Article

Nurturing Sustainability Changemakers through Transformative Learning Using Design Thinking: Evidence from an Exploratory Qualitative Study

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Abstract: Globally, society faces significant problems, from climate crisis to persistent poverty. Education for Sustainable Development offers an approach to achieving a sustainable society. The challenge is creating changemakers with the knowledge, mindset, and competencies to innovate. Teaching sustainability tends to be discipline-specific, taught content-heavy via "spoon-feeding" and neglecting student agency changes. To overcome these challenges, we developed a programme to "teach" innovation for sustainability that combines transformative learning and design thinking as the pedagogy. Classes were anchored by solving a real-world sustainability challenge, facilitating experience transformation into new knowledge. Design Thinking is a transdisciplinary methodology that helps different disciplines collaborate on addressing complex problems. However, there is limited empirical evidence to support the effectiveness of this transformative pedagogy in sustainability education. What is the value of combining Design Thinking and Transformative Learning as a pedagogy in sustainability education? Based on the University College Dublin Innovation Academy's Professional Diploma of Innovation for Sustainability, we address this research question by exploring the impacts of the programme design. Data were collected during and after the programme through students' reflections and observation field notes of teaching sections. Findings show that the programme design supported developing a sustainability mindset, sustainability literacy, and creative confidence. All characteristics support becoming a changemaker.

Keywords: design thinking; transformative learning; education for sustainable development; educational evaluation; curriculum development

1. Introduction

Globally, society faces significant problems, from climate crisis to persistent poverty. Education for Sustainable Development (ESD) or Sustainability Education was founded with the ambition to build knowledge of sustainability and, more importantly, to develop sustainability changemakers who directly contribute toward creating a sustainable society [1]. The changemakers are people with a bias to action, strong sustainability values, and a wide range of skills and competencies, which they apply to create sustainability transitions on individual, organisational and systems levels [2].

Universities play a significant and unique role in these sustainability transformations via the ESD [3]. Some scholars call it the Higher Education for Sustainable Development (HESD) [4]. During the past years, higher education institutions worldwide have been providing sustainability education to a wide range of students, either by integrating sustainable development into existing curricula across single disciplines such as business, education, law, etc. [5] or designing new interdisciplinary programmes in sustainability science. For the past decade, the number of sustainability education programmes at universities and colleges alone in the USA has surpassed 1500, representing a significant increase in the

global total [6]. Advancing the transition towards sustainability calls for changemakers with different qualities and characteristics, which ideally will be reflected as key learning outcomes of ESD. There remains a question, however, among educators, learners, and practitioners about what these qualities might look like. Several scholarly attempts have been made to articulate these qualities and potential associated learning outcomes of ESD.

Most notably, Wiek et al. [7] and later Wiek et al. [8] proposed a framework that supports ESD programmes and curriculum development. The framework encompasses five key sustainability competencies. These are widely defined as knowledge, skills, and attitudes that enable successful performance and problem-solving of real-world sustainability problems, including values-thinking competency, futures-thinking competency, strategic-thinking competency, interpersonal competency, and integrated problem-solving competency. More recently, Brundiers et al. [9], in their Delphi study, further developed the framework by redefining existing competencies, proposing a hierarchy, and adding two competencies (intrapersonal competencies/mindset and implementation competencies). They called for more empirical research on the legitimacy of these new competencies, especially intrapersonal competencies/mindset.

Furthermore, facilitating ESD requires innovations in teaching and learning [10]. Nevertheless, the current practice of teaching and learning sustainability education tends to be outdated, discipline-specific, taught content-heavy via "spoon-feeding", and focus on teaching "about" sustainability rather than preparing students' agency of advancing transformation [11,12]. In this traditional pedagogy, the predominant mode of information dissemination is single-directional, wherein the instructor imparts knowledge to the listeners as students.

In addition, Sustainable Development (SD) is a multifaceted and intricate concept subject to diverse interpretations across various academic disciplines and within various social and cultural contexts. ESD educators need to collaborate and link different disciplines in novel ways to support students' social learning systems thinking and help them explore sustainability issues holistically with an open mind instead of seeking a predetermined technical solution bounded in a single discipline [13]. This has become even more important in today's digital era, where knowledge "about" sustainability (concepts, frameworks, and facts) is easy to access. Therefore, ESD should focus on cultivating mindsets, skills, and competencies critical to converting knowledge into innovations for sustainability transformation [14].

In the past few years, several innovative pedagogical approaches in ESD, as a response, have been proposed and then piloted in the higher education context, most notably action-based learning, experiential learning (EL) [15], transformative learning (TL) [16], and real-world problem-solving [17]. However, there is still no widely accepted teaching and learning model in ESD. This is partly because of a lack of empirical evidence on impacts that detail what instructional practices are applied in the classroom and how they might connect with relevant outcomes to developing changemakers for SD [18].

Furthermore, while the above-mentioned innovative pedagogies promise to deliver favourable outcomes in sustainability education [10], they are not without disadvantages, such as being difficult, uncomfortable, unstructured, and time-consuming [19]. There could be a major issue in sustainability education given that sustainability itself and SD are both contested concepts [20,21]. In this context, Design Thinking (DT) is potentially a remedy for the drawbacks through a guided process, helping learners transform internally and externally to become innovative problem solvers [22]. In practice, DT has been applied in many other settings in higher education to support TL/EL, such as in management education (e.g., [23]) and engineering education (e.g., [24]).

What is the value of combining Design Thinking and Transformative Learning as a pedagogy in sustainability education to cultivate sustainable changemakers? We explore this key research question by examining the impacts of the pedagogy model using the case study of the UCD Innovation Academy Professional Diploma of Innovation for Sustainability in Ireland. The programme moves beyond EL, using a transformative pedagogy structured through DT to

cultivate sustainability changemakers for early and mid-career professionals by focusing on (1) mindset change, (2) sustainability literacy, and (3) building creative confidence. Data were collected during and after the programme through students' reflections and teachers' observation field notes.

This paper makes two significant contributions to the research and practice of ESD. First, we propose a novel ESD pedagogical model potentially relevant to a wide range of students. The framework details how different pedagogical elements of TL and DT complement each other to facilitate the development of sustainability changemakers. By doing so, we address the ongoing challenges students, educators, programme administrators, and funders face concerning the ambiguity of ESD interventions and associated learning outcomes. Second, we argue that mindsets and creative confidence are equally important to other SD competencies as potential ESD programme learning outcomes. By empirically examining the impacts of the pedagogical model on early- and mid-career professionals, we found students' transformation of not only sustainability literacy but also sustainability mindset and creative confidence to practice and act on sustainability challenges. This occurs independent of the diversity of students' backgrounds and lack of experience in sustainability before the course. All outcomes support becoming a changemaker.

The paper is structured as follows. The next section problematises the current practice of ESD that might limit learners with incremental change of knowledge building. We then propose a new pedagogical model that helps develop sustainability changemakers. The following section details the research methodology with the case study description and chosen data collection and analysis methods. The findings show that because of the programme, students changed their sustainability mindset, knowledge, and confidence to become changemakers. Finally, we present the conclusions drawn from the study, a discussion, limitations, and implications.

2. Literature Review and Theoretical Framework

The paper looks to contribute to helping higher education educators better prepare students to lead sustainability transitions by helping build an empirical basis for pedagogical decisions. Nurturing changemakers requires developing their competencies, mindsets, and confidence. The pedagogy needs to accomplish at least three outcomes: (1) instil basic sustainability literacy (also known as competencies), (2) transform mindsets, and (3) build individual confidence. To place this study in the context, we start by looking at the challenges to ESD because sustainability is a contested and dynamic concept. We identify mindset change as a critical differentiation between EL and TL, which is required to produce changemakers. Lastly, we identify DT as a pedagogy that can support TL, offering a structured process that includes social learning, critical reflections, and psychological safety, which, when combined, supports building creative confidence for changemakers.

