, LCS-HE, was a pivotal endeavor in tailoring sustainability education specifically for academic leaders. Table 5.1 provides a summary of how the findings from each chapter influenced the development of the LCS-HE simulation.

Table 5.1 Integration of Findings from Chapters 2 to 4 into LCSHE Simulation

Chapter	Key Findings	Impact on LCSHE Simulation Design
2	Different leadership models are linked to sustainability leadership in higher education.	Informed the simulation to accommodate transformational and distributed forms of leadership.
3	Universities integrate sustainability into all aspects of operations, education, research, and community engagement. Sustainability outputs in universities are linked to triple bottom line outputs.	Informed the need to balance triple bottom line outputs (social, environmental, and economic) in the simulation feedback cards.
4	Key stages of sustainability implementation in universities include awareness, interest, preparation, practice, and institutionalization stages. Cyclical nature of the implementations and feedback of success and sustainability outputs back to vision, goals, and strategies.	Led to the inclusion of specific examples of activities, strategies, challenges, and success stories in the descriptions of scenarios, in-game stakeholders and their roles, activities, gameboard stages, and feedback cards. Feedback loop nature such as celebrating success can achieve more buy-in from top leadership and more funding and resources. Integration of change management principles (Kotter's stages) which can be achieved when players strategically use different activities in strategic order.

The process of integrating these findings into the simulation design was characterized by a series of decisions aimed at enhancing realism, applicability, and balance. This involved ensuring a mix of triple bottom line examples in the simulation, integrating change management principles, and incorporating a diverse range of examples and activities from the qualitative study. Each chapter contributed unique insights that influenced specific aspects of the simulation's design, from accommodating diverse leadership styles to balancing triple bottom line considerations and integrating change management principles. This structured approach ensured that the revised simulation is not only grounded in academic research but also tailored to address the multifaceted challenges and opportunities associated with sustainability leadership in higher education.

Given the differences between university structures and business organizations, the researcher adapted the simulation to reflect these distinctions. This included creating new problem contexts, job titles, organizational structures, and

decision rules tailored for higher education. The initial version of the higher education simulation was designed in English language with consideration for use in the South East Asian cultural context. Subsequently, this English version was translated into the Myanmar language, resulting in the creation of the LCSHE-M variant. Owing to the initial version's already inclusive South East Asian cultural considerations, no further adaptations were deemed necessary for the Myanmar context. Additionally, the use of generic titles for positions and faculty departments (Science and Social Science) negated the need for adjustments to fit specific university contexts within Myanmar.

5.3.3.3 Develop the Preliminary Product. During the development of the premilitary product, the researcher worked in conjunction with the programmer to implement the new changes into the simulation. According to de Jong et al. (1994), the simulation needs to meet the following models.

1. Runnable model: the overall model that will make the simulation run. In this case, the runnable model represented the university systems where change for sustainability can occur.
2. Cognitive model: the addition of knowledge so that the simulation becomes an effective learning environment. In this case, the cognitive model comprised the theory and concepts of sustainability, change management, and university as complex organizations.
3. Instructional model: the incorporation of the instructional support. The simulation included the instruction of sustainability concepts, change process and management in universities, and how to use the simulation so that learners can develop and sharpen their skills as a change leader from novice level to change master level.
4. Learner model: the tracking of learning taking place. The simulation recorded different action sequence and strategies used by the learners, the number of bennies achieved, and the level of change occurred.
5. Interface model: the appearance of the simulation. This simulation showed the names of the stakeholders, action buttons for students to select, different stages of change, the progression of stakeholders across different stages on the game board, number of bits and bennies,

year of implementation, and other function buttons such as saving the simulation, and viewing previous moves (see figure 5.2).

5.3.3.4 Preliminary Field Test. A test for usability was carried out as a form of formative assessment to gather information on the stability of the simulation, integrity of the decision-making rules, appropriateness of the case for higher education context, and any technical bugs. The test for usability for LCSHE-M was conducted with a few lecturers working in a higher education setting in Myanmar. In conjunction with the preliminary test, a feedback document (see Appendix E) with multiple-choice questions, open-ended questions and error-tracking was distributed to the lecturers in order to gain their experience, suggestions, and recommendations for further improvement in the simulation.

5.3.3.5 Preliminary Product Revision. By using the feedback gathered from the lecturers during the test for usability, the simulation was updated and revised to enhance its features, minimize the bugs, and improve the overall user experience. The researcher ensured that the updated simulation was running smoothly and was ready for field testing.

5.3.3.6 Main Field Test. The next step was to test for educational effectiveness of the simulation by using a quasi-experimental method. There were no control group in this study and the participants were lecturers and administrators (n = 50) working in a private higher education in Myanmar. The author provided a four-week professional development program which consists of a two-hour online training workshop on Saturday each week. The simulation was used in a real-life learning environment in the four weeks training period.

In Week 1, participants were given an explanation on the research project, the overview of the simulation, login details for each student, the case scenario, role cards and action descriptions. After the explanation, the participants were asked to sign the consent form and answer questions in the pre-test (see Appendix F). Under the guided supervision and demonstration of the author, the participants played the simulation for the first time. Each time a participant plays, their action strategy, bennies gained, number of people in each stage of change were automatically recorded. The participants were asked to play the simulation at least 5 times in each week.

During Week 2 to 3, participants were encouraged to play the simulation several times during their own time in order to apply the knowledge gained from the lectures. The lectures during Week 2 to 3 includes sustainability concepts, change leadership and management, and change processes. The students were made aware that they would be taking the simulation as an exam in Week 4 and were therefore instructed to practice as much as they could.

In Week 4, the participants played the simulation for the final time in the online class as an exam. The data from the first to the final play were automatically recorded and were be used in the data analysis. During this session, the students also competed the post-test.

5.3.3.7 Data Collection. The author acknowledged that there were some limitations associated with the validity of using single group quasi-experimental design. In order to address that, data were collected from multiple sources to evaluate the efficacy of the simulation. Data collection in this study was conducted through two primary methods. The first method utilized the simulation itself, which automatically recorded data such as Bennies scores and participant actions each time the simulation was played. The second method involved forum participation on the Moodle learning platform, where participants discussed their experiences, challenges faced, and knowledge gained throughout the simulation.

The simulation automatically recorded useful data such as level of mastery in change leadership, bennies, Kotter's stages achieved, and the number of stakeholders in sustainability stage each time a participant plays the simulation. Players achieved different levels of mastery in leading change for sustainability in a university. The levels were apprentice, novice, manager, leader, expert, and change master. The simulation automatically recorded the level of mastery the player has achieved in each play.

Figure 5.4 Bennies indicator in the simulation

The number of bennies gained (see Figure 5.4) ranged from low (0 to 2999), medium (3000 to 7999), and high (above 8000). Bennies indicated how much impact the university have had on social, environmental, and economic sustainability. The simulation automatically recorded the amount of bennies gained in each play.

The simulation also showed and recorded the number of Kotter's eight stages achieved. The stages were (1) communication of purpose, (2) create a guiding team, (3) create and communicate a shared vision of change, (4) enable people to act, (6) create quick wins, and (7) make the change part of the university culture.

Lastly, the number of times participants play were also recorded through the simulation platform and were used to determine engagement and motivation which influenced the learning achievement of the participants.

5.3.3.8 Data Analysis. This study employed a quantitative approach to evaluate student engagement and performance within the LCSHE-M simulation, complemented by qualitative forum discussion analysis. For data analysis, Excel (Microsoft, 2019) and SPSS Version 26.0 (IBM Corp, 2019) was used for descriptive statistics and comparative statistics. The study involved 50 participants over

a four-week workshop period, focusing on the frequency and duration of simulation plays and participation in related forum discussions on the Moodle platform.

To evaluate student engagement with the LCSHE-M simulation, quantitative data from 50 participants over a four-week workshop period were analyzed. Quantitative data included the number of times participants played the simulation outside classroom sessions, total time spent on the simulation, and the duration of each game session. Descriptive statistics were employed to summarize these engagement metrics, providing insights into the level of commitment and interaction students had with the simulation.

Skill performances, indicated by Bennies scores, the number of stakeholders reaching the sustainability stage (stakeholder mobilization), and Change Mastery level, were analyzed to measure the improvement in students' sustainability benefits over time. The application of Kotter's stages of change was analyzed to determine how students' understanding and application of change management theory evolved throughout the simulation. This section of the analysis was crucial for assessing the practical application of theoretical knowledge in a simulated environment.

A comprehensive analysis of the Bennies scores, stakeholder mobilization, change mastery level, and the progression of Kotter Stage achievements ranging from the initial baseline to the final exam, was conducted. Descriptive statistics provided an overview of the progression, while inferential statistical analysis was performed to confirm the significance of observed changes.

Repeated measure ANOVA is an analysis of variance test which can be used to compare the means two or more datapoints from the same group (Cohen et al., 2018). Therefore, repeated measure ANOVA was suitable to compare the means of data collected in each week for Bennies scores and stakeholder mobilization. To account for potential violations of the sphericity assumption, Mauchly's Test of Sphericity was applied. Upon detecting a violation, the Greenhouse-Geisser correction was utilized to adjust the degrees of freedom for the repeated measures ANOVA, ensuring the accuracy of the test results. Pairwise comparisons, adjusted using the Bonferroni method, were conducted to examine the differences in Bennies scores across various time points, offering a detailed view of students' skill enhancement over the workshop duration.

Repeated measure ANOVA served as an appropriate statistical tool for analyzing time series data, particularly in this context where it facilitated simultaneous comparison of means across multiple groups. For time series data from the simulation study, repeated measure ANOVA enabled evaluation of significant differences in mean achievements among groups over time (Creswell & Creswell, 2018). This methodological choice ensured rigorous and comprehensive analysis of the effectiveness of various simulation scenarios or interventions.

Given the ordinal nature of the data, the Friedman Test was used to test for statistical significance in the changes observed over time among change mastery levels and the progression of Kotter Stage achievements, with Kendall's W providing a measure of effect size. Additionally, the Wilcoxon signed-rank tests further elucidated the differences between each pair of time points, highlighting statistically significant improvements and the depth of participants' learning.

Moreover, qualitative data were gathered from forum discussions on the Moodle learning platform, which were used to supplement quantitative findings and offer deeper insights into participants' learning experiences. This combination of data sources allowed for a comprehensive analysis of engagement, reflecting both the depth and breadth of participant interaction with the LCSHE-M simulation.

5.3.3.9 Main Product Revision. The main field test from the quasi-experiment yielded findings that informed further revisions of the simulation. Based upon past studies of simulation revision (Hallinger & Kantamara, 2001; Hallinger et al., 2017), possible foci for revision include the context, nature and cost of activities, decision rules, and the instructional process used to accompany the simulation. For instance, participants recommended that leftover bits, up to 2 bits, be carried over to the next year.

5.3.3.10 Dissemination. A key outcome of this R&D project was the creation of a Myanmar version of the Leading Change for Sustainability in Higher Education (LCSHE-M) online computer simulation. The researcher sought to disseminate information about the simulation at local and international conferences and journals. In addition, the researcher developed instructional materials (e.g., PowerPoint

presentations, recorded lecture videos) and a user manual to facilitate the use of the simulation by educators in Myanmar.

5.3.4 Ethical Issues

The quasi-experimental part of this empirical research involved the participation of human subjects. This study followed the ethical principles of voluntary participation, informed consent, confidentiality, and minimization of harm to participants (Cohen et al., 2018). This study had received approval from the ethics board, Mahidol Institutional Review Board (IRB), and the Certificate of Approval (COA No. 2022/06-152) from Mahidol IRB is included in Appendix I to ensure adherence to ethical guidelines.

In the first lecture of the course, the researcher explained the aim of the research, the type of data to be collected, and how it would be collected. Additionally, the students were informed that participation was voluntary and they could refuse to participate without any negative consequences. The participants were prompted to give their consent through a Google form (see Appendix G). As the simulation was used as part of the course, there was minimal disruption to the flow, structure, and learning objectives of the course. Additionally, the students were not burdened with extra study time.

5.4 Results

5.4.1 Student Engagement

In analyzing the engagement with the LCSHE-M simulation among 50 participants over a four-week workshop period, the data indicated a very high level of involvement (see Table 5.2 and Figure 5.5). Participants played the simulation outside of classroom sessions with varying frequency, ranging from as few as 4 times to as many as 117 times, with an average of 39 plays per student over the three-week period. This demonstrated a high degree of commitment to learning with the simulation, suggesting that the activity was engaging and of interest to many students.