2.1. Education for Sustainable Development

Understanding sustainability and SD is crucial to designing, implementing, and delivering ESD [25]. The challenge is that SD is a contested concept [20,26]. It is contested because the discourse used by competing individuals, organisations, and societies focuses on trying to control its agenda and development [27]. As a result, two significant challenges face using ESD to prepare changemakers. First, there is no uncontested definition of ESD [21]. Some approaches to ESD can be prescriptive [25], while others use the complexity of sustainability to manipulate students' viewpoints [27]. ESD needs to address sustainability as a contested concept [28] and embrace pedagogical approaches that foster and encourage discourse [29]. This discourse must explore different and diverse social and economic viewpoints and contexts and not be limited to narrow perspectives, for example, environmental aspects [27] or "green capitalism". Ultimately, sustainability is a dynamic process and cannot begin with a predetermined definition; instead, a social consensus (which is context-dependent) about what constitutes sustainable and unsustainable be-

haviour is required [30]. Thus, developing changemakers requires pedagogies that support understanding context and engaging in discourse and social learning.

The second issue is that ESD approaches can be unclear, detached, or abstract, with vague learning outcomes [25]. Nevertheless, students are expected and required to learn the competencies to enact sustainability [31]. However, if SD is contested and ESD unclear, that raises the question of which competencies should be acquired and to what level. There have been efforts over the years to define required competencies in a broad sense [9,31]. At the same time, sustainability is a dynamic concept [30]; the competencies required today will shift to a degree we cannot know. A better approach is to look at literacies—the knowledge, skills, and mindsets that inspire a person to build a sustainable future and enable them to make effective decisions [32]. Warren et al. [33] see literacies as "a collection of skills that, once achieved and formed, can manifest a particular level of competence that can be measured in the future." This definition suggests that sustainability literacy can be seen as a process of building depth in the competencies [34]. A literacy approach supports gradually building competencies and offering flexibility to add other skills that may be more appropriate in a different context.

The dynamic nature of sustainability challenges ESD pedagogies. Often, ESD focuses students on the existing job markets, preparing them only to make incremental changes [12]. Instead, sustainability is about transitioning society to achieve human well-being, which requires changes in skills, mindsets, and intrapersonal skills [9]. These changes are too complex to address by merely increasing individual knowledge [35], which frequently is the approach of higher education reinforcing the status quo [36]. Thus, ESD must look at pedagogies to facilitate the transformational change of individuals (mindsets, sustainability literacy, and confidence) and society.

2.2. Transformational Learning (Mindsets)

Commonly in ESD literature, EL and TL are used interchangeably without critically reflecting on the objectives to be archived in sustainability [37]. The difference is vital if specific and intentional pedagogies are to advance the development of changemakers. EL is "the process whereby knowledge is created through the transformation of experience resulting from the combination of grasping and transforming experience" [38]. It is a broad pedagogy but lacks explicit, structured approaches to changing mindsets to support creating changemakers. In contrast, TL is "...learning that transforms problematic frames of reference—sets of fixed assumptions and expectations (habits of mind, meaning perspectives, mindsets)—to make them more inclusive, discriminating, open, reflective, and emotionally able to change" [29]. In this definition, TL transforms mindsets and builds students' confidence. Most literature reviews for ESD competencies frameworks neglect the mindset and confidence elements required for the changemakers [31]. A recent Delphi study suggests further research on mindsets is needed but neglects to address the confidence [9]. The goal of TL is more than just converting experience into competencies but includes the transformation of unsustainable mindsets [37].

2.3. DT as a Pedagogy

Moore [19] asks how we can shift to TL if it is difficult, uncomfortable, and time-consuming. DT offers a pedagogy to establish a learning environment and processes that enable TL to occur [39]. DT is a problem-solving technique emphasising empathy, creativity, and cooperation to produce innovative solutions. Understanding user needs, brainstorming potential ideas, prototyping, and iterating based on feedback are all part of nurturing a human-centred and iterative design process. A typical structure of DT used in the iterative design process is (1) empathy (deeply understanding user's needs), (2) define (their problem), (3) ideate (come up with ideas for a solution), (4) prototype (build or visualise a potential solution), and (5) test (see if the solution meets users' needs).

DT is a structured process that helps learners transform internally and externally to become innovative problem solvers [22]. It creates an environment that shifts individuals'

mindsets [35,39] and fosters creative confidence [40]. The changes in individuals are not just superficial; studies have found alterations in DT users' brain functions [41,42]. The structure works as a scaffolded intervention [43]. Scaffolding allows students to learn by doing and completing tasks that are more difficult than they could without DT [44]. DT also shifts people's values by focusing on human needs [45,46]. The approach encourages learners to reframe problems [22] and support a dynamic view of sustainability [30]. DT is structured to facilitate changing how individuals see the world while letting go of their fears and self-limiting beliefs [22] (aligning well with the definition of TL). DT pedagogy includes using reflections, creating psychological safety, and facilitating social learning to build students' confidence to tackle sustainability challenges.

Reflection is at the heart of the design process, changing and reinforcing mindsets [40]. Matsuo and Nagata (2020) [47] see critical reflection as a "second-order or higher meta-learning process" necessary for TL to occur [29] to shift habits of mind and points of view [19]. Providing time and space for reflection and dialogue is among the most frequently acknowledged requirements for successful TL processes [37]. The underlying cycle of transformation progresses through a succession of introspections, individually and collectively, on viewpoints and thought patterns to change one's frame of reference [19,37,47]. In the case of sustainability, reflection must be intentionally guided to encourage a critique of relationships students take for granted (e.g., production, consumption, power, and/or justice). Without this review, they may fail to gain a fundamental understanding of sustainability [48]. Thus, students using DT to address sustainability challenges must reflect on sustainability in the design process.

DT helps teams solve problems by nurturing social learning [45] through developing shared understandings of problems [49] and emotional intelligence [40]. Social learning is considered to result from and is a precursor to TL [50]. Learners working together develop shared understandings of sustainability, helping to address its contested nature Field (Wright and Wrigley, 2019) [51] and supporting the transition process [52]. People's participation in a shared process promotes psychological safety [53]. Social learning through cooperation supports the creation of innovations for sustainability and supports the changemakers in the field [54].

DT helps educators create an environment where learners feel safe to support internal and external transformations [55]. It supports creating the psychological safety [22], a critical element that supports learners' reflection and social learning in TL. First, when learners experience psychological safety, they feel safe to reflect, creating a transitional state—an interruption of routine perception, thought, and behaviour patterns followed by being open to new possibilities [56]. Second, psychological safety aids social learning to enhance understanding of self and others [37,57]. Thus, DT produces psychological safety supporting TL.

Bryant et al. [50] reminds us, "The agency, empowerment and confidence to tackle sustainability challenges is one of the key capacities needed in the world." Creative confidence is recognised as an outcome of the DT process [40,46,58]. Creative confidence comprises two factors: creative agency, "the ability to apply one's creativity", and creative self-efficacy [59]. Traditional education trains students to "know" before acting [60]. DT encourages learning from doing through repetition and iteration, which builds confidence through a scaffolded process [40]. In that process, people's self-efficacy is increased by having them attempt and accomplish increasingly more complex tasks [40,43,58]. When used repeatedly, DT promotes "creative confidence" or mindsets that support "creative self-efficacy" [51,61]. Studies show DT increases participants' confidence [62,63], which is critical to preparing changemakers to lead sustainability transitions.

2.4. Theoretical Model

Figure 1 Pedagogy for Nurturing Sustainability Changemakers combines the literature review and the authors' experience to propose a theoretical framework. The framework is intended to inform teaching and research. Like DT, the Pedagogy for Nurturing Sus-

tainability Changemakers is an iterative process, not linear. It starts with a sustainability problem. The DT process is viewed as a series of scaffolded interventions that support mindset change and, ultimately, TL. Sustainability literacy is foundational for students to develop. In relation to design methods, students are taught standard design thinking techniques such as prototyping, etc. Psychological safety is not a single technique; activities that support building it are intentionally designed into classes (e.g., team or class contracts). Mindset development includes traditional and sustainability mindsets intentionally developed through activities, reflection, discussions, and repetition. Social learning is intentionally fostered through group work. Reflections are a normal part of the DT process. Creative confidence is an outcome of the entire process. All the elements are essential for creating changemakers. These areas are explored in this study.
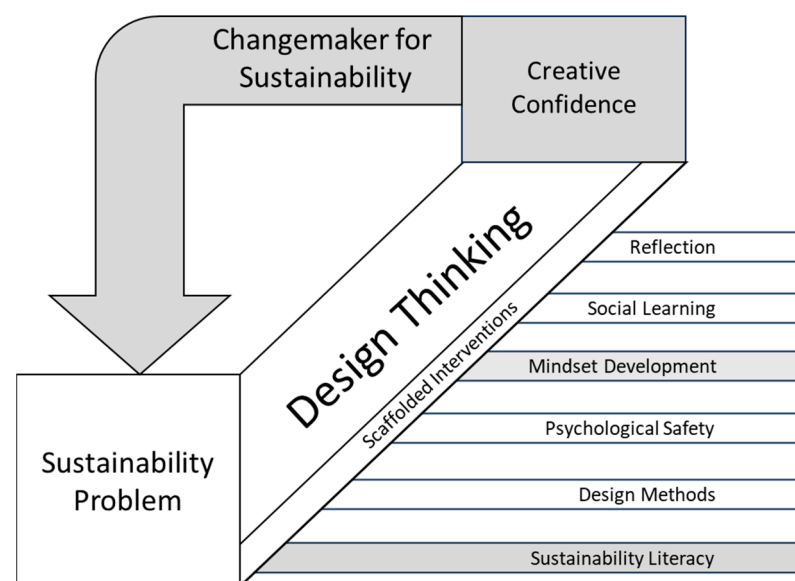

Figure 1. Pedagogy for Nurturing Sustainability Changemakers through Transformative Learning using Design Thinking.

3. Methodology

3.1. Research Design

To examine the research question, we conducted an exploratory single-case study with embedded cases using qualitative methods [64]. This is a valuable approach, given the limited number of existing impact studies of TL in sustainability education in the literature [39]. The aim is not for statistical generalisation but rather for analytical generalisation [64] by explaining in depth the role of transformative pedagogy in teaching sustainability, which matches well with the key strengths of qualitative methods. We purposely chose the Professional Diploma in Innovation for Sustainability at UCD Innovation Academy in Ireland as a case study. It was purposely built to cultivate sustainability changemakers using TL structured with DT pedagogy.

Data were collected during and after the course. By employing triangulation in data collection, we relied on multiple data sources to seek convergent findings, leading to greater validity [65]. The primary data source included students' reflections on their learning journey. This was supplemented by field notes of training sessions.

3.2. Case Description

The Professional Diploma in Innovation for Sustainability was delivered for the first time in 2022–2023 by the UCD Innovation Academy in Ireland. The programme targets early- and mid-career professionals lasting a full academic year (9 months). The programme moves beyond teaching "about" sustainability and focuses on cultivating sustainability

changemakers—those with the ability, intention, and confidence to act on the ongoing sustainability challenges [35]. Throughout the programme, students were equipped with the sustainability mindset, sustainability literacy (as a learning outcome, which included toolsets and methods), and skillset to address sustainability challenges. The classes are facilitated rather than taught. Facilitators support students' learning journey as opposed to memorising content. There are no exams, and all modules are pass/no pass.

In 2022–2023, 99 students participated in the programme in three cohorts. According to a baseline survey (response rate: 58%), students came from mixed backgrounds in relation to their age, employment experience, and educational background. The average age of the sample was around 47 years old. Over half of the surveyed respondents held a bachelor's degree (or equivalent) as their highest education background, while 42.4% held a master's degree (or equivalent) when registered for the course. A small number held a PhD (6.88%). Regarding work experience, most surveyed students were employed (70%) or self-employed (5%) and holding junior/senior roles in several industries yet have had no previous working experience in sustainability.

Programme learning outcomes were designed to help develop sustainability literacy in students. The broad interpretation of literacy is the knowledge, skills, and mindsets that inspire a person to build a sustainable future and enable them to make effective decisions [32]. This helped establish from literature and practice that a sustainability-literate person understands:

- The core principles of environmental and social systems (i.e., systems thinking)
- How to assess scientifically credible information
- How to make informed and responsible decisions (e.g., toolsets and methods)

These established the programme's learning outcomes. These outcomes were woven into the scaffolded interventions to inform intentional pedagogical choices that shaped the teaching approach. A crucial part of teaching DT is intentionally developing target mindsets. We created a sustainability mindset consisting of three well-known design mindsets deemed to support the goals of creating sustainability changemakers and three newly developed sustainability-focused mindsets. Here are the six mindsets the programme design sought to instil:

- Bias to Action (supports transformational vs incremental change)
- Radical Collaboration (supported by social learning)
- DT as a Process (links to DT as a structured process)
- Practice Sustainability as a verb and not a noun (links to sustainability as a contested concept)
- Use the SDGs to frame Sustainability (links to sustainability as a contested concept)
- Preparing people for the future (links to DT human-centred approach to sustainability outcomes).

To produce changemakers, the programme relies on transformative pedagogy (practice/method for teaching) intentionally structured with a DT pedagogy that combines a focus on real sustainability problems, design and sustainability methods, psychological safety, social learning, and reflection (See Figure 1). For hands-on problems, besides standard in-class lectures, students were assigned final assessments based on practical activities solving practical, real-world sustainability challenges. These varied depending upon the individual. For example, a Fortune 500 beverage company employee looked at circular uses of existing waste by-products. An employee of a national delivery organisation looked at increasing biodiversity at offices. On the other extreme, several students looked at local community improvements, from increasing neighbourhood recycling to converting a parking space into a community garden. Also, learners will have completed two significant assessments required, including a Climate Change Adaptation Plan and a Sustainability Report, at the end of module two and module three, respectively. The assignments are part of a scaffolded process, building students' abilities and confidence. In addition, students were required to complete reflections after each module.

3.3. Data Collection

The primary data include written final student reflections. Student reflections have been widely recognised as reliable data sources in education research and, more specifically, in sustainability education [66]. As a compulsory part of the programme assessment, students must reflect on their learning journey for each module and submit their reflections shortly after the module's end to keep the memory fresh in the students' minds. The student reflection template was semi-structured, balancing structured questions built around essential learning outcomes with open-ended questions. Open-ended questions allow students to freely express their perspectives on many themes, such as the "most important learning takeaways from the course", "aspects of the programme that they found most valuable for the learning experience", or "potential application of these learnings in the future", to name a few. These reflections, therefore, generated rich data to describe students' perspectives of learning outcomes, experiences, feelings, emotional events, lessons learnt, and potential applications of the learning in the future, to name a few areas. This research focused only on the final reflections. This was exploratory research to test the viability of establishing ongoing research into teaching methodology and student outcomes. One consequence is that some indicators, e.g., mindset change, may appear weaker because students mention them in reflections for earlier modules.