In terms of the total time spent on the simulation, the data further illustrated this high level of engagement. The amount of time dedicated to the simulation varied substantially among participants, with the minimum time spent being 1 hour and the maximum reaching up to 23 hours, averaging around 13 hours per participant. This significant investment of time outside of regular class hours indicated that the simulation was not only a compelling part of the participants' learning experience but also a key tool for self-directed learning.

Table 5.2 Descriptive statistics of student engagement with LCSHE-M

Time	N	Median	Mean	SD	Min	Max
Total Play	50	31.5	39	24.836	4	117
Total Hour	50	11	13	6.454	1.13	23.75
Avg Min per Play	50	24	27	13.127	11.65	72.6

Additionally, the duration of each game session varied widely, ranging from as short as 11 minutes to as long as approximately 1.3 hours, with an overall average session time being around 27 minutes. This variation in session lengths indicates a diversity in how participants interacted with the simulation. Some engaged in relatively brief sessions, possibly focusing on specific aspects of the game or limited by time constraints, while others invested significantly more time per session, suggesting a deeper immersion into the simulation and possibly a more thorough exploration of its features or strategic decision-making.

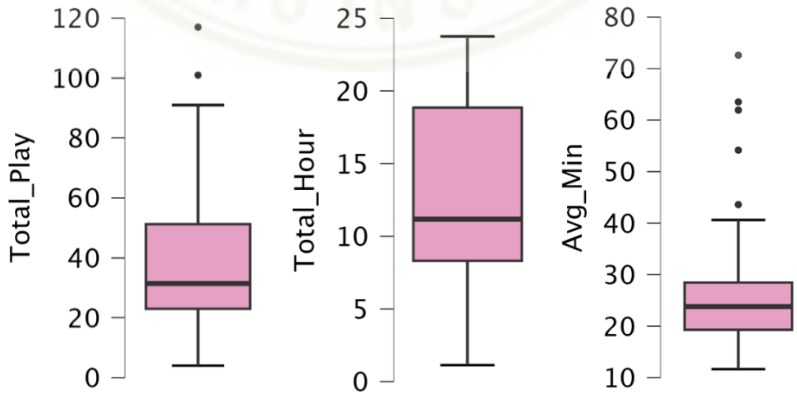

Figure 5.5 Boxplots of total plays, total hours, and average time per play (in minutes) for LCSHE-M simulation

Beyond their active engagement with the LCSHE-M simulation, students also participated in forum discussions on Moodle, further enriching their learning experience throughout the course. In the first week, there were 33 forum posts from 28 students, which increased to 43 forum posts from 36 students in the second week, indicating deeper engagement and more in-depth discussions as students became more familiar with the simulation. However, in the third week, the number of posts slightly decreased to 29 forum posts from 29 students, possibly reflecting a consolidation of understanding or increased confidence in navigating the simulation. This pattern of forum participation, alongside the simulation interaction, highlights a comprehensive educational approach, combining practical, interactive learning with reflective and collaborative discussions, thereby enhancing the overall depth and quality of the learning experience.

The considerable hours spent interacting with the simulation and forum discussions suggests that participants found the exercise meaningful and relevant to their learning goals. The variation in time commitment could have been reflective of different learning styles, levels of interest in the subject matter, varying degrees of familiarity and comfort with simulation-based learning, or varying time constraints based on other responsibilities. Keep in mind that the participants were all working as full-time faculty members and administrators who were participating in a professional development experience, not a classroom where their participation and results would be graded.

Moreover, the sustained engagement over a period of weeks showed that the simulation managed to engage participants over time. This is a crucial feature of effective educational tools. The LCSHE-M simulation appeared to have been successful in providing an immersive and engaging learning experience, encouraging students to invest time and effort in exploring and understanding the complexities of sustainability leadership in higher education.

5.4.2 Skill Performance: Sustainability Benefits (Bennies Scores)

In this study, a comprehensive analysis of participant performance in the LCSHE-M simulation was conducted, revealing significant improvements in their

sustainability benefits (Bennies scores) over time. Initially, participants found the simulation challenging, as evidenced by relatively low scores at the baseline. The average Bennies score at this stage was 309 (see Table 5.3), reflecting an early struggle in conceptualizing and executing effective sustainability strategies.

Table 5.3 Descriptive statistics of LCSHE-M bennies scores over time

Time	N	Mean	SD	Min	Max
Baseline Bennies	45	309	613.697	0	2500
Week 1 Avg Bennies	45	2256	1693.228	0	6323
Week 2 Avg Bennies	45	5263	2206.126	1470	10133
Week 3 Avg Bennies	45	7293	2034.614	2300	11010
Final Bennies	45	10124	2484.499	2300	14775

The qualitative forum discussions from Week 1 reflected these initial challenges. Participants expressed uncertainty in navigating the simulation, with one stating, "At least one error occurs every time I play." This struggle to effectively conceptualize the change process was a common sentiment. However, there was a beginning of understanding, as another participant realized the importance of recognizing each character's traits, noting, "After playing for 5 times, I did happen to realize one should invest him or her time in making himself or herself understand the characteristic of each individual."

Despite the initial difficulties, a consistent pattern of improvement was observed during the four-week module (see Figure 5.6). By the end of the first week, the average score increased to 2256, suggesting that participants were beginning to grasp the intricacies of the simulation and apply their knowledge more effectively. In Week 2, as per forum discussions, participants started to exhibit a deeper understanding. One participant shared, "In week two, I reached the Change Master stage in the simulation... It's easier to persuade people to be in the sustainability stage if we know their mindsets and behaviors." This evolving comprehension of the simulation's dynamics marked an important shift in their learning process.

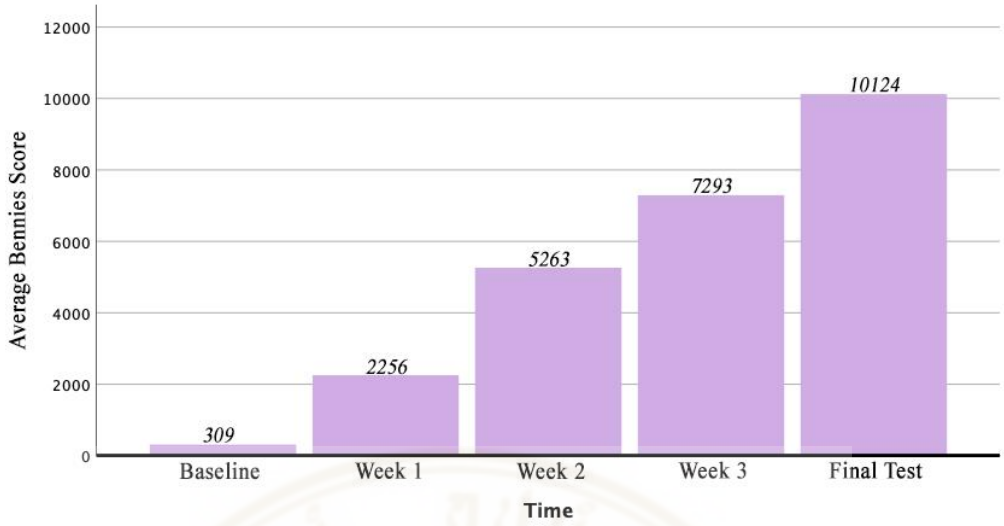

Figure 5.6 Improvement of LCSHE-M bennies scores over time

The trend of improvement continued, with average scores rising to 5263 in Week 2 and 7293 in Week 3. By Week 3, the forum discussions shifted toward a more sophisticated grasp of leadership and change management concepts. A participant reflected, "From week 3 lesson, I have learned the difference between Management and Leadership, the importance of leadership competency as a powerful strategy and strategies to lower resistance skillfully." This illustrates the practical application of theoretical knowledge to the simulation context.

Table 5.4 Pairwise comparisons of LCSHE-M bennies scores over time

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Baseline	Week 1	-1946.889*	231.521	.000	-2413.488	-1480.290
	Week 2	-4953.911*	327.772	.000	-5614.492	-4293.330
	Week 3	-6984.244*	307.321	.000	-7603.609	-6364.880
	Final Test	-9815.156*	379.362	.000	-10579.709	-9050.602
Week 1	Baseline	1946.889*	231.521	.000	1480.290	2413.488
	Week 2	-3007.022*	246.952	.000	-3504.721	-2509.324
	Week 3	-5037.356*	290.244	.000	-5622.303	-4452.408
	Final Test	-7868.267*	416.098	.000	-8706.857	-7029.676
Week 2	Baseline	4953.911*	327.772	.000	4293.330	5614.492
	Week 1	3007.022*	246.952	.000	2509.324	3504.721

Table 5.5 Pairwise comparisons of LCSHE-M bennies scores over time (cont.)

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
	Week 3	-2030.333*	211.197	.000	-2455.972	-1604.695
	Final Test	-4861.244*	452.831	.000	-5773.865	-3948.624
Week 3	Baseline	6984.244*	307.321	.000	6364.880	7603.609
	Week 1	5037.356*	290.244	.000	4452.408	5622.303
	Week 2	2030.333*	211.197	.000	1604.695	2455.972
	Final Test	-2830.911*	354.328	.000	-3545.012	-2116.810
Final Test	Baseline	9815.156*	379.362	.000	9050.602	10579.709
	Week 1	7868.267*	416.098	.000	7029.676	8706.857
	Week 2	4861.244*	452.831	.000	3948.624	5773.865
	Week 3	2830.911*	354.328	.000	2116.810	3545.012

By the final exam, the average score had peaked at 10124, demonstrating substantial progress and skill development among the participants. This improvement in Bennies scores suggested a meaningful advancement in participants' abilities to strategize and engage with the simulation, likely enhanced by the structured reflection through online forums and repeated gameplay. Students actively shared strategies and solutions to challenges they encountered, enhancing their learning experience.

The inferential statistical analysis, necessitated by the initial difficulty and subsequent improvement, confirmed the significance of these observed changes. Mauchly's Test of Sphericity indicated a violation of the sphericity assumption (Mauchly's W = .252, χ^2 = 58.536, p = .000), leading to the application of the Greenhouse-Geisser correction to the overall repeated measures ANOVA. The significant results (F = 279.553, p = .000) post-correction confirmed the statistically significant differences in Bennies scores across the different time points. Additionally, pairwise comparisons (see Table 5.4), adjusted for multiple comparisons using the Bonferroni method, provided a detailed view of how participants' performances evolved over time. Each successive week showed a statistically significant improvement from the previous, indicating a continuous learning process and skill enhancement. Notably, the lack of ceiling effects in the progression of Bennies scores

suggested that the simulation provided a sufficiently challenging and engaging context for ongoing improvement.

In summary, the qualitative data from the forums complemented the quantitative findings, revealing a journey from initial struggles to a comprehensive understanding of change management and leadership. The LCSHE-M simulation proved to be an effective tool for enhancing participants' understanding and application of sustainability strategies. The significant week-by-week improvements in Bennies scores, combined with the robustness of the ANOVA results, demonstrated the simulation's role in facilitating meaningful learning and skill development in sustainability leadership.

5.4.3 Skill Performance: Stakeholder Mobilization

In this study, a comprehensive analysis was conducted to evaluate participant performance in the LCSHE-M simulation, specifically focusing on the skill of effectively mobilizing stakeholders toward the sustainability stage by the end of Year 3 of gameplay. The quantitative data illustrated a marked progression in the participants' abilities to navigate the simulation's characters to the final stage, reflecting their strategic learning and application of engagement techniques.

Table 5.6 Descriptive statistics of LCSHE-M stakeholder mobilization over time

Time	N	Mean	SD	Min	Max
Baseline No of People in Sus Stage	45	1	1.853	0	8
Week 1 Avg No of Ppl in Sus Stage	45	5	4.100	0	14
Week 2 Avg No of Ppl in Sus Stage	45	12	5.689	0	24
Week 3 Avg No of Ppl in Sus Stage	45	15	4.659	1	22
Final No of Ppl in Sus Stage	45	19	4.729	1	24

As seen in Table 5.5, the baseline data showed an average of only 1 person (character) reaching the sustainability stage, indicating the participants' initial challenges in strategizing stakeholder engagement within the simulation. The average number of stakeholders increased to 5 people in Week 1. The qualitative feedback from participants offered a deeper understanding of their experiences and learning curves throughout the simulation. In the first week, one participant mentioned, "By playing

this simulation, I've got a lot of experience & knowledge how and when to use different strategies to persuade team members based on their characters," highlighting the initial struggle yet emerging insight into effective stakeholder mobilization strategies. Another participant's difficulty in advancing 'resistant' characters to the sustainability stage underscored the nuanced understanding required to engage stakeholders effectively.