In addition to the reflection, data was complemented by facilitators' observation notes over 50 h of taught and mentoring sessions in the programme per cohort. Therefore, these data are beneficial to shed light on the relationship between specific programme design elements, students' responses, and the context.

3.4. Data Analysis

We adopted an inductive grounded-theory approach to content analysis for developing a data structure that strengthens the qualitative rigour [67,68]. In the first step, we were guided by Saldaña [69] to conduct open coding, where we got familiar with the data by reading the transcripts, kept an open mind, and finally highlighted informant keywords, phrases or sentences linking to research topics.

In the second step, we performed axial coding by seeking relationships among these open codes and recoded them if needed [70]. This analytical process merged conceptual similarities, eventually leading to a small and manageable number of first-order codes. In the third step, we compared emerging codes to observational data to establish context for the emerging themes and ground data interpretation [see Appendix A].

In order to conclude, data were placed in a cross-case display table that indicated the number and weighting of the data across cases (i.e., showing the count of responses for mindsets, sustainability literacy, and creative confidence [71]. This step helped identify patterns in the data. Further, this counting method illustrates how well the concepts are grounded in the data [71]. This intends to demonstrate how well the concepts are rooted in the data sources.

Only final reflections were analysed. As a result, students would have completed three interim reflections (at the end of the preceding modules). Also, they will have completed three significant assessments required, including a Climate Change Adaptation Plan, a Sustainability Report, and a Final Changemaker project focusing on sustainability running three months. Thus, reflections were analysed knowing that students had passed the programme and each completed a significant body of work. The last reflection was completed as part of completing the final project module and the programme. Hence, these reflections were rich with data on the various impacts of the course on students.

4. Results

4.1. Mindset Transformation

TL and DT look to foster mindset change. To make our societies more sustainable, ESD must take a holistic approach that considers people's entire mindset and encourages consistent behaviour and preference patterns [72]. Mindsets affect cognitive, motivational, and

emotional processes and how people act in certain situations [73]. They link skills, knowledge, attitudes, and habits of mind. The programme prioritised developing six mindsets as outcomes for students: three from the realm of DT: (a) Bias to action, (b) DT is a process, and (c) Radical collaboration and three from Sustainability, (d) Practice sustainability as a verb and not a noun, (e) Use the SDGs to frame sustainability, and (f) Preparing people for the future. Below, we will briefly explain why these six were selected and the strength of each found in the reflections. Table 1 presents numbers that represent the strength of the pattern for mindset transformation based upon aggregated student reflection analysis [71].

Table 1. Strength of the pattern for mindsets transformation.

Radical Collaboration	10
DT as a Process	9
Bias to Action	8
Practicing Sustainability as a Verb and not a noun	7
Helping People prepare for the Future	6
Using SDGs to frame sustainability.	5
TOTAL	45

4.1.1. Radical Collaboration

The complexity and contested nature of sustainability require radical collaboration, a core principle of DT [74]. It aligns with sustainability because no individual or discipline can tackle sustainability challenges [75]. This is reflected well in this student's reflection:

> *"For the past ten years, I've worked closely with people with similar backgrounds to myself, so I found it an interesting challenge and opportunity to work with people from different backgrounds. I felt like they added a unique viewpoint and insight into the problem solving aspect of the projects in particular." (Student 56)*

Notably, the DT process as a pedagogy supports radical collaboration in diverse teams [39]. The following reflects this idea well:

> *"...how helpful design thinking can be for interdisciplinary groups in building trust, fostering interdisciplinary collaboration and effective problem-solving." (Student 84)*

Except for reflections, all major assessments had the option for teamwork, and all minor assessments were performed in teams. Teamwork is consistently required to build students' ability to collaborate radically. The regular requirement for teamwork helps build students' "affinity for teamwork" [51] as indicated here:

> *"...I had never opted for group work before completing this module... Having other members of the team to bounce ideas off was useful and I really saw the value of collaboration as part of the design thinking process... if you are doing a project on your own, I believe that space must be given to collaboration or valuable learning opportunities may be lost." (Student 62)*

In the above quote, we see hints of a personal transformation in terms of teamwork; the DT process supported transforming students through radical collaboration. The following quote is more explicit:

> *"...I learnt a lot about dealing with people and pushed myself outside my comfort zone by reaching out to people I had no previous interaction with. I feel the course has enabled me to communicate and collaborate better with different personality types and organisations/groups..." (Student 55)*

The reflections show how DT as a pedagogy supports TL by shifting mindsets on teamwork as defined by both Hoggan [76] as experiences and Mezirow [29] as reframing.

From a project perspective, students learn the value of working in groups. From a personal perspective, students who are personally challenged (distrustful, shy, etc.) to undertake teamwork build new skills. Thus, there was a strong indication of the development of the radical collaboration mindset.

4.1.2. Bias to Action

Changemakers must act to transition to sustainability, making the mindset "Bias to action" essential. The bias-to-action mindset is a core principle taught in the DT [74] because it aligns with the abductive epistemological approach to design. This was a good match for sustainability due to the urgency of the climate crisis, etc. [77]. Similar to Kijima [62], we found evidence of the bias to action mindset development. Interestingly, students reflected changes in two broad areas: (1) overcoming perceived personal limitations and (2) acting on sustainability. The following is an example of a student who experienced a personal shift:

> *"The Bias to Action was something I was very proud of doing. I am not naturally an outgoing person. I approached my local [organisations], both in person and via email. I got varying levels of responses. . . It was difficult, but as well as establishing connections it was also a confidence builder." (Student 63)*

All classes constantly reinforced the bias to action through forms of hands-on learning. Saggar [42] found similar results for bias toward action by creating EL opportunities. The following student commented on how bias to action was structured in the class:

> *"All of the modules taught me different aspects and I feel this all culminated in the final project where we had to put the learning for all of the previous modules into action." (Student 23)*

Students interpreted bias to action more broadly, such as seeing themselves as a potential actor in the sustainability transition. This is best viewed as a form of global citizenship. Hennesey and Mueller [78] argued that DT supports developing this form of global competency. Here are two examples:

> *". . .the course has fired me up to explore more possibilities to innovate sustainably in my area [profession] and to start more conversations in the area and create momentum for action." (Student 11)*

> *"By identifying the key challenges specific to my [business], I realised that I had the power to initiate change right now without the need for a huge amount of investment. This realisation was empowering as I didn't have to wait for others to solve the problems. Instead, I could start with small, definite actions within my control." (Student 48)*

The reflections and literature show that mindset bias to action was developed and experienced via elements in the programme. In addition, students mention behavioural outcomes such as overcoming perceived personal limitations and acting more in global citizenship capacity in sustainability.