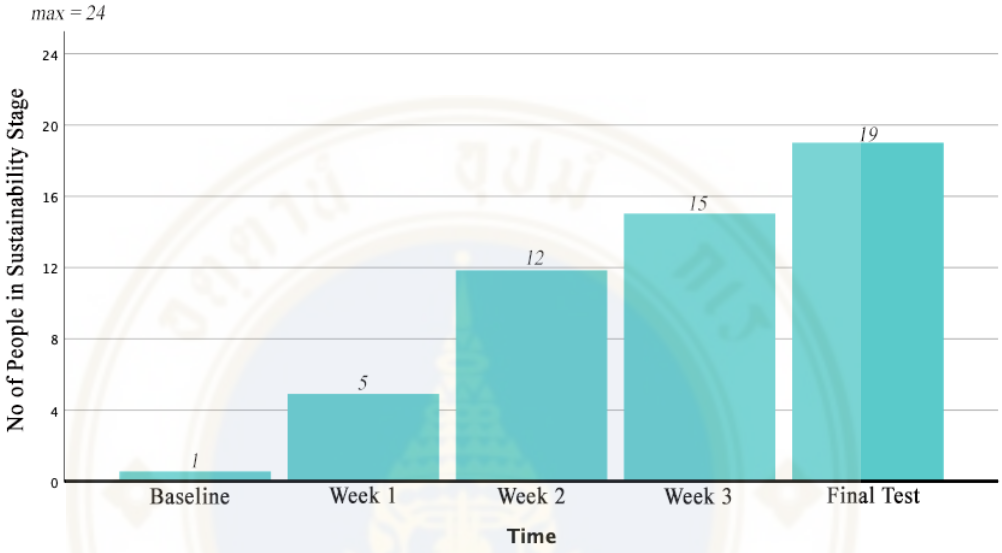

Figure 5.7 Improvement of LCSHE-M stakeholder mobilization over time

As the weeks progressed, there was a gradual increase in the average number of stakeholders reaching the sustainability stage (see Figure 5.7). In Week 2, one participant noted, "It's easier to persuade people to be in the sustainability stage if we know their mindsets and behaviors," indicating a deeper comprehension of stakeholder dynamics. This was further evidenced by the increased average number of people reaching the sustainability stage, from 5 people in Week 1 to 12 people in Week 2.

By Week 3, participants' reflections revealed significant advancements in their understanding and application of change leadership and stakeholder engagement strategies. One participant summarized their learning, stating, "Understanding how to approach and handle people is very important to be a good leader and manager," which was mirrored in the quantitative data showing improved performance in mobilizing

characters to the sustainability stage. The mean number of characters reaching this stage gradually increased to15 people in Week 3 and to 19 people by the final session.

These findings provide a comprehensive profile of the participants' growth in effectively mobilizing stakeholders within the LCSHE-M simulation. The increased number of characters reaching the sustainability stage, coupled with participant reflections, highlighted the effectiveness of the simulation as a tool for enhancing strategic stakeholder engagement skills crucial for leading change for sustainability in higher education settings.

The inferential statistical analysis conducted on the LCSHE-M simulation's data for skill performance in effective stakeholder mobilization highlighted the significant progression of participants' abilities over time. The analysis began with Mauchly's Test of Sphericity, which indicated a violation of the sphericity assumption (Mauchly's $W = 0.373$, $\chi^2 = 41.838$, $p < .001$). This led to the application of the Greenhouse-Geisser correction ($\varepsilon = 0.715$) to adjust the degrees of freedom for the subsequent within-subjects effects analysis.

The results of the within-subjects effects, using the Greenhouse-Geisser corrected F-test, confirmed statistically significant changes in the number of people reaching the sustainability stage across the different time points ($F = 214.438$, $p < .001$). This significant outcome indicated a profound impact of the simulation on enhancing the participants' skills in mobilizing stakeholders to achieve sustainability goals.

Pairwise comparisons outlined in Table 5.6 further detailed the participants' performance evolution, revealing statistically significant mean differences between all time points, indicating consistent improvement in participants' strategic mobilization skills. For instance, the progression from the baseline to Week 1 showed a significant increase (Mean Difference = -4.356, $p = .000$), with this trend continuing robustly through to the final assessment (Mean Difference from Baseline to Final = -18.444, $p = .000$). These pairwise comparisons illuminated the effectiveness of the simulation in fostering participants' abilities to engage and mobilize stakeholders effectively.

Table 5.7 Pairwise comparisons of LCSHE-M stakeholder mobilization over time

(I) Time	(J) Time	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
Baseline	Week 1	-4.356*	.563	.000	-6.020	-2.691
	Week 2	-11.289*	.821	.000	-13.716	-8.862
	Week 3	-14.467*	.703	.000	-16.543	-12.390
	Final Test	-18.444*	.766	.000	-20.710	-16.179
Week 1	Baseline	4.356*	.563	.000	2.691	6.020
	Week 2	-6.933*	.579	.000	-8.646	-5.221
	Week 3	-10.111*	.699	.000	-12.178	-8.044
	Final Test	-14.089*	.864	.000	-16.644	-11.534
Week 2	Baseline	11.289*	.821	.000	8.862	13.716
	Week 1	6.933*	.579	.000	5.221	8.646
	Week 3	-3.178*	.611	.000	-4.983	-1.373
	Final Test	-7.156*	.913	.000	-9.855	-4.456
Week 3	Baseline	14.467*	.703	.000	12.390	16.543
	Week 1	10.111*	.699	.000	8.044	12.178
	Week 2	3.178*	.611	.000	1.373	4.983
	Final Test	-3.978*	.616	.000	-5.798	-2.158
Final Test	Baseline	18.444*	.766	.000	16.179	20.710
	Week 1	14.089*	.864	.000	11.534	16.644
	Week 2	7.156*	.913	.000	4.456	9.855
	Week 3	3.978*	.616	.000	2.158	5.798

In summary, both the qualitative reflections from participants and the quantitative ANOVA results revealed a journey of significant skill development in stakeholder mobilization. The LCSHE-M simulation proved instrumental in enhancing participants' strategic capabilities to engage stakeholders toward achieving sustainability stages, validated by statistically significant week-by-week improvements.

5.4.4 Skill Performance: Change Mastery Level

The LCSHE-M simulation offered participants a dynamic platform to develop their change management skills, quantified through the 'Change Mastery Level' which combined Bennies scores with stakeholder mobilization effectiveness. This scale, which designates 1 as Apprentice, 2 as Novice, 3 as Manager, 4 as Leader, 5 as Expert, and 6 as Change Master, provided a structured metric for assessing participants' progress and skill acquisition over time. The descriptive statistics captured in Table 5.7 and Figure 5.8 revealed a clear trajectory of improvement in change mastery levels across the simulation's duration.

At the baseline, the average change mastery level was at the lower end of the spectrum, with a mean of 1 (Apprentice level), indicating most participants started with minimal understanding and skills in managing change effectively within the simulation environment. This initial phase saw participants grappling with the basics of the simulation, as reflected in the participant quotes. One mentioned, "The first week of playing simulation was difficult. I don't understand how to play and how to control people. In my first week, I reached the manager level in this game," highlighting the steep learning curve encountered at the outset.

Table 5.8 Descriptive statistics of LCSHE-M change mastery level over time

Time	N	Mean	SD	Min	Max
Baseline Change Mastery Level	50	1	.482	1	3
Week 1 Avg Change Mastery Level	47	2.5	1.081	1	5
Week 2 Avg Change Mastery Level	47	4	1.062	2	6
Week 3 Avg Change Mastery Level	50	5	.974	2	6
Final Change Mastery Level	50	5.8	.771	3	6

By Week 1, there was a noticeable shift, with the average change mastery level rising to 2.5 (Novice and Manager levels). Participants' reflections from this period illustrated their evolving understanding and application of the simulation's principles. For example, one participant reached the Leader level but sought further clarification on how to integrate Kotter's 7 steps into their strategy, indicating a deeper engagement with the simulation's educational objectives.

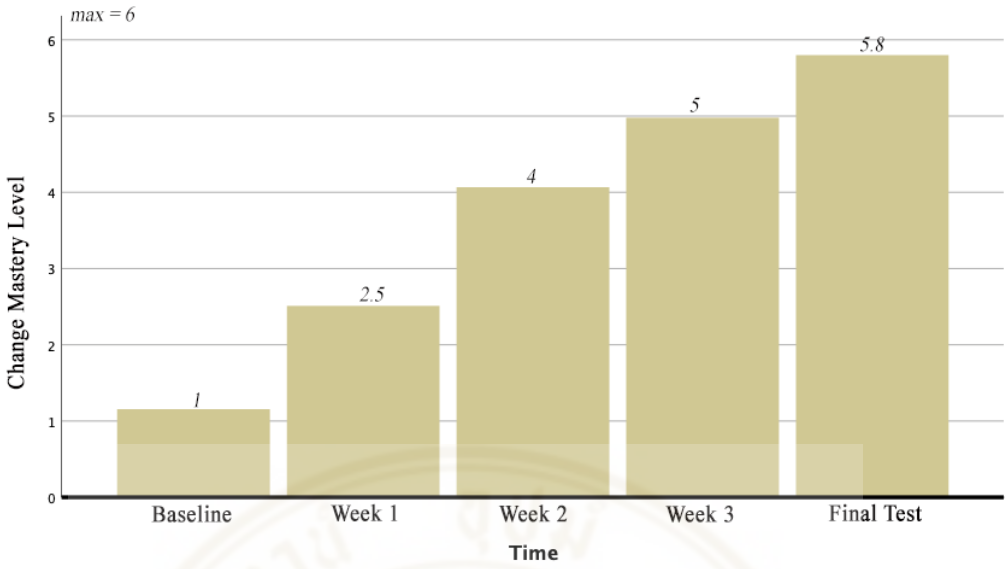

Figure 5.8 Improvement of LCSHE-M change mastery level over time

The upward trend continued into Week 2, with the average level reaching 4 (Leader level), signifying that many participants had advanced to Leader or Expert status. Participants began to recognize the importance of strategic influence and the role of individual characters in achieving sustainability goals, as one noted, "In week 2, I started to realize the influence of some people on the fellows and the strategies for those people. The frequency of achieving the lowest position was less than the first week, but still, I have no idea for the laggards to convince to move in the simulation."

By Week 3 and the final assessment, participants had largely mastered the simulation's complexities, achieving an average level close to Change Master (5 and 5.8, respectively). This mastery was not without its challenges, as participants continued to seek understanding and refinement of their strategies. "After studying the Week Three Lecture, I gained an understanding of the characteristics and the importance of the leadership competency as every organization is formed with people. Moreover, I also learned the differences between change leadership and change management. Although these two strategies are different, both are required to have an effective organizational change in its own ways. The lecture about Kotter's 8 Step Change Model was also helped with playing the simulation, but I still could not perform the 'Communication of Purpose' strategy even after achieving the Change Master

level," one participant reflected, encapsulating the nuanced learning outcomes facilitated by the simulation.

The Friedman Test, as presented in Table 5.8, revealed a highly significant difference in change mastery levels over time ($\chi^2 = 166.273$, df = 4, $p < .001$), with a Kendall's W of 0.924 indicating a strong effect size. This outcome illustrated a significant overall improvement in participants' change management skills as they progressed through the simulation, demonstrating that the experience had a profound and statistically significant impact on their development.

Table 5.9 Friedman test for change mastery level over time

Factor	Chi-Squared	df	p	Kendall's W
Time	166.273	4	< .001	0.924

Further analysis using the Wilcoxon Signed-Rank Test provided detailed pairwise comparisons between each of the simulation's time points (see Table 5.9). The results consistently showed highly significant differences ($p < .001$) when comparing baseline mastery levels with those achieved in subsequent weeks, as well as between each successive week leading up to the final test. These findings confirmed that each stage of the simulation contributed to a statistically significant improvement in change mastery levels.

Table 5.10 Wilcoxon Signed-Rank test for change mastery level over time

(I) Time	(J) Time	W	z	p
Baseline	Week 1	0.000	-5.373	< .001
	Week 2	0.000	-5.968	< .001
	Week 3	0.000	-6.154	< .001
	Final Test	0.000	-6.154	< .001
Week 1	Baseline	741.000	5.373	< .001
	Week 2	7.500	-5.410	< .001
	Week 3	0.000	-5.841	< .001
	Final Test	0.000	-5.968	< .001
Week 2	Baseline	1128.000	5.968	< .001
	Week 1	812.500	5.410	< .001
	Week 3	10.500	-4.824	< .001
	Final Test	7.500	-5.552	< .001

Table 5.11 Wilcoxon Signed-Rank test for change mastery level over time (cont.)

(I) Time	(J) Time	W	z	p
Week 3	Baseline	1275.000	6.154	< .001
	Week 1	1035.000	5.841	< .001
	Week 2	550.500	4.824	< .001
	Final Test	0.000	-4.937	< .001
Final Test	Baseline	1275.000	6.154	< .001
	Week 1	1128.000	5.968	< .001
	Week 2	895.500	5.552	< .001
	Week 3	528.000	4.937	< .001

The statistical analyses, through both the Friedman and Wilcoxon Signed-Rank Tests, provide compelling evidence of the LCSHE-M simulation's impact on participant learning and development. This quantitative validation, coupled with qualitative feedback from participants, illustrated a comprehensive and effective learning experience facilitated by the simulation.

5.4.5 Knowledge Application: Kotter's Stages

In the final part of the analysis, the study analyzed how participants' application of Kotter's stages of change (Kotter, 1996) evolved over time using the LCSHE-M simulation. This analysis was pivotal in understanding the extent to which students applied their knowledge of Kotter's change management theory in a practical, simulated environment. Notably, the workshop on Kotter's stages was only introduced at the beginning of Week 3, providing limited time for practice before the final exam in Week 4. The descriptive statistics and inferential tests offered insights into this learning process.

Table 5.12 Descriptive statistics for Kotter stage achievement over time

Time	N	Mean	SD	Min	Max
Baseline No of Kotter Stages	45	0.5	.570	0	2
Week 1 Avg No of Kotter Stages	45	1.5	.918	0	4
Week 2 Avg No of Kotter Stages	45	2	1.375	0	5
Week 3 Avg No of Kotter Stages	45	3	1.462	1	6
Final No of Kotter Stages	45	3.5	1.375	1	6

Table 5.10 (Descriptive Statistics) revealed a clear trajectory of improvement in the number of Kotter stages (maximum 7 stages) achieved by participants. Initially, at baseline, participants showed limited familiarity with Kotter's theory, achieving an average of only .36 stages, with a maximum of 2 stages. This early phase was marked by uncertainty in applying the theory, as one participant expressed, "I have reached the Leader level but I'm not sure about the 7 Kotters." This comment reflected the initial confusion and lack of clarity in understanding Kotter's stages.

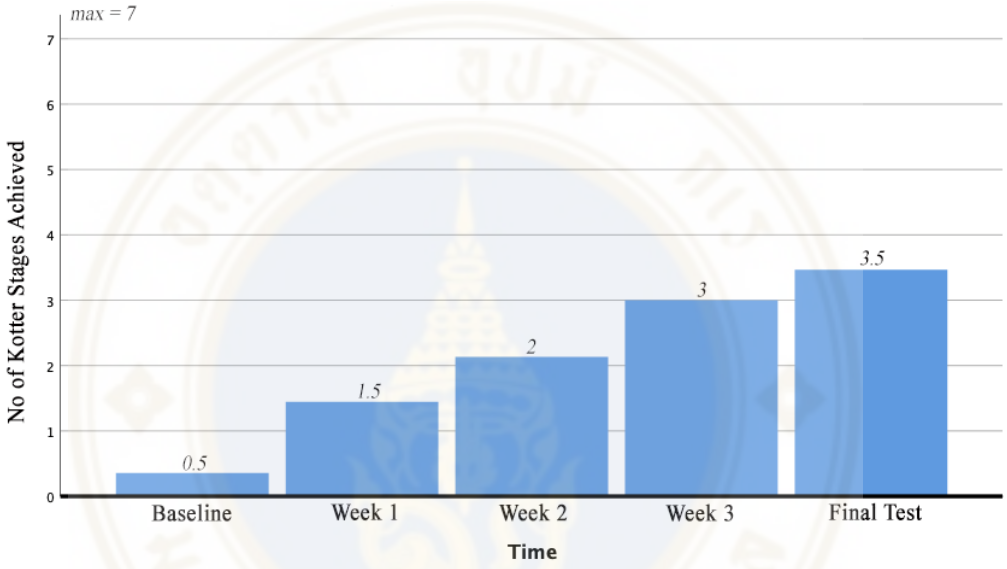

Figure 5.9 Improvement of LCSHE-M Kotter stages over time

By Week 1, there was a noticeable improvement (see Figure 5.9). The average number of stages achieved increased to 1.5, with some participants reaching up to 4 stages. This progression indicated that students began to grasp the basics of Kotter's theory. A participant's remark, "After playing several times, I became the Change Master... I just could not make Cherry, Aye Aye, Paing Zay, and Arkar reach to 'Preparation' stage in the Week 1," suggested an early but evolving effort to apply Kotter's stages.

The trend of increasing understanding continued into Week 2, where the average stages achieved rose to 2, and some participants reached up to 5 stages. During this week, a participants noted, "In week two, I reached the Change Master stage in simulation... It's easier to persuade people to be in the sustainability stage if we know

their mindsets and behaviors." This deeper insight into the change process and strategic alignment with Kotter's stages shows a more sophisticated understanding and application of the theory.

The introduction of the workshop on Kotter's Stages at the beginning of Week 3 further enhanced this understanding. The average stages achieved by students increased to 3, with a maximum of 6 stages. Students' reflections in the forum discussions demonstrated this improvement. One student stated, "From week 3 lesson, I have learnt the difference between the Management and Leadership... and the understanding of 8 Kotter change steps play a vital role when making the changes in an organization." Another mentioned, "In Week 3, I learnt that leaders must grasp the differences between leadership and management... I also understand the importance of understanding the eight stages of change and applying them to the simulation using Kotter's change model." These comments illustrated a more comprehensive and practical application of Kotter's theory within the simulation context.

By the final exam, participants' average achievement in Kotter Stages further increased to 3.5, with the maximum of 6 stages. This continuous improvement in applying Kotter's stages, particularly after the Week 3 workshop, demonstrated the effective use of the LCSHE-M simulation as a tool for enhancing students' understanding and practical application of change management principles.

Additionally, the results from the Friedman Test (see Table 5.11) confirmed the statistical significance of these changes over time. With a Chi-Squared value of 128.504 ($df = 4$, $p < .001$) and a high Kendall's W of 0.714, it was clear that the differences in the number of Kotter stages achieved across the five time points were statistically significant.

Table 5.13 Friedman Test for Kotter stage achievement over time

Factor	Chi-Squared	df	p	Kendall's W
Time	128.504	4	< .001	0.714

Additionally, the Wilcoxon signed-rank tests (see Table 5.12) provided further evidence of significant differences between each pair of time points. The tests showed that each successive week, including the final exam, had statistically significant

improvements from the previous (all $p < .001$). This was true even for the comparison between Week 3 and the final exam, although the difference was less pronounced ($p = 0.014$).

Table 5.14 Wilcoxon Signed-Rank test for Kotter stage achievement over time

(I) Time	(J) Time	W	z	p
Baseline	Week 1	8	-4.949	< .001
	Week 2	9.5	-5.383	< .001
	Week 3	0	-5.968	< .001
	Final Test	0	-6.093	< .001
Week 1	Baseline	587	4.949	< .001
	Week 2	27	-3.772	< .001
	Week 3	22.5	-5.047	< .001
	Final Test	9	-5.533	< .001
Week 2	Baseline	810.5	5.383	< .001
	Week 1	324	3.772	< .001
	Week 3	58	-4.32	< .001
	Final Test	73	-4.633	< .001
Week 3	Baseline	1128	5.968	< .001
	Week 1	718.5	5.047	< .001
	Week 2	608	4.32	< .001
	Final Test	169.5	-2.383	0.014
Final Test	Baseline	1225	6.093	< .001
	Week 1	894	5.533	< .001
	Week 2	788	4.633	< .001
	Week 3	460.5	2.383	0.014

The progression in the number of Kotter Stages achieved reflected a growing understanding and application of Kotter's change management theory by the participants. The increase in the average number of stages achieved, particularly after the introduction of the workshop in Week 3, indicated that the workshop likely played a crucial role in enhancing participants' understanding and application of the theory.

5.5 Discussion

5.5.1 Interpretation of the Findings

The LCSHE-M simulation study revealed significant insights into the efficacy of simulation-based learning in enhancing sustainability leadership within higher education. Drawing upon foundational literature (Hallinger et al., 2020; Moon, 2015; Pasin & Giroux, 2011), our findings resonated with the established belief that simulation-based learning serves not only as a pedagogical tool but also as a medium through which complex real-world challenges, particularly those pertaining to sustainability, can be addressed.

The engagement metrics from our study demonstrated a high level of participant involvement, with an average of 39 simulation plays per student, reflecting a deep commitment to learning and an intrinsic interest in the subject matter. This high degree of engagement and the substantial time investment aligned with several studies (Bond et al., 2020; Phillips et al., 2014; Wong & Liem, 2021) which noted the critical role of educational technology in facilitating student engagement through interactive and immersive learning environments. Therefore, the LCSHE-M simulation provided a dynamic platform for students to engage deeply with the content, reflecting the 'psychological state that energizes students' (Wong & Liem, 2021). This engagement is critical for navigating the complexities of sustainability and change management, where understanding is deepened through active participation and critical reflection.

Comparatively, the results from Chatpinyakoop et al. (2022) and Nguyen et al. (2024) offered an intriguing parallel to the findings of the LCSHE-M simulation. Both studies reported significant improvements in participants' abilities to conceptualize and implement change strategies over time. Chatpinyakoop et al.'s study involved 87 Master of Management students in Thailand using the LCS-B (business) version, while Nguyen et al.'s research included 32 Master of Education students in Vietnam utilizing the LCS-S (K-12 schools) version, highlighting the versatility and impact of LCS across different educational settings and countries.

While these studies demonstrated the efficacy of simulations in enhancing understanding and application of sustainability and change management principles, the LCSHE-M simulation's focus on the specific context of higher education leadership

presented unique insights. Additionally, this study further distinguished itself by focusing on professional development within the higher education sector in Myanmar, rather than a graduate school course, thereby contributing uniquely to the fields of simulation-based learning, sustainability, and the international application of LCS simulation in higher education.

Similar to the findings of Chatpinyakoop et al. (2022) and Nguyen et al. (2024), LCSHE-M reported skill performance improvements, as measured by Bennies scores, stakeholder mobilization, and change mastery level, which showcased a clear trajectory of learning and skill development over the course of the simulation. The progressive improvement not only demonstrated the potential of simulations to enhance strategic thinking and decision-making but also aligned with the notion of experiential learning discussed by Kolb and Kolb (2005) and Bourgault (2012). The quantitative and qualitative improvements observed illustrated the simulation's capacity to replicate complex organizational dynamics, offering a practical platform for applying leadership and change management theories in a controlled environment.

A noteworthy aspect of this study was the participants' initial challenge in navigating the simulation, particularly in applying Kotter's change management principles. Although our analysis revealed significant improvements in applying the knowledge of Kotter's change management principles, the initial difficulty is reflective of the broader challenges inherent in leading change for sustainability within university settings, as discussed by Buller (2015) and Wentworth et al. (2020). The complexity of university ecosystems, characterized by diverse disciplines and a high degree of autonomy, necessitated a nuanced approach to change leadership which is adaptable and responsive.

Additionally, the final average achievement of Kotter stages was 3.5, which was slightly below the achievements reported by Chatpinyakoop et al. (2022) and Nguyen et al. (2024). This disparity could be attributed to the later introduction of Kotter's stages in the workshop sessions, providing participants with limited time to integrate these principles into their strategic planning and execution within the simulation. This finding suggested that while theoretical underpinnings were crucial, the timing and method of their integration into simulation-based learning played a

pivotal role in determining the depth of practical application and conceptual understanding achieved by participants.

The comparison between the LCSHE-M simulation and Lozano, Ceulemans and Seatter (2015) also revealed significant contrasts in pedagogical strategies and learning outcomes. While Lozano, Ceulemans and Seatter (2015) focused on embedding organizational change management for sustainability as a course in a degree program to foster a holistic understanding and change agent capabilities among students, the LCSHE-M simulation offered a targeted, immersive experience that emphasized strategic decision-making and stakeholder engagement within a specific context. The approach of Lozano, Ceulemans and Seatter (2015) was broader, aiming to cultivate a foundational mindset shift across environmental and business disciplines, whereas the LCSHE-M simulation honed specific skills and knowledge applicable to sustainability leadership. Both approaches highlighted the critical need for sustainability education that combines theory with practical application, yet differing in delivery and experiential engagement, showcasing diverse methods of preparing students for sustainability challenges.