4.1.3. DT Is a Process

DT's structure makes people feel safe because the simple templates encourage change conversations and boost creative confidence and output [22]. The clear-cut format helps students remember and apply it [79]. This mindset focuses on getting people to trust in the process. This is reflected in the following two reflections:

> *"I appreciated the structure of Design Thinking and the confidence I had gained in it; I knew to trust in the process." (Student 21)*

> *"The course further gave me confidence -when it comes to problem solving/ designing solutions. . . thanks to the Design Thinking process—encouraging you to actually understand a problem and the different users involved. The process sort of allows you to become almost an expert in the problem at hand." (Student 53)*

Sustainability problems are wicked problems. As discussed above, sustainability is a contested concept. Thus, DT is a good match with sustainability because it is well suited for addressing wicked problems [61,63,80]. This application was understood by students:

"Design thinking methodology proved itself again to be a very robust process to uncover or create new solutions to a 'wicked problem.' The stages and phases if followed and if you allow yourself to fully embrace them and trust the process to help you, it will inspire and create new solutions." (Student 16)

Some students reflected on the appropriateness of the combination of sustainability and DT in greater detail, suggesting it was a good fit [81]:

"The course taught us not only about sustainability, but also how design thinking can be incorporated into it. Design thinking is a powerful approach that can be applied to sustainability projects, such as [project]. . . .The various steps in design thinking are not to be thought of as a linear process, but rather a loop, which in itself helps to really define the problem." (Student 60)

"Human drivers play a crucial role in shaping sustainable practices and driving positive change. Whether through individual choices, policy-making, or corporate actions, humans are both the cause of unsustainable practices and the agents of change. Reflecting on human drivers has made me recognize [sic] the power of collective action and the importance of fostering a mindset that prioritizes [sic] sustainability." (Student 60)

The reflections showed how students embraced the "DT as a process" mindset in two ways. First, a change from traditional problem-solving methods suggests students learned new ways to tackle problems as illustrated here [51]:

"What this design thinking process has highlighted to me is that by taking the normal process route, I will only find the answers I have been predisposed to find. . . Using the design thinking process, I went forward and back many times, but now have a deep knowledge of what our stakeholders value, their feelings on our project and our organisational culture. It has given me a newfound confidence in our abilities as a [organisation] to deliver more." (Student 75)

Second, seeing DT as a process transformed how students thought about and approached problem-solving. The various mindsets work together. For example, bias to action is supported by this mindset, which allows iterative approaches to be structured [62]. Students reframed how to approach problems. This is reflected here:

"I can see that the design thinking process encourages an iterative approach as we constantly refined and evolved our ideas based on new feedback and insights. I feel that this dynamic element to the process allowed us to adapt to changing circumstances and user needs and therefore led to a better outcome." (Student 62)

The mindset of DT as a process played a significant part in transforming how students solve problems in general and approach sustainability problems.

4.1.4. Practice Sustainability as a Verb and Not a Noun

This mindset was developed to encourage students to avoid bringing preconceived ideas to sustainability problem-solving. This is grounded in an often-cited idea from Wilkinson and Cary [30]: "We face a dynamic process where the starting point cannot be a fixed idea of sustainability; rather, it must be a social consensus we consider unsustainable." This point of view aligns with the human-centeredness of DT [61]. The roots of the approach are from the work of Sustainability Transitions, which focuses on developing shared strategies for change based on a shared consensus of the needs of people affected by the change [26,82]. The programme-educated students to see sustainability as a contested concept and context-dependent. Students realised that to implement solutions, they needed to move from preconceived expectations to understanding their users, as illustrated by this reflection:

> *"We need to take the human element as the core of our research. It was not easy to understand before creating the solution because the natural reaction is to come up with a solution that it was ideal but for our own standards and ideas. " (Student 50)*

This mindset assumes no right answer for sustainability, and the topic is too complex [83] (CITE) to know everything; instead, it requires continual education. This is captured here:

> *"One of my main ambitions in taking this on was to educate myself further on the topic of sustainability ...I also come away feeling comfortable that its [sic] not really possible to know it all and that it's a continual process of education and change." (Student 34)*

The excerpt below captures the essence of the mindset. The students were working with the ESD committee of a large company. Their assumption is that the committee knew everything about sustainability. Here is what they learned illustrating that practising sustainability is a verb, demonstrating the mindset:

> *"Testing our first solution wasn't as expected. Instead of start testing our solutions we found ourselves obliged to do some teaching materials to the company Team to get the company team involved and engaged. I was expecting them to know more about sustainability as an ESG committee. I was a bit against spending our time and energy on doing some teaching and explanation to demonstrate why this solution until I realised this is the only way to get them involved and make real impact happens." (Student 43)*

The mindset was also intended to focus people on solutions and avoid preconceived attitudes [84], for example, doom and gloom. The intention was to empower students to act in a capacity, however large or small. The mindset supports reframing sustainability as an opportunity to innovate, as these quotes illustrate:

> *"If we look at climate change as totally 'doom and gloom' with insurmountable problems we will throw our hands up in defeat—me included. If we change the language to show what can be achieved with actions, people are more likely to listen, react positively, and do something." (Student 87)*

The reflections highlight the mindset's focus on listening to and empowering people to act and how students put Wilkinson and Cary's [30] call into practice.

4.1.5. Preparing People for the Future

This mindset is intended to focus students on identifying stakeholders' needs so they develop solutions. The core idea is grounded in the original Brundtland [85] call to action: "Meeting the needs of current stakeholders". It also sought to counterbalance the misconception that sustainability is just about the environment. The focus on people is intended to link it to DT, a human-centred method. An essential part of this mindset is thinking broadly about sustainability (i.e., environmental, social, and economic).

> *"One aspect of the diploma that really challenged my thinking was reframing the concept of sustainability and the environment to being connected and part of a bigger system which are all interlinked. It is part of a system that we all as humans contribute to and are responsible for." (Student 73)*

The mindset is a reminder that SD is a new development process, not just the greening of capitalism (or any other form of government) [86]. Thus, how we define sustainability must start with achieving human well-being within planetary boundaries [87]. This is reflected in this quote:

> *"This course has also led to a renewed thirst for learning in this space of innovation and sustainability, and helping me and others play some part in making the world a better for us all, and our future generations—even if it is only one grain of sand at a time, and fuelled a belief in the power of making real change in this world and for our collective futures on this planet." (Student 3)*

With this mindset, the students acknowledge the interdependence of environmental and social systems but are focused on supporting people [50]. They develop broader goals of making the world a better place.

4.1.6. Use the SDGs to Frame Sustainability

The programme promotes this mindset because the SDGs have emerged as a typical (yet contested) way to understand sustainability [88]. Sustainability can be an abstract idea. Students are taught that the SDGs are "a way" to consider what constitutes human well-being. Similar to the UN's "The SDG Partnership Guidebook," the focus is on getting people engaged with broad goals rather than individual targets [89]. The use of SDG as a framework gives students a foundation, as this example illustrates.

> *"I am enthusiastic about continuing to develop my knowledge in this subject, and I'm convinced that through partnering with others, utilising the SDGs as a framework, taking action, and actively practising sustainability, I'll create a sustainable mentality." (Student 26)*

SDGs are widely understood and can be used immediately to communicate sustainability [12]. Adding this mindset helped students at personal and professional levels to understand and support others in understanding sustainability, as illustrated below:

> *"In terms of filling my gaps and knowledge I feel I gained more of a deeper understanding about ecosystems and how to use the Sustainable Development Goals to tell a sustainability story." (Student 40)*

> *"The 17 Sustainable Development Goals provide a universally recognised platform in which companies can communicate their sustainability performance and targets to stakeholders, consumers, and employees. The SDG's help businesses build trust and collaboration with peers, governments, customers, and society." (Student 45)*

The SDGs are increasingly used to define what "doing good" means in business [90]. Thus, students are using the SDGs as a common language, which has been adopted broadly by for-profit, non-profit, and governmental organisations.

4.2. Achieving Sustainability Literacy

Sustainability literacy refers to the perspectives and insights that help students understand SD's interconnected environmental, social, and economic aspects [91]. Looking at the literature and our practice, we developed a version of sustainability literacy with three learning outcomes (LO). Communicating literacy as the goal was essential because many students thought they would become experts with the programme (consisting of only four modules). Framing the programme learning outcomes as sustainability literacy set realistic expectations and aligned our teaching activities. Literacy was framed as a sustainability-literate person around (1) understanding the core principles of environmental and social systems (systems thinking), (2) understanding how to make informed and responsible decisions, and (3) understanding how to assess scientifically credible information.

To demonstrate LOs, students submitted the following work: in Module 2, a Climate Change Adaptation Plan and Reflection. In Module 3, Sustainability Report and Reflection; in Module 4 (the final module), a project report covering their 3-month sustainability changemaker project and a reflection. Modules 2 and 3 also included class lectures in which the relationship between LOs and class material was clearly explained. Below are the results of the LOs detected in the final reflection. Table 2 presents the indicative strength of the pattern for sustainability literacy based on aggregated student reflection analysis [71].

Table 2. Strength of the pattern for sustainability literacy.

The core principles of environmental and social systems	11
How to make informed and responsible decisions (e.g., toolsets and methods)	8
How to assess scientifically credible information	4
TOTAL	23

4.2.1. Understand the Core Principles of Environmental and Social Systems (and How They Interact)

Systems thinking is a competency for sustainability [31]. To develop students' ability to engage in system thinking, the LOs understand the core principles of environmental and social systems (and how they interact) was set. Systems thinking is necessary to recognise cascading effects, minimise unintended consequences, and evaluate trade-offs [92]. These concepts were introduced in modules 2 and 3, which covered environmental systems and human systems, respectively. Students recognised that systems thinking requires a shift in mindset:

"Embracing sustainability requires a collective effort and a shift in mindset. By recognizing the interconnectedness of our actions and the potential of innovative solutions like [by product] utilization, we can move towards a more sustainable and resilient future." *(Student 60)*

"From the outset, I was drawn to this course by the promise of exploring innovative solutions to some of the most pressing environmental and social challenges we face today. Little did I know just how much this course would expand my understanding of sustainability and inspire me to think creatively about the possibilities for positive change." *(Student 64)*

The quotes also show that students connected DT to systems thinking (e.g., creative techniques) [93]. They are focused on identifying solutions to environmental and social problems. This shows a shift from accepting a problem to seeing it as a chance for innovation. Some students were more precise about describing the interconnectedness and demonstrating a holistic view of systems:

"The environment and our social systems are deeply intertwined. To make changes and disrupt current patterns and norms it helps to utilise Systems View models to understand the current structures. [iceberg model]." *(Student 45)*

"Engaging in the "Innovations for Sustainability" project broadened my perspective on sustainability challenges and the interconnectedness of various stakeholders. By examining the [deleted] industry's environmental impact, I developed a holistic understanding of the need for innovative solutions that balance economic growth, social responsibility, and environmental stewardship." *(Student 17)*

Students now understand that addressing sustainability problems effectively will require efforts to balance socio-economy-environments perspectives simultaneously. They recognised that social and environmental systems were interconnected [91] as these students share:

"I always cared about the environment, but the course deepened my understanding of the interconnectedness between human actions and the health of our planet." *(Student 1)*

Governance was critical in discussing social systems and the need to guide human behaviours. This was emphasised in this reflection:

"The role of Governance is essential to the connection of human behaviour and social systems. Corporate Governance ensures firms make balanced and ethical business decisions and cultivates a culture of integrity and considers how their processes and business actions impact societies wellbeing." *(Student 45)*

Although the programme focused on developing students' systems thinking competencies, they developed related sustainability competencies such as Normative and Anticipatory Competencies [31] as these illustrate:

> *"From completing the course I've learned to see sustainability equally as an ethical responsibility for me as an individual, consumer and person working in business, and also as a huge opportunity to innovate."* (Student 56)

> *"To innovate in sustainability, we must examine our lifestyles, consumption behaviours and patterns, and the impact of our actions on the planet and on future generations. This examination prompts us to identify the unsustainable practices and systems that perpetuate environmental degradation, resource depletion, and social inequities. It compels us to question the prevailing economic models that prioritize growth at the expense of environmental sustainability and social well-being."* (Student 31)

A core idea promoted in the class was connecting human well-being and ecosystems [94]. Focusing on understanding the core principles of environmental and social systems (and how they interact) supported students in developing a core sustainability competency—systems thinking. In addition, using reflection as a learning tool supported students in making connections by seeing systems in the broadest context.

4.2.2. Understand How to Make Informed and Responsible Decisions

This learning outcome was intended to be an umbrella category that exposes students to tools and frameworks used to understand and measure sustainability. Sustainability requires new methodologies and conceptual frameworks to address sustainability challenges in new and transformative ways, not just advanced work in traditional disciplines [95]. Hence, the programme introduces students to new methods, for example, LCA, Carbon Footprinting, DPSIR, Water Footprinting, Planetary Boundaries, etc. At a high level, students learn about the various tools used to measure sustainability and support decision making, which is seen as sustainability literacy [48]. Tools/methodologies are something students can take away from building their abilities as these two quotes show:

> *"I now feel better equipped to contribute to meaningful discussions and make informed decisions that align with sustainable practices."* (Student 1)

> *"...I feel that I now understand the main principles, the UN SDGs, the main tools for calculations and for monitoring existing and future commitments."* (Student 85)

Students find tools useful in operationalising sustainability [39]. It is one thing to speak of ecosystem services being impacted by climate change and another to give tools to measure human impacts, as this quote illustrates:

> *"The lifecycle and carbon footprint analysis were also really helpful in gaining an overview of the more technical and practical sustainability skills. That knowledge helped me during the development of the Sustainability Report for the [organisation]."* (Student 40)

> *"This course has already created tangible growth in my career. Producing a sustainability report for [organisation], building a deeper understanding of climate change and the tools and frameworks for measuring, reporting, and reducing impact gave me confidence and the baseline understanding needed to get my new job..."* (Student 84)

The above demonstrates, as was set out, sustainability literacy, "the knowledge, skills, and mindsets that help compel an individual to become deeply committed to building a sustainable future and allow him or her to make informed and effective decisions to this end" [32]. The tools were explored in other assessments, such as the sustainability report. As part of the more extensive programme, the tools contributed to building students' confidence and empowering them. Student reflection shows how this LO was met.

4.2.3. Understand How to Assess Scientifically Credible Information

The programme reinforced students' critical thinking by setting a learning objective to help them recognise scientifically credible information [96]. This also helps students recognise the perspective of the discourse offered by competing views on sustainability [27]. Social media and, more broadly, the internet information knowingly or unknowingly promote greenwashing. Conversely, factual information is sometimes called "Fake News". This is also a critical change for students, given that they depended heavily on information in newspapers and social media, which was not always accurate. Students reported developing skills to recognise or evaluate the veracity of information, for example:

"In addition, I developed skills in evaluating scientifically credible information and effectively communicating about sustainability. This is especially important in today's world where there is a lot of misinformation and greenwashing. Being able to distinguish reliable sources and communicate clearly and credibly has given me confidence in advocating for sustainability and making well-informed decisions." (Student 26)

"The course brought to light how to recognise or at least [sic] try to recognise scientifically credible information. Investigation steps that I will carry with me. 1. Are there expertise involved in the production of this information? 2. Has a recognisable/legit (+sustainable) body produced this/funded this? 3. Is supporting data available?" (Student 53)

Students felt that these skills gave them confidence in selecting and communicating information, as this student indicates:

"Recognising the importance of scientifically credible information, I conducted a review of the literature to gain a better understanding of the issues of GHG emissions from livestock production, particularly from the dairy sector." (Student 46)

There are many claims about how livestock farming contributes to climate change. This reflection shows that the student did not uncritically accept or deny assertions and looked for credible methods in dairy farming [96].

"The course really helped when it came to communicating about science in a meaningful way, not solely from the teaching aspect, but also from having a diverse cohort of ages and backgrounds in the class. We had bankers, bakers and sailors in the class—thus lots of different knowledge and backgrounds." (Student 53)

The last reflection shows how the students recognised they were engaging in various discourses around sustainability based on classmates' backgrounds [27]. The reflections show how students developed a more critical approach to information, ensuring it was credible and considering the source(s).