Lastly, the significant statistical results, supported by repeated measure ANOVA, Friedman and Wilcoxon Signed-Rank tests, affirmed the effectiveness of the LCSHE-M simulation as a robust educational tool that facilitated not only the acquisition of knowledge and skills pertinent to sustainability leadership but also the application of complex theoretical frameworks in a practical context. The progression observed in participants' mastery levels and their strategic engagement with the simulation's challenges provided a compelling narrative of growth and development, emphasizing the potential of simulation-based learning to bridge the gap between theory and practice in the realm of sustainability education (Hallinger et al., 2020; Moon, 2015; Pasin & Giroux, 2011).

5.5.2 Limitations

While the findings of this study are promising, there were several limitations that should be acknowledged. Firstly, the relatively short duration of the workshop (four weeks) may not have allowed for a full exploration of the complexities involved in sustainability leadership and change management. Additionally, the

introduction of Kotter's Stages workshop in Week 3 provided limited time for students to practice and apply these concepts before the final assessment.

Another limitation was the reliance on self-reported data from forum discussions, which may be subject to biases such as social desirability or selective reporting. While the quantitative data from the simulation provided objective measures of student performance, the qualitative insights gleaned from the forums were interpreted with caution.

Furthermore, the study was conducted with a specific group of students in a particular educational context, which may limit the generalizability of the findings. The experiences and backgrounds of the students, as well as the specific design of the LCSHE-M simulation, might influence the applicability of the results to other settings or populations.

These limitations demonstrated the need for further research, potentially incorporating longer durations for workshops, earlier introductions of key conceptual frameworks, and broader participant samples to enhance the robustness and applicability of findings in the field of sustainability leadership within higher education.

5.5.3 Implications

The instructional approach of the LCSHE-M simulation highlighted a critical implication for simulation-based learning: the necessity to balance the delivery of theoretical knowledge with the facilitation of practical skills application. The structure of the LCSHE-M simulation, while effective in fostering an initial understanding of sustainability and change leadership, demonstrated the need for earlier and more consistent integration of practical application opportunities throughout the learning process.

Moreover, the simulation's impact on developing professional competencies and key competencies for sustainable development suggested an important implication. The transition of participants from a basic understanding of change principles to a sophisticated application in strategic decision-making illustrated the transformative potential of simulation-based learning in higher education. This transformation was in line with the broader goals of education for sustainable development, aimed at equipping learners with the knowledge, skills, and values

necessary for a sustainable future (Barth et al., 2007; Pacis & VanWynsberghe, 2020; Wiek et al., 2011).

Furthermore, insights into the challenges and opportunities of implementing simulation-based learning for sustainability education provided valuable implications for curriculum designers and educators. By optimizing the strengths of simulation-based learning and addressing instructional design challenges, higher education can enhance its capacity to develop sustainability leaders capable of addressing our time's complex challenges.

Lastly, this study's findings had implications across several domains. Notably, the literature on simulation-based learning called for more experimental research beyond learner perceptions, a gap this research addressed by evaluating learning outcomes through simulation (Hallinger et al., 2020; McGrath et al., 2021; Nguyen et al., 2024). Furthermore, the LCSHE-M simulation's development and its adaptability across languages and cultural contexts offered an educational tool with broad applicability, providing an implication for its potential in training university stakeholders globally to lead change for sustainability.

5.5.4 Conclusion

In conclusion, the LCSHE-M simulation study contributed to the expanding corpus of knowledge on the efficacy of simulation-based learning in cultivating sustainability leadership within higher education. While the study validated the pedagogical value of simulations in enhancing understanding and application of change management principles, it also highlighted the critical importance of instructional design in maximizing the potential of simulation-based learning. The findings suggested that a more balanced approach, incorporating both theoretical exploration and practical application from the outset, could further enhance learning outcomes. As higher education institutions continue to evolve in response to the pressing challenges of sustainability, the LCSHE-M simulation serves as a powerful example of how innovative educational practices can enhance the development of future leaders committed to sustainable change.

CHAPTER VI
CONCLUSION

6.1 Summary of Key Findings

The dissertation aimed to explore the dimensions, challenges, and opportunities of sustainability leadership within higher education institutions. Specifically, it sought to understand the intellectual structure of existing literature, identify gaps in current research, examine qualitative insights from sustainable university initiatives, and develop a computer simulation to aid in leading change for sustainability in the higher education context, particularly within the Myanmar setting.

Chapter II focused on the intellectual structure of literature on sustainability leadership within higher education, employing an author co-citation analysis (see Table 6.1). This chapter revealed a fragmented field with emerging clusters of research that highlight the importance of leadership in driving sustainable practices in higher education. Key findings include the identification of four major research clusters: Sustainability Leadership, Education for Sustainability, Managing Campus Greening, and Managing Change and System Integration. These clusters highlighted the multi-faceted nature of sustainability leadership and the need for a holistic approach that encompasses educational, operational, and strategic dimensions.

The insights from Chapter II shaped the subsequent chapters by providing a foundation for understanding the complex landscape of sustainability leadership. This understanding informed the scoping review in Chapter III, where the identified gaps in empirical studies guided the research questions and methodology. Additionally, the intellectual structure informed the qualitative study in Chapter IV, focusing the investigation on how these clusters manifest in practice within sustainable university initiatives.

Chapter III presented a scoping review of research on sustainability leadership in higher education. The review highlighted a significant gap in empirical studies, with most literature focusing on conceptual or theoretical aspects of

sustainability leadership. Despite the plethora of conceptual models proposed, such as the Rhineland leadership model (Avery, 2005) and the sufficiency economy philosophy (Avery & Bergsteiner, 2020), their application remains largely theoretical with limited empirical validation specifically in the educational sector.

Table 6.1 Summary of Key Findings and their Significance across Chapters

Chap-ter	Focus	Key Findings	Significance
II	Intellectual Structure of Sustainability Leadership Literature	Identified critical research clusters: Sustainability Leadership, Education for Sustainability, Managing Campus Greening, Managing Change and System Integration.	Lays the groundwork for enhancing leadership strategies within higher education by pinpointing essential areas of research. Gaps in knowledge such as green supply chain management in universities.
III	Scoping Review of Sustainability Leadership	Identified a lack of empirical studies despite numerous theoretical models. Highlighted roles of sustainability leadership in transforming university practices through stakeholder engagement, curriculum integration, and operational greening.	Proposes a new conceptual model of sustainability leadership aimed at enhancing organizational and societal resilience. Crucial for holistic policy development using systems thinking.
IV	Qualitative Study on Sustainability Practices in Universities	Explored how leaders in higher education institutions manage change for sustainability. Identified key stages in the change process: awareness, interest, preparing, implementing, and institutionalizing. Highlighted the crucial role of transformational leadership and the supportive role of distributed leadership in these stages.	Provides robust empirical support for change management process for sustainability in higher education. Establishes the importance of specific leadership practices that significantly contribute to the success of sustainability initiatives, serving as a foundation for developing targeted leadership training programs. Offers practical guidance for integrating sustainability into university operations
V	Development of a Computer Simulation	Developed and validated a novel computer simulation designed to enhance university leaders' competencies in managing sustainability efforts effectively. The simulation was well-received and demonstrated high engagement levels among participants and improvement in skills and knowledge application.	Demonstrates the transformative potential of simulation-based learning in building leadership capacities. Offers a scalable tool that can be adapted to different contexts to improve sustainability practices across universities.

This scoping review emphasized the critical roles that sustainability leadership can play in transforming university practices, including aligning the university's vision with sustainability goals and enhancing stakeholder commitment across various institutional levels. For example, the integration of sustainability in curriculum and research, the transformation of university operations towards greener practices, and the active engagement with community projects were identified as key areas where sustainability leadership can make a tangible impact.

Significantly, this scoping review proposed a novel conceptual model of sustainability leadership intended to foster transformative changes in university policies and operational behaviors, aiming at both organizational and societal resilience. Nevertheless, this chapter further pointed to the urgent requirement for empirical studies to better understand the specific outcomes and impacts of sustainability leadership initiatives. These outcomes are expected to encompass significant university wide transformations and educational integrations that could potentially increase institutional and societal resilience to environmental challenges.

Building on the findings from Chapter III, Chapter IV was directly influenced by the identified need for empirical insights. The qualitative study in Chapter IV aimed to fill the empirical gap by exploring the practices and challenges of sustainability leadership in action. The diverse conceptualizations of sustainability leadership from Chapter III also informed the development of the computer simulation in Chapter V, ensuring it accommodated various leadership styles and approaches.

Chapter IV explored activities, processes, challenges, and practices for sustainable universities through a qualitative study. This chapter provided in-depth insights into how leaders in higher education institutions manage change for sustainability. The research identified several critical stages in the change process which include creating awareness, igniting interest, preparing, implementing and institutionalizing new approaches. It was found that the success of sustainability projects often hinges on the ability to navigate these stages effectively, with each stage demanding specific strategies and actions. Therefore, this chapter not only contributed to academic knowledge in the field of sustainable development in higher education but also served as a practical guide for institutions aiming to integrate sustainability into their core operations.

Moreover, this qualitative exploration has enriched our nuanced understanding of sustainability leadership within higher education institutions, highlighting that effective leadership in this context combines elements of transformational and distributed leadership models. A key finding was the significance of transformational leadership, which plays a crucial role in the successful implementation of sustainability policies. Leaders like U1's President, who genuinely commit to community and sustainability goals, foster a deeper and more lasting commitment to sustainability initiatives among stakeholders. Additionally, distributed leadership was shown to enhance sustainability efforts in loosely coupled organizations such as universities, promoting inclusivity by involving a diverse range of stakeholders - students, faculty, and administrative staff - in leadership roles and thereby expanding the reach and impact of these initiatives.

The practical insights from Chapter IV were crucial for the development of the computer simulation in Chapter V. Understanding the challenges and strategies of sustainability leadership in practice informed the design of the simulation, ensuring it was relevant and useful for university leaders. This chapter's findings also highlighted the importance of integrating sustainability across all university operations, a principle that was embedded into the simulation scenarios.

Chapter V introduced the development and assessment of a computer simulation designed to support the learning of university leaders about sustainability. Key findings from this research indicated that the LCSHE simulation effectively engages participants, significantly improving their skills in leading change toward sustainability and applying knowledge of change leadership concepts in a higher education setting. The simulation leveraged a quasi-experimental design to demonstrate improvements across various competencies essential for sustainability leadership, such as stakeholder engagement, strategic decision-making, and the practical application of theoretical knowledge.

The significance of this study lies in its potential to transform leadership development in higher education concerning sustainability. By bridging the gap between theoretical knowledge and practical application, the LCSHE simulation serves as a critical tool for universities, especially in developing contexts like Myanmar, to foster leaders capable of implementing sustainable changes effectively. This is

particularly pertinent as universities globally struggle with practical implementations of sustainability despite numerous initiatives.

Implications of this study were profound; it highlighted the need for continued innovation in educational methods to equip current and future university leaders with the skills necessary to lead complex sustainability initiatives. Furthermore, the adaptability of the simulation to different cultural contexts suggested that it could be implemented widely across various educational systems with appropriate modifications, potentially having a global impact on sustainability education in higher education.

The findings across these chapters collectively advanced the literature on sustainability leadership in higher education by providing a nuanced understanding of the field's intellectual structure, the current state of research, and practical insights from successful sustainability initiatives. Importantly, the dissertation contributed a novel tool in the form of a computer simulation, designed to enhance the capacity of university leaders to lead change for sustainability. This tool not only filled a gap in educational resources but also offered a scalable solution that can be adapted across different cultural and institutional contexts.

Moreover, the findings emphasized the critical role of leadership in navigating the complexities of sustainability in higher education. It highlighted the need for leaders to embody a commitment to sustainability, to engage diverse stakeholders effectively, and to integrate sustainability principles across all university operations and academic programs. In doing so, the dissertation provided valuable frameworks and insights that can guide future research, policy-making, and practice in the field of sustainability leadership.

6.2 Limitations

The limitations of this thesis on "Developing Leadership for Sustainability in Higher Education" were multifaceted, reflecting the inherent challenges in conducting comprehensive research in an evolving field. First and foremost, the reliance on qualitative data from a limited number of universities might not capture the full diversity and range of practices in sustainability leadership across the global higher

education landscape. While the insights derived were valuable, they represented a snapshot that might not fully account for all the variations in institutional size, culture, resources, and geographical context. The qualitative nature of the analysis, despite its depth, introduced the possibility of subjective interpretation.

The study's focus on specific universities, chosen for their advancements in sustainability, meant the findings might not be universally applicable across all types of higher education institutions, especially those at different stages of sustainability integration or with varying levels of resource availability. This selection bias highlighted the need for caution in generalizing the study's conclusions to the entire higher education sector.

Further, the dissertation acknowledged the dynamic nature of sustainability leadership, where ongoing changes in environmental, social, and governance (ESG) criteria, policy landscapes, and stakeholder expectations can rapidly alter the context within which universities operate. This fluidity meant that what constituted effective sustainability leadership is continually evolving, posing a challenge for research aiming to provide definitive guidance.

A notable limitation pertained to the development and assessment of the LCSHE-M simulation aimed at enhancing leadership capabilities toward sustainability. This innovative approach, while promising, was constrained by its initial implementation phase and limited feedback from participants. The simulation study's scope was restricted to a small sample of lecturers and administrators in higher education sector, which may not provide a comprehensive understanding of its effectiveness across broader and more diverse educational contexts. Additionally, the study did not fully explore the potential long-term effects of simulation-based learning on leadership practices, suggesting an area for future research and development.

The recommendation for future research to include a broader and more diverse set of universities is pivotal. Expanding the scope to include institutions from different geographic and socio-economic contexts would enrich the understanding of how sustainability leadership manifests under various conditions. Moreover, incorporating quantitative studies or mixed-method approaches could offer a complementary perspective to the primarily qualitative insights, potentially unveiling patterns or correlations not apparent through qualitative analysis alone.

Longitudinal studies are suggested to track the sustainability initiatives over time, providing insights into their durability, impact, and the evolution of leadership practices. This approach could address another limitation of the current study which was the temporal scope. Sustainability initiatives and leadership practices unfold over years and capturing their full impact requires sustained observation and analysis.

Lastly, the study's limited exploration of student activism in driving sustainability changes pointed to an area suitable for further inquiry. As higher education institutions increasingly recognize the value of engaging all stakeholders in sustainability efforts, understanding the role and impact of student-led initiatives could offer valuable lessons for enhancing institutional sustainability.

6.3 Implications

The bibliometric review revealed an implication that the absence of scholars associated with sustainable supply chain management within the Managing Campus Greening school of thought on the co-citation map suggests a potential 'blind spot' in both literature and practice (Hallinger, 2020; Kainzbauer et al., 2021). Furthermore, the importance of leadership not only in catalyzing change but also in supporting the institutionalization of sustainability values across various domains of the university has been underscored (Cebrián et al., 2013; Dyer & Dyer, 2017; Grecu & Ipiña, 2014; Menon & Suresh, 2020), warranting further research and theorizing in this dimension of sustainability leadership.

The scoping review highlighted the pressing need for empirical research on sustainability leadership in higher education (Leal Filho et al., 2020; MacDonald & Shriberg, 2016). Future studies should focus on clearly defining and measuring sustainability leadership constructs, investigating their impact on organizational changes and educational outcomes. This research direction is vital for gaining insight into the effective components of sustainability leadership and their contributions to institutional sustainability goals. Additionally, examining the operational balance among competing university goals and understanding the emergence and distribution of sustainability leadership within universities are crucial research areas (Cebrián et al., 2013). Constructing a survey instrument to measure sustainability leadership in higher

education, such as adapting frameworks like Honeybee sustainable leadership practices (Avery & Bergsteiner, 2020; Kantabutra & Saratun, 2013), which may not directly apply to the higher education context, is also essential.

The qualitative study presented several implications for practice, research, and policy in the realm of sustainability leadership within higher education. Firstly, policy recommendations emphasized the development of clear and comprehensive policies that integrate sustainability across all university operations, leveraging established frameworks like STARS (AASHE, 2019; Purcell et al., 2019). Additionally, policymakers are encouraged to incentivize sustainability initiatives and integrate sustainability criteria into accreditation and ranking systems, thereby nurturing a culture of sustainability (Leal Filho et al., 2020; Sanchez-Carillo et al., 2021).

Secondly, universities are urged to emulate successful sustainability integration models demonstrated by institutions like U1, U2, and U3. This entails the creation of sustainability-focused positions, committees, and offices, emphasizing the need for dedicated resources and personnel to drive sustainability initiatives. Furthermore, there is a critical emphasis on stakeholder engagement and the integration of sustainability principles into the curriculum, research, and operational practices, advocating for a holistic approach to sustainability in higher education (Leal Filho et al., 2020; Robinson & Pedersen, 2021).

Lastly, as a research implication, it is imperative to differentiate between sustainable leadership (Davies, 2007; Hargreaves & Fink, 2006) and sustainability leadership (Alkaher & Avissar, 2018; Aung & Hallinger, 2023; Leal Filho et al., 2020). Sustainable leadership conceptualized by Hargreaves and Fink (2006) and Davies (2007) primarily concerns sustaining leadership effort, while sustainability leadership encompasses a broader scope, including social, environmental, and economic sustainability aspects (Leal Filho et al., 2020). This distinction is crucial for refining research methodologies, conceptual frameworks, and measurement tools to accurately capture the nuances of each leadership approach within the context of higher education sustainability initiatives.

The quasi-experimental study on the LCSHE-M simulation yielded several critical implications for simulation-based learning in higher education. Firstly, it emphasized the need to balance theoretical knowledge delivery with practical skills

application throughout the learning process (Barth et al., 2007; Wiek et al., 2011). While the simulation effectively fostered an initial understanding of sustainability and change leadership, there is a clear call for earlier and more consistent integration of practical application opportunities to enhance learning outcomes.

Secondly, the study highlighted the transformative potential of simulation-based learning in developing professional competencies and key competencies for sustainable development (Barth et al., 2007; Pacis & VanWynsberghe, 2020; Wiek et al., 2011). Participants' progression from basic understanding to sophisticated application in strategic decision-making underscores the alignment of simulation-based learning with the broader goals of education for sustainable development.

The LCSHE-M simulation's development and evaluation showcased its immense potential as an educational tool in supporting sustainability leadership within higher education. The study conducted in Myanmar served as part of a broader validation program for the LCS simulation (Chatpinyakoop et al., 2022; Hallinger et al., 2020; Nguyen et al., 2024), with results affirming its applicability and potential impact within the Myanmar context. This finding advocated for the dissemination of the LCSHE-M in Myanmar, leveraging various platforms and partnerships to ensure its wide adoption.

Concurrently, the production of the LCSHE in English represented a strategic product that can be utilized more broadly, offering significant implications for global sustainability education. The adaptability of the LCSHE across linguistic and cultural contexts demonstrated its global utility, hinting at its potential for widespread application in sustainability education across different sectors (Chatpinyakoop et al., 2022; Hallinger et al., 2020; Nguyen et al., 2024). Furthermore, the LCSHE simulation complements existing tools like STARS, offering a unique, interactive approach to developing sustainability leadership skills. It holds promise for both new entrants and existing members of the STARS rating system, providing a practical tool to refine sustainability strategies, identify areas for improvement, and enhance overall sustainability performance.

Research implications of this study emphasized the importance of investigating the effectiveness of various instructional approaches in simulation-based learning across diverse educational objectives. Potential research questions emerged,

such as: How do different instructional designs influence learning outcomes in simulation-based learning environments? What are the optimal strategies for balancing the delivery of theoretical knowledge with the application of practical skills in simulation-based learning? Moreover, the study could progress to explore the potential of artificial intelligence, machine learning, and neural network models to offer more randomized and realistic responses within simulation-based learning (Dai & Ke, 2022). This suggested a need for further research to explore how the integration of these technologies could enhance the authenticity and effectiveness of simulations.

The implications for policymakers lie in the broader applicability and effectiveness of simulation-based learning for sustainability education. Specifically, policymakers should consider supporting and promoting initiatives that integrate simulation-based learning into higher education curricula to enhance sustainability leadership development globally (Hallinger et al., 2020; McGrath et al., 2021; Nguyen et al., 2024). This implies a need for policy frameworks that incentivize universities to adopt and integrate simulation-based learning tools like the LCSHE-M simulation, which has demonstrated transformative potential in developing sustainability leaders capable of addressing complex global challenges (Barth et al., 2007; Pacis & VanWynsberghe, 2020; Wiek et al., 2011).

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APPENDICES

Appendix A: Email Recruitment Letter to Participants

Dear Sustainability Coordinator:

My name is Pwint Nee Aung and my nationality is Myanmar (Burma). I am currently studying Ph.D. in Sustainable Leadership at College of Management, Mahidol University in Bangkok, Thailand. I am seeking your help in meeting the requirements of research for my Ph.D. Thesis entitled "Leading the Change to Sustainable Universities: A Qualitative Study".

The aim of my thesis project is to explore the key stages, obstacles and activities experienced in universities during the projects and programs designed to enhance their sustainability. I am particularly interested in the role leaders at different organizational levels play in managing change for sustainability in higher education institutions. Furthermore, I would like to find out how leaders overcome obstacles to making their universities more sustainable.

I would like to request your participation in the following ways. I will be collecting data using a 60-minute interview and would appreciate being able to interview you at a time that is convenient for you via ZOOM. Participation is completely voluntary and you will be able to withdraw at any point during the research project. I will be asking you to sign a consent form regarding this event.

The identity of you, your department and your university will be kept confidential and will not be identified in my thesis. Your contribution will be recorded in ZOOM and you will be provided a copy of the interview transcript to verify and check for accuracy. You will have 10 days from receiving the transcript to edit and/or withdraw any of your data.

I do hope that you will agree to take part and that you will find this participation of interest. If you agree to participate in an interview, simply contact me at pna1988@gmail.com with a signed informed consent form attached. We will talk further by email about setting up a convenient time to meet via ZOOM.

If you have any queries about the project, you may contact me and my research supervisor at College of Management, Mahidol University. My supervisor is Professor Philip Hallinger and may be contacted by email hallinger@gmail.com

Thank you for considering this request; I look forward to your participation in this study.

Yours sincerely,

Pwint Nee Aung
Ph.D. Candidate
College of Management, Mahidol University
pna1988@gmail.com

Appendix B: Consent Form for Qualitative Study

Consent Form – Adult Participants
Participant's consent

I agree to participate in the research project entitled "Leading the Change to Sustainable Universities: A Qualitative Study" being conducted by Pwint Nee Aung of the College of Management, Mahidol University. The purpose of this study is to investigate the key processes, obstacles, and the role leaders at different organizational levels play in managing change for sustainability in higher education institutions.

I understand I understand that my participation in this project is strictly voluntary and that information will be treated confidentially. I understand that everything I say will be kept confidential and none of the information I give will identify me and the only persons who have access will be the researcher and her supervisor. I also understand that all the information I give will be stored securely on the personal computer of the researcher for a period of five years.

I understand that my interview with the researcher, which is expected to take 1 hour, will occur via ZOOM, will be recorded and transcribed with the opportunity to verify the transcription.

I understand that if I am not comfortable with the discussion and wish to discontinue participation in the study, I will be free to leave without penalty. I also understand that I will be provided with a transcript of the interview for verification.

I am aware that if I have any questions about my participation in the project, I may contact Pwint Nee Aung at pna1988@gmail.com or +959 4480 26167.

I may also contact the researcher supervisor and Program Chair of Ph.D. in Sustainable Leadership, Professor Philip Hallinger, at hallinger@gmail.com or +66-81-881-1667.

I agree to take part in this project.