4.3. Creative Confidence

A core concept of changemakers is a bias to action [2]. Although mindsets are developed, a student's (creative) confidence influences an individual's effectiveness. DT is a cumulative process transforming the learner [22]. Therefore, elements of creative confidence share some similarities with mindsets and learning outcomes. As discussed above, creative confidence consists of creative agency and creative self-efficacy; both were detected in students' reflections after the class. Table 3 presents the indicative strength of the pattern for creative confidence based on aggregated student reflection analysis [71].

Table 3. Strength of the pattern for creative confidence.

Creative Agency	8
Change Agent	8
Creative Self-Efficacy	5
TOTAL	21

4.3.1. Creative Self-Efficacy

As discussed, creative self-efficacy is an individual's belief in their ability to perform a task or activity. A major source of creative self-efficacy is DT, which builds students' confidence by being a structured process [40]. These concepts were shared in the following:

"The appreciation that I got from both [mentors] gave me confidence that I have indeed applied what I have learnt from them during this course. I would highly recommend this course to anyone looking to make a good change to the society. I am glad that I was able to attend this course and successfully complete it as I made this sustainable change to my company." (Student 67)

"... the journey itself was exciting, scary at times, as I suppose my confidence was growing throughout the course ...And now, having gone through the entire 4 modules and going through sustainability reports and being more confident...I then had the confidence to start reaching out to others within my [organisation] to actually get buy in and figure out what they were doing..." (Student 18)

A vital ingredient for developing confidence is creating an environment with psychological safety. DT builds confidence by being a structured process, and the mindset of trusting the process is developed in the students [97]. The DT process also includes the various scaffolded exercises through which students learn the process, as shared here:

"Using the design thinking process, I went forward and back many times, but now have a deep knowledge of what our stakeholders value, their feelings on our project and our organisational culture. It has given me a new found confidence in our abilities as a [organisation] to deliver more." (Student 75)

"...it was great to have the mentor sessions prior to the final project as it created an understanding that [facilitators] were there to help us achieve rather than 'test us'. It created the important 'psychological safety' that we had worked on in our first week." (Student 13)

The excerpt from a student below highlights how sustainability was connected to the structured process (as highlighted above) and how DT created a context that helped their confidence, providing a structure for sustainability:

"The course and final project has given me the appropriate language and knowledge around sustainability to allow me to make more informed decisions, influence other and better understand the most appropriate course of action to take. In my professional life this was a gap previously and hindered my ability to speak about sustainability in my way that I felt was persuasive for others." (Student 72)

It is important to remember that creative self-efficacy is an emergent outcome resulting from all the programme elements coming together [51,61] instead of being a one-off, as reflected by the students' end-of-programme reflections.

4.3.2. Creative Agency

The second element of creative confidence is creative agency (i.e., the ability of the student to apply their creativity) [59]. Creative agency is interpreted as practising sustainability in future projects or roles. Again, it can be seen as an outcome of the entire process to which the mindset bias to action contributes. There was compelling evidence from students' reflections. These students are explaining that they will have more agency going forward based on what they learned in the programme:

"successfully bringing a Design Thinking process to life within the [organisation] process gives me confidence to incorporate Design Thinking into future projects that I will be involved in." (Student 31)

"It has given me the confidence to believe in my ability as a leader, as a catalyst for change and for positive action in my company as it applies to sustainability, but also just in how I interact with other people and the whole design thinking concept..." (Student 24)

The programme was scaffolded to give students assessments in the second and third classes, creating a foundation to undertake their final project in the fourth class [43]. The structure helped students build creative agency, as these excerpts indicate:

". . . I have gained some tools and some genuine insights into how to approach real life issues and feel confident that I can make a difference into the future." (Student 25)

"My confidence in my ability to deliver future projects and use design thinking methodology has increased substantially as a result of this course." (Student 55)

The following quote shows how learning through a structured programme was essential to building their confidence to act (creative agency).

"I grew in confidence, through doing the project—I learnt by doing." (Student 21)

The preceding quotes suggest that the students will apply what they learned in future actions, indicating creative agency. When combined with creative self-efficacy, the creative agency produces the creative confidence necessary to produce changemakers.

4.3.3. Changemakers

As stated above, we defined changemakers as people with a bias to action, strong sustainability values, and a wide range of skills and competencies, which they apply to create sustainability transitions on individual, organisational, and systems levels [2]. Students were required to complete a three-month-long sustainability project. There were 75 projects completed, making the final project an indicator of achieving creative confidence (agency and self-efficacy), which ultimately supported them in acting like a changemaker. Students highlight how they built confidence and achieved their desired goals [24,51]:

"It is a testament to the programme to see the knowledge gained over the past months turned into actions and solutions to sustainability problems." (Student 10)

"This was a real challenge for me as it meant I was going to have to push myself beyond the quiet speaking [individual] I am into someone who's more confidence and more authority, especially in the sustainability space." (Student 12)

This quote showed that the students realised their efforts fit into a more extensive system but were important [2]. Developing creative confidence by completing the final projects, students felt they were changemakers making a difference in the world. Below illustrates these feelings:

"Even as small a grain of sand counts as part of the global movement to embrace serious global challenges, and to achieve each of our sustainable development goals, and to recognise that all of us, as individuals, communities and nations have our parts to play in achieving these goals by 2030. This project reflects one tiny little part of the global matrix or tapestry—but one that is I believe equally important and valuable force for positive change it delivers." (Student 3)

". . . I'll be taking the information on sustainability and the knowledge that I have learned as a strong foundation to build on to build on in my career to make a contribution to my workplace and to the world around me. . ." (Student 24)

Below are specific examples showing that students became changemakers. Many projects were grounded in the "real world". The programme prepared them, and they used their final project as a change project, as quoted here:

"For the purpose of this project I plan to build on the actions already implemented and develop areas further." (Student 48)

"It was important for me to base my project on something that would make a positive change in real life and one that I could continue to work on long after finishing the course." (Student 13)

The student's quote illustrates this paper's core idea and the programme about TL and DT. Students need to develop new skills and mindsets, which contribute to building their confidence to act as sustainability changemakers [24].

> *"It also shifted my personal viewpoint and mindset. In my first reflection on this course, I was writing about my struggles with anxiety. The course helped me to empower myself to step outside of my comfort zone and contribute to a meaningful change in promoting sustainability. The final project and the entire course have allowed me to upskill in a real-world situation."* (Student 26)

Through the course, the students experienced the process of developing creative confidence, resulting in perceiving themselves as changemakers. As discussed above, becoming a changemaker relied on the entire process (see Figure 1) to occur.

5. Discussion and Conclusions

Society faces significant problems, from climate crisis to persistent poverty, for which changemakers are needed to help transition to a sustainable society. This study ponders the question: "What is the value of combining DT and TL as a pedagogy in sustainability education?" We explored the impacts of the "Nurturing Sustainability Changemakers Pedagogy" model on cultivating sustainability changemakers in the context of early- and mid-career professionals. This research purpose is closely aligned with calls from UNESCO and others in the literature for detailing the ESD intervention (e.g., learning outcomes, pedagogy, etc.) and examining the effectiveness of ESD in encouraging student agency toward SD [18,98].

The model establishes critical components needed in pedagogy to create changemakers who can lead a transition to a sustainable society. It shows that DT pedagogy creates a learning environment and processes for achieving TL [39]. Empirical data from student reflections and teaching observation found that the pedagogical model supports transforming (1) mindsets and (2) sustainability literacy. With the newly gained mindsets and literacy, students gained creative confidence to act on sustainability issues, independent of students' backgrounds and level of experience in sustainability before they participated in the programme.

This work helps advance the research and practice of ESD in the higher education context in several ways. First, we directly contribute to the field by developing a novel ESD pedagogical model. The framework describes in detail (see Figure 1) how various DT and TL pedagogical components work together to support learning outcomes that foster the development of sustainability changemakers. Therefore, we contribute to helping address the ongoing challenges students, educators, programme administrators, and funders face concerning the ambiguity of ESD interventions [10,99]. Together with current attempts (e.g., [100]), we suggest a pedagogical format of sustainability education interventions, which might serve as a reference point for future research (to refine the theoretical model further) and practice (to replicate or upscale teaching and learning activities).

Second, we extend traditional ESD competencies (i.e., knowledge, skills, and attitudes), arguing that mindsets and creative confidence are equally important to solving sustainability problems. This insight is crucial and in line with recent research in both mindset literature and ESD literature. Mindset transformation is a beacon for future behaviours (Ade, 2018) [73]. We provide empirical evidence to advocate for the concept of mindset over intrapersonal competencies [9]. This assertion is grounded in the explanation of TL offered by Hoggan [76], which argues that it causes shifts in thoughts, feelings, actions, and even consciousness. All these suggest that the process is more profound than just acquiring a competency. This study found that mindset changes in six elements in the context of this research. These mindset changes emerged due to students practising DT and TL.

This study has several limitations. First, to the best of our knowledge, this exploratory study is among the first to examine the impacts of combining TL and DT as a pedagogy in ESD. However, this research is exploratory in nature, giving ample space for future research. Education intervention affects learners differently and under different conditions [101]. Consequently, we suggest future studies to open the backbox of the ESD Programme. For instance, this can be carried out by focusing on the explanatory mechanisms by which ESD produces specific impacts. There is a need for an in-depth understanding of the possible mechanisms (explanations) that connect specific activities/pedagogies (as learning triggers) with the different impacts and phases of the student learning process for different groups of learners. Future students must also identify the conditional context where ESD works best to produce targeted positive outcomes.

Secondly, this research, heavily dependent on the qualitative method, fits well with the research question yet poses challenges to the internal and external validity. Future research should expand the research design and employ an experiment/quasi-experiment design that includes control groups. In addition, the sample includes a narrow student segment in early-/mid-career from a single case of an ESD Programme in Ireland. If the findings can be expanded to other segments, they should be explored.

Thirdly, future research should also consider examining ESD's longer-term impacts on multiple analysis levels within a longer time frame following the end of the ESD Programme by using a longitudinal approach. This is a missing piece in the study due to time limits. With a newly gained mindset, skillset, and creative confidence, how (and if) do these new learnings translate well into actions and benefit students' individual well-being or career development? What factor explains why graduates from the same cohort perform differently long after the end of the course? What can be the potential organisational/economic/social impacts, etc.? All these mentioned questions are essential to answer.

Appendix A

First-order codes	Second-order codes	Aggregate theme

- Bias to Action:
- Design Thinking is a process:
- Radical Collaboration:
- Practice Sustainability as a verb and not a noun:
- Use the SDGs to frame Sustainability:
- Preparing people for the future:

→ Mindset transformation

- Understand the core principles of environmental and social systems (and how they interact):
- Understand how to assess scientifically credible information:
- Understand how to make informed and responsible decisions

→ Developing sustainability literacy

- Creative self-efficacy
- Creative agency
- Changemakers

→ Developing Creative Confidence

Foundation for sustainability changemakers

References

1. UNESCO. *Education for Sustainable Development Goals: Learning Objectives*; UNESCO Publishing: Paris, France, 2017.
2. Buhr, M.; Harms, D.; Schaltegger, S. Individual change agents for corporate sustainability transformation: A systematic literature review. *Benchmarking Int. J.* 2023, *ahead-of-print*. [CrossRef]
3. Price, E.A.; White, R.M.; Mori, K.; Longhurst, J.; Baughan, P.; Hayles, C.S.; Gough, G.; Preist, C. Supporting the role of universities in leading individual and societal transformation through education for sustainable development. *Discov. Sustain.* **2021**, *2*, 49. [CrossRef]
4. Rieckmann, M. Future-oriented higher education: Which key competencies should be fostered through university teaching and learning? *Futures* **2012**, *44*, 127–135. [CrossRef]
5. Sammalisto, K.; Sundström, A.; Von Haartman, R.; Holm, T.; Yao, Z. Learning about sustainability—What influences students' self-perceived sustainability actions after undergraduate education? *Sustainability* **2016**, *8*, 510. [CrossRef]
6. Weiss, M.; Barth, M. Global research landscape of sustainability curricula implementation in higher education. *Int. J. Sustain. High. Educ.* **2019**, *20*, 570–589. [CrossRef]
7. Wiek, A.; Withycombe, L.; Redman, C.; Mills, S.B. Moving Forward on Competence in Sustainability Research and Problem Solving. *Environment* **2011**, *53*, 3–13. [CrossRef]
8. Wiek, A.; Kay, B. Learning while transforming: Solution-oriented learning for urban sustainability in Phoenix, Arizona. *Curr. Opin. Environ. Sustain.* **2015**, *16*, 29–36. [CrossRef]
9. Brundiers, K.; Barth, M.; Cebrián, G.; Cohen, M.; Diaz, L.; Doucette-Remington, S.; Dripps, W.; Habron, G.; Harré, N.; Jarchow, M.; et al. Key competencies in sustainability in higher education—Toward an agreed-upon reference framework. *Sustain. Sci.* **2021**, *16*, 13–29. [CrossRef]
10. Lozano, R.; Merrill, M.Y.; Sammalisto, K.; Ceulemans, K.; Lozano, F.J. Connecting Competences and Pedagogical Approaches for Sustainable Development in Higher Education: A Literature Review and Framework Proposal. *Sustainability* **2017**, *9*, 1889. [CrossRef]
11. Gordon, I.; Bawa, K.; Bammer, G.; Boone, C.; Dunne, J.; Hart, D.; Hellmann, J.; Miller, A.; New, M.; Ometto, J. Forging future organizational leaders for sustainability science. *Nat. Sustain.* **2019**, *2*, 647–649. [CrossRef]
12. Redman, A.; Wiek, A. Competencies for Advancing Transformations Towards Sustainability. *Front. Educ.* **2021**, *6*, 785163. [CrossRef]
13. Cortese, A.D. The critical role of higher education in creating a sustainable future. *Plan. High. Educ.* **2003**, *31*, 15–22.
14. Mogensen, F.; Schnack, K. The action competence approach and the 'new' discourses of education for sustainable development, competence and quality criteria. *Environ. Educ. Res.* **2010**, *16*, 59–74. [CrossRef]
15. Sinakou, E.; Donche, V.; Van Petegem, P. Action-orientation in education for sustainable development: Teachers' interests and instructional practices. *J. Clean. Prod.* **2022**, *370*, 133469. [CrossRef]
16. Sipos, Y.; Battisti, B.; Grimm, K. Achieving transformative sustainability learning: Engaging head, hands and heart. *Int. J. Sustain. High. Educ.* **2008**, *9*, 68–86. [CrossRef]
17. Brundiers, K.; Wiek, A.; Redman, C.L. Real-world learning opportunities in sustainability: From classroom into the real world. *Int. J. Sustain. High. Educ.* **2010**, *11*, 308–324. [CrossRef]

18. UNESCO. *Education for Sustainable Development: A Roadmap*; UNESCO: Paris, France, 2020.
19. Moore, J. Is higher education ready for transformative learning? A question explored in the study of sustainability. *J. Transform. Educ.* **2005**, *3*, 76–91. [CrossRef]
20. Geels, F.W. Ontologies, socio-technical transitions (to sustainability), and the multi-level perspective