Signed: _____

Name: _____

Date: _____

Appendix C: List of STARS Platinum/Gold-Rated Universities

No	Institution	Location	STARS Version	Rating
1	Arizona State University	United States, AZ	2.2	Platinum
2	Colorado State University	United States, CO	2.1	Platinum
3	Cornell University	United States, NY	2.2	Platinum
4	Stanford University	United States, CA	2.1	Platinum
5	State University of New York College of Environmental Science and Forestry	United States, NY	2.2	Platinum
6	Thompson Rivers University	Canada, BC	2.1	Platinum
7	University of California, Berkeley	United States, CA	2.2	Platinum
8	University of California, Irvine	United States, CA	2.1	Platinum
9	University of Connecticut	United States, CT	2.1	Platinum
10	University of New Hampshire	United States, NH	2.1	Platinum
11	Université de Sherbrooke	Canada, QC	2.1	Platinum
12	Agnes Scott College	United States, GA	2.2	Gold
13	American University	United States, DC	2.2	Gold
14	Appalachian State University	United States, NC	2.1	Gold
15	Babson College	United States, MA	2.1	Gold
16	Bard College	United States, NY	2.2	Gold
17	Bates College	United States, ME	2.1	Gold
18	Belmont University	United States, TN	2.1	Gold
19	Bennington College	United States, VT	2.2	Gold
20	Berea College	United States, KY	2.1	Gold *
21	Binghamton University	United States, NY	2.2	Gold
22	Bowdoin College	United States, ME	2.1	Gold
23	Bucknell University	United States, PA	2.1	Gold
24	California Polytechnic State University	United States, CA	2.1	Gold
25	Cal State University, Channel Islands	United States, CA	2.2	Gold
26	California State University, Chico	United States, CA	2.1	Gold
27	California State University, Northridge	United States, CA	2.1	Gold
28	California State University, Sacramento	United States, CA	2.2	Gold
29	California State University, San Marcos	United States, CA	2.2	Gold
30	Carnegie Mellon University	United States, PA	2.1	Gold
31	Central Michigan University	United States, MI	2.2	Gold
32	Chatham University	United States, PA	2.1	Gold

33	Clarkson University	United States, NY	2.1	Gold
34	Colby College	United States, ME	2.1	Gold
35	Colgate University	United States, NY	2.1	Gold *
36	College of the Atlantic	United States, ME	2.1	Gold
37	Colorado College	United States, CO	2.2	Gold
38	Columbia University	United States, NY	2.1	Gold
39	Concordia University	Canada, QC	2	Gold *
40	Connecticut College	United States, CT	2.2	Gold
41	Dalhousie University	Canada, NS	2.2	Gold
42	Dawson College	Canada, QC	2.1	Gold
43	Denison University	United States, OH	2.1	Gold
44	Dickinson College	United States, PA	2.2	Gold
45	Emerson College	United States, MA	2.1	Gold
46	Emory University	United States, GA	2.2	Gold
47	Fanshawe College	Canada, ON	2.1	Gold
48	Fleming College	Canada, ON	2.1	Gold
49	Florida Gulf Coast University	United States, FL	2.2	Gold
50	Florida State University	United States, FL	2.1	Gold
51	Furman University	United States, SC	2.2	Gold
52	George Mason University	United States, VA	2.2	Gold
53	George Washington University	United States, DC	2.2	Gold
54	Gonzaga University	United States, WA	2.2	Gold
55	Grand Valley State University	United States, MI	2.2	Gold
56	Green Mountain College	United States, VT	2.1	Gold
57	HEC Montréal	Canada, QC	2.2	Gold
58	Hampshire College	United States, MA	2.1	Gold
59	Haywood Community College	United States, NC	1.2	Gold *
60	Humber College	Canada, ON	2.2	Gold
61	Humboldt State University	United States, CA	2.2	Gold
62	Indiana University Bloomington	United States, IN	2.2	Gold
63	Indiana University-Purdue University Indianapolis (IUPUI)	United States, IN	2.2	Gold
64	Iowa State University	United States, IA	2.1	Gold
65	Ithaca College	United States, NY	2.1	Gold
66	James Madison University	United States, VA	2.1	Gold
67	Kankakee Community College	United States, IL	2	Gold *
68	Keene State College	United States, NH	2.2	Gold
69	Lehigh University	United States, PA	2.2	Gold

70	Lewis & Clark College	United States, OR	2.2	Gold
71	Loyola Marymount University	United States, CA	2.2	Gold
72	Loyola University Chicago	United States, IL	2.2	Gold
73	Luther College	United States, IA	2.1	Gold
74	Macalester College	United States, MN	2.2	Gold
75	Massachusetts Institute of Technology	United States, MA	2.1	Gold
76	McGill University	Canada, QC	2.2	Gold
77	Miami University	United States, OH	2.1	Gold
78	Michigan State University	United States, MI	2.1	Gold
79	Middlebury College	United States, VT	2	Gold *
80	Mohawk College	Canada, ON	2.1	Gold
81	Muhlenberg College	United States, PA	2.1	Gold
82	New York University	United States, NY	2.1	Gold
83	North Carolina State University	United States, NC	2	Gold *
84	Northern Arizona University	United States, AZ	2.2	Gold
85	Northland College	United States, WI	2.2	Gold
86	Northwestern University	United States, IL	2.2	Gold
87	Nova Scotia Community College	Canada, NS	2.2	Gold
88	Oberlin College	United States, OH	2	Gold *
89	Oregon State University	United States, OR	2.2	Gold
90	Pacific Lutheran University	United States, WA	1.1	Gold *
91	Pennsylvania State University	United States, PA	2.2	Gold
92	Polytechnique Montreal	Canada, QC	2.1	Gold
93	Pomona College	United States, CA	2	Gold *
94	Portland State University	United States, OR	2.2	Gold
95	Princeton University	United States, NJ	2.1	Gold
96	Rice University	United States, TX	2.1	Gold *
97	Royal Roads University	Canada, BC	1.1	Gold *
98	Saint Mary's College of California	United States, CA	2.2	Gold
99	San Diego State University	United States, CA	2.1	Gold
100	San Jose State University	United States, CA	2.2	Gold
101	Santa Clara University	United States, CA	2.2	Gold
102	Seattle University	United States, WA	2.2	Gold
103	Simon Fraser University	Canada, BC	2.1	Gold
104	St. John's University, New York	United States, NY	2	Gold *
105	State University of New York at Cortland	United States, NY	2.1	Gold
106	Sterling College (VT)	United States, VT	2.1	Gold

107	Stevens Institute of Technology	United States, NJ	2.2	Gold
108	Texas A&M University	United States, TX	2.2	Gold
109	The American College of Greece	Greece	2.2	Gold
110	The Ohio State University	United States, OH	2.1	Gold
111	The University of Texas at Dallas	United States, TX	2.1	Gold
112	Unity College	United States, ME	2.1	Gold
113	Universite Laval	Canada, QC	2.1	Gold
114	University College Cork	Ireland, Co. Cork	2.1	Gold *
115	University at Albany	United States, NY	2.1	Gold
116	University at Buffalo	United States, NY	2.1	Gold
117	University of Alaska Fairbanks	United States, AK	1	Gold *
118	University of Alberta	Canada, AB	2.1	Gold
119	University of Arizona	United States, AZ	2.1	Gold *
120	University of Arkansas	United States, AR	2.1	Gold
121	University of British Columbia	Canada, BC	2	Gold *
122	University of Calgary	Canada, AB	2.1	Gold
123	University of California, Davis	United States, CA	2.2	Gold
124	University of California, Los Angeles	United States, CA	2.2	Gold
125	University of California, Merced	United States, CA	2.1	Gold
126	University of California, Riverside	United States, CA	2.2	Gold
127	University of California, San Diego	United States, CA	2.2	Gold
128	University of California, Santa Barbara	United States, CA	2.2	Gold
129	University of California, Santa Cruz	United States, CA	2.1	Gold
130	University of Cincinnati	United States, OH	2.2	Gold
131	University of Colorado Boulder	United States, CO	2.1	Gold
132	University of Colorado Colorado Springs	United States, CO	2.2	Gold
133	University of Dayton	United States, OH	2.1	Gold
134	University of Georgia	United States, GA	2.2	Gold
135	University of Guelph	Canada, ON	2.2	Gold
136	University of Houston	United States, TX	2.1	Gold
137	University of Illinois, Urbana-Champaign	United States, IL	2.1	Gold
138	University of Louisville	United States, KY	2.1	Gold
139	University of Manitoba	Canada, MB	2.1	Gold
140	University of Maryland, College Park	United States, MD	2.1	Gold
141	University of Massachusetts Amherst	United States, MA	2.2	Gold
142	University of Massachusetts Lowell	United States, MA	2.1	Gold
143	University of Miami	United States, FL	2.1	Gold

144	University of Michigan	United States, MI	2.1	Gold
145	University of Minnesota, Duluth	United States, MN	2.1	Gold
146	University of Minnesota, Morris	United States, MN	2.1	Gold
147	University of Minnesota, Twin Cities	United States, MN	2	Gold *
148	University of Missouri	United States, MO	2.1	Gold
149	University of North Carolina Chapel Hill	United States, NC	2.2	Gold
150	University of Northern Iowa	United States, IA	1.1	Gold *
151	U. of Ontario Institute of Technology	Canada, ON	2.1	Gold
152	University of Oregon	United States, OR	2.2	Gold
153	University of Pennsylvania	United States, PA	2.1	Gold
154	University of Pittsburgh	United States, PA	2.2	Gold
155	University of Puget Sound	United States, WA	1.1	Gold *
156	University of Richmond	United States, VA	2.1	Gold
157	University of San Diego	United States, CA	2.2	Gold
158	University of South Florida (Tampa)	United States, FL	2.1	Gold
159	University of St. Thomas	United States, MN	2.2	Gold
160	University of Texas Rio Grande Valley	United States, TX	2.1	Gold *
161	University of Texas at Austin	United States, TX	2.2	Gold
162	University of Utah	United States, UT	2.2	Gold
163	University of Vermont	United States, VT	2.2	Gold
164	University of Victoria	Canada, BC	2.2	Gold
165	University of Virginia	United States, VA	2.2	Gold
166	University of Washington, Seattle	United States, WA	2.1	Gold
167	University of Wisconsin-Milwaukee	United States, WI	2.1	Gold
168	University of Wisconsin-Oshkosh	United States, WI	2.1	Gold *
169	University of Wisconsin-Stevens Point	United States, WI	2.1	Gold
170	Vassar College	United States, NY	2.2	Gold
171	Virginia Tech	United States, VA	2.2	Gold
172	Warren Wilson College	United States, NC	2.2	Gold
173	Wartburg College	United States, IA	2	Gold *
174	Washington University in St. Louis	United States, MO	2.1	Gold
175	Wellesley College	United States, MA	2.1	Gold
176	Wells College	United States, NY	2.1	Gold *
177	Western University	Canada, ON	2.1	Gold *
178	Wilfrid Laurier University	Canada, ON	2.1	Gold
179	Worcester Polytechnic Institute	United States, MA	2.1	Gold
180	Yale University	United States, CT	2.2	Gold

Appendix D: Interview Protocol

Procedure:

1. Thank the participant for their time and contribution in the research study.
2. Review the focus of the study.
3. Review the consent for recording, confidentiality, and asked for any questions.
4. Asked the interview questions.
5. Thank the participant again, asked if they would like to add any additional information.
6. Remind the participant of voluntary withdraw, and confidentiality.

Interview Questions:

1. Could you give an overview of your university's engagement with sustainability?
    a. When did it begin?
    b. Any key events along the way?

2. Can you please give an overview of your relationship with the university, including years involved and primary responsibilities held?
    a. Were you with the university when the plan to incorporate sustainability was first initiated?

3. What is your role in leading change for sustainability at your university?
    a. What are the key responsibilities?

4. How was the idea of change for sustainability introduced at your university, how did the change start?
    a. What were the motivations for starting the change?
    b. Did they come from the university itself or from outside of the university?
    c. Who were the main players in the change?

5. What were the goals of initiated change?
    a. How were the goals created?
    b. How were the goals communicated to the stakeholders?
    c. In your opinion, were these goals understood by members of the university? If not, why?

6. Where does leadership come from?
    a. Is there a team responsible?
    b. How is leadership distributed?
    c. How has ownership transferred to other stakeholders?
    d. Have they assumed leadership?

7. What main steps and what activities did you use to achieve sustainability goals?

8. How did you inspire and get commitment from other members of the university to implement this change?
    a. What specific approaches worked well and in which situation?
    b. What specific approaches did not work well and in which situation?

9. How would you describe your relationship and cooperation with other members of university in the process of change?
    a. In your opinion, how did the other members of the university react to the proposed changes?
    b. How would you describe their level of resistance to the changes?

10. In which aspects of the university (e.g. building, curriculum, university structure) was the change process easier? Why?
    a. Which aspects of the university proved difficult to incorporate change? Why?

11. How is the university different today compared to five years ago?
    a. Can you give examples of the progress for social, economic, and environmental factors?
    b. Specific examples for campus greening, purchasing and supply chain, curriculum, engagement, etc.
    c. What were some of the biggest success celebrated?

12. Were there any quick wins along the way that gave more momentum to the change process?

13. In your opinion, what were the main obstacles and limitations you encountered in your work on reforms?

14. How did you address those obstacles, what methods did you use in your work on leading change?
    a. How did you analyze the cause of the obstacles?
    b. How did you reflect on the actions you have taken to address the obstacles?
    c. What do you do when the challenge was not resolved?

15. How was the progress of sustainability implementation processes monitored and measured?
    a. What were the key indicators?

Appendix E: Feedback for Preliminary Testing of the Simulation

Part I: Ease of Use

Please provide the most suitable response for you:

	Very Easy	Easy	Average	Difficult	Very Difficult
User-friendliness of the simulation	☐	☐	☐	☐	☐
Difficulty in gaining bennies	☐	☐	☐	☐	☐
Difficulty in moving the stakeholders	☐	☐	☐	☐	☐
Difficulty in achieving change master	☐	☐	☐	☐	☐
Difficulty in achieving Kotter's stages	☐	☐	☐	☐	☐

Part II: Clarity of Simulation

Please provide the most suitable response for you:

	Fully	Partly	Some what	A little	Not at all
Understanding the meaning of the activities	☐	☐	☐	☐	☐
Understanding roles of the stakeholders	☐	☐	☐	☐	☐
Understanding the response (pop-up) cards	☐	☐	☐	☐	☐
Understanding different domains of a university that need transformation	☐	☐	☐	☐	☐
Understanding how universities can change for sustainability	☐	☐	☐	☐	☐
Understanding the role of sustainability leadership in higher education	☐	☐	☐	☐	☐

Part III: Suggestion and Recommendation

1. Are any activities missing that could be used to support successful change for sustainability in universities?

2. What difficulties did you encounter while playing the simulation?

3. What suggestions would you make to improve the simulation?

Part IV: Error Tracking

Please use the following table to track error and report bugs encountered when playing the simulation.

Description of error or bug	**Where it was encountered**	**Date and time**
E.g. Pat didn't move	Use Sustainable Practices	Mon 20 Dec 11:35 PM (BKK Time)

Appendix F: Pre-test and Post-test

Questions

Full Name: User Id:
Gender: Age:
Job position: Years of experience:

Part I: Knowledge of sustainability

Please provide the most suitable response for you:

	I don't know about it	I've heard of it but don't know much about it	I could explain this but only in general terms	I could explain it well
Circular economy	☐	☐	☐	☐
Education for sustainable development	☐	☐	☐	☐
Environmental education	☐	☐	☐	☐
Global citizenship	☐	☐	☐	☐
Social sustainability	☐	☐	☐	☐
Triple bottom-line	☐	☐	☐	☐
Social responsibility	☐	☐	☐	☐

Part II: Knowledge of managing change to sustainability

The questions that follow are based on this short case.

You have been promoted as the Director of Sustainability of the Office of Sustainability at the University X that wishes to build a sustainable university. This will require the university to adjust key processes such as teaching and learning, research, operations, facilities and community outreach toward sustainable development. Faculty and staff members will join as cross-disciplinary teams to assess current university processes, compare these with sustainability policies and redesign them for sustainability. You will be working with a diverse set of stakeholders of the university who are aware of 'sustainability' and 'sustainable development' in a general way, but not in much detail. Most faculty and staff are not opposed to examining current approaches or adopting new practices, but doesn't understand what will be involved in this project yet.

Please select the correct answers.

1. In approaching your work with the university in the first several months, what would be your goals?
    a. To get information about the people, their interests, skills, and relationships
    b. To give information to others about sustainability and inspire them to become involved
    c. To change the university culture toward sustainability
    d. To train them with the skills they need to use the new system

e. A & B

2. From which levels of faculty and staff would expect resistance?
    a. You should expect some resistance from all levels of people.
    b. There won't be resistance since staff knows the project comes from the Office of Sustainability.
    c. Only the university executive members are likely to resist.
    d. Resistance will be highest among the level of lecturers and staff.
    e. Resistance will be highest among middle level managers.

3. How important is the University president support in implementing the new system at the university?
    a. Not very important
    b. Moderately important
    c. Important but not essential to success
    d. Essential to successful implementation in the school
    e. None of the above

4. How would you begin working with faculty and staff in the university on the project?
    a. Send a brief information packet to faculty and staff on why's and how's of sustainability
    b. Start by talking to University president and deans
    c. Hold a presentation for faculty and staff where you share information about the project
    d. Do an assessment of current practices
    e. All of the above

5. After about six months, you notice that several groups of faculty and staff are slow to change. They understand what sustainability is and accept the need to change core processes to become more sustainable. However, they remain uncertain about how to redesign the working and teaching systems. Which strategy would you advise?
    a. talk to them individually
    b. give them written information about sustainability in a large group meeting
    c. arrange training for groups
    d. get university president and deans to order them to use new sustainable practices
    e. hold a celebration where faculty and staff share their success

6. Assume that you have identified Ms. L, a senior lecturer as an informal leader among her colleagues. Although she is friendly, she is very quiet in meetings, and has yet to demonstrate her support for the project. What should you do?
    a. wait and see what she does
    b. give up, nothing will work with people like Ms. L
    c. keep going back to talk to her to find out why she objects to the project
    d. send her to a workshop about sustainability

e. treat her as others, involve her in some activities, but don't let her stop you

7. A group of staff identify a problem with university campus facilities which leads to waste and extra costs. They urge the supplier's product development team to redesign packaging so that shipping costs and materials waste is reduced. This is consistent with which of the following sustainability concepts?
    a. Triple bottom line
    b. Circular economy
    c. Social sustainability
    d. Sustainable consumption
    e. None of the above

8. Late in the 2nd year of implementation, lecturer's interest in sustainability began to drop. Many lecturers are using new practices effectively, but some other have lost interest and gone back to using their old teaching methods. What could you do to reenergize lecturers and increase momentum for change?
    a. Tell lecturers who are not using the new systems they will not receive bonuses
    b. Hold a party but only invite those who are using the new teaching methods
    c. Organize a Sustainability Week to show lecturers and students improvements that have resulted from using more sustainable practices
    d. Place warning memos in the personnel files of lecturers who are not cooperating
    e. A & D

9. Over a period of two years, staff in the university increasingly adopt sustainable practices. Senior administrators of the university consider steps that could be taken to embed sustainability in the university culture. Which activity would help to achieve this goal?
    a. Hold more training for staff
    b. Develop an annual corporate sustainability report
    c. Visit other universities to observe their sustainable practices
    d. Survey faculty and staff attitudes and beliefs
    e. B & C

10. Which of the following obstacles to sustainable change efforts is most difficult to overcome?
    a. Faculty and staff lack skill to use new practices
    b. Faculty and staff lack interest and motivation to sustainable change
    c. Faculty and staff don't understand what the sustainable change is for
    d. Lack of budget
    e. Lack of management support

Part III: Sustainability mindset

Please indicate the extent of your agreement/disagreement with the statements by using the following scale.

No	Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Because the future is unknown, we should maximize our benefits today.	☐	☐	☐	☐	☐
2	Wealthy nations have earned their economic benefits and should not be expected to sacrifice for the benefit of other countries.	☐	☐	☐	☐	☐
3	My society should promote equal opportunities for males and females in school and the workplace.	☐	☐	☐	☐	☐
4	What I do as an individual does not have much impact on the environment.	☐	☐	☐	☐	☐
5	Changing what I buy and use in my daily life can make a positive difference for the environment.	☐	☐	☐	☐	☐
6	Economic development helps everyone so we should not limit what businesses do to gain profits.	☐	☐	☐	☐	☐
7	Universities have a responsibility to improve the quality of life in the communities where they reside, even when it increases their costs.	☐	☐	☐	☐	☐
8	I can make changes that have a positive impact on the world around me.	☐	☐	☐	☐	☐
9	The purpose of a business is to make profit so it should not be held responsible for the labor practices of its suppliers.	☐	☐	☐	☐	☐
10	I have a responsibility to make changes to my behavior for the benefit of my community and society.	☐	☐	☐	☐	☐
11	I am willing to pay more for products that I believe are environmentally friendly.	☐	☐	☐	☐	☐

Appendix G: Consent Form for Quasi-Experimental Study

Consent Form – Adult Participants
Participant's consent

I agree to participate in the research project entitled "Designing a Computer Simulation for Leading Change for sustainability in Higher Education" being conducted by Pwint Nee Aung of the College of Management, Mahidol University. The purpose of this study is to redesign and test the effectiveness of a computer simulation which can be used as a developmental tool to train sustainability leaders in universities.

I understand I understand that my participation in this project is strictly voluntary and that information will be treated confidentially. I understand that everything I say will be kept confidential and none of the information I give will identify me and the only persons who have access will be the researcher and her supervisor. I also understand that all the information I give will be stored securely on the personal computer of the researcher for a period of five years.

I am aware that if I have any questions about my participation in the project, I may contact Pwint Nee Aung at pna1988@gmail.com or +959 4480 26167.

I may also contact the researcher supervisor and Program Chair of Ph.D. in Sustainable Leadership, Professor Philip Hallinger, at hallinger@gmail.com or +66-81-881-1667.

I agree to take part in this project.

Signed: _____

Name: _____

Date: _____

Appendix H: Example Integration of Qualitative Findings in LCSHE Simulation

The table below connects simulation activities and their outcomes or rewards, as detailed in the 'Activities' and 'Feedback Cards' columns, to the insights gleaned from qualitative research. Activities represent steps in the change process within universities, while feedback cards outline the results and rewards for engaging in these activities. The design of both elements is grounded in the research findings, as illustrated by the 'Examples from Universities' and 'Principles Derived from Findings' columns.

Activities (Simulation)	Feedback Cards (Simulation)	Examples from Universities	Principles Derived from Findings
Use Sustainable Practices	These stakeholders commit to working with the student senate in campus engagement activities to increase student awareness and interest of sustainability issues.	U1, U9 and U12's Eco Reps program to foster a campus-wide sustainability culture	Awareness Stage Interest Stage Campus Engagement
Use Sustainable Practices	These stakeholders commit to eliminate the use of plastic water bottles in their departments.	U5's campus-wide policy to ban single-use plastics	Practice Stage Environmental sustainability Campus operations
Use Sustainable Practices	These stakeholders commit to doing weekly "walk-through" inspections of their faculty buildings to identify possible ways to save energy, reduce waste, and support circular economy through recycling.	U12's Recycling as starter package U6's circular economy (e.g. resell used books)	Practice Stage Environmental sustainability Campus operations
Use Sustainable Practices	These stakeholders initiate pilot projects on carbon foot-printing in neighborhood schools.	U9's project of carbon foot-printing for schools	Practice Stage Environmental Sustainability Community Engagement
Use Sustainable Practices	These stakeholders initiate a food recovery program that will distribute leftover food from university's food services and events to those in need.	U2's programs that repurpose food waste to support local communities.	Environmental Sustainability Community Support Sustainable Food Management
Use Sustainable Practices	These stakeholders commit to working with colleagues in other departments and faculties to initiate interdisciplinary curriculum projects on key sustainability topics.	U6's development of sustainability-focused courses and interdisciplinary projects	Practice Stage Sustainability Education Interdisciplinary Projects
Use Sustainable Practices	These stakeholders volunteer to help the university review staff selection and orientation practices to ensure that new employees have awareness and commitment to sustainability.	U4's approach to embedding sustainability in human resources practices	Practice Stage Social Sustainability

Use Sustainable Practices	These stakeholders each commit to linking some of their research and publications to the university's priority sustainability research areas aimed at supporting achievement of the UN's sustainable development goals.	U5's focus on aligning research objectives with SDGs	Practice Stage Sustainability Research SDGs

The table can be interpreted as a bridge between theoretical insights and practical application, offering a comprehensive view of how qualitative research findings on sustainability leadership and practices can be operationalized within an educational simulation. By engaging with the activities and feedback cards in the simulation, participants can experientially understand the principles and practices of sustainability leadership as observed in real-world university settings.

Appendix I: Ethics Approval from Mahidol IRB

Institutional Review Board, Institute for Population and Social Research, Mahidol University (IPSR-IRB)

Established 1985

COA. No. 2022/06-152

Certificate of Approval

Protocol No.: IPSR-IRB-2022-152

Title of Project: Developing Leadership for Sustainability in Higher Education

Approval Includes:

1) Principal Investigator: Ms. Pwint Nee Aung
   Affiliation: College of Management, Mahidol University
2) Submission Form Version Date 16 June 2022
3) Research Proposal Version Date 16 June 2022
4) Interview Guideline Version Date 16 June 2022
5) Participant Information Sheet Version Date 16 June 2022
6) Informed Consent Form Version Date 16 June 2022

IPSR-IRB is in Full Compliance with International Guidelines for Human Research Protection such as Declaration of Helsinki, The Belmont Report, CIOMS Guidelines and the International Conference on Harmonization in Good Clinical Practice (ICH-GCP)

Date of Approval: 30 June 2022
Date of Expiration: 29 June 2023

Signature of Chairperson: .....

(Associate Professor Dr. Chalermpol Chamchan)

IPSR-IRB Chair

List of Co – Investigators

-

All IPSR-IRB Approved Investigators must comply with the Following:

1. Conduct the research according to the approved protocol.
2. Conduct the informed consent process without coercion or undue influence, and provide the potential subjects sufficient time to consider whether or not to participate.
3. Use only the Consent Form bearing the IPSR-IRB Approval stamp.
4. Obtain approval of any changes in research activity before commencing and informed research participants about the changes for their consideration in pursuing the research.
5. Timely report to serious adverse events to IPSR-IRB and any new information that may adversely affect the safety of participants.
6. Provide IPSR-IRB the progress reports at least annually or as requested.
7. Provide IPSR-IRB the final reports when completed the study procedures.

.....

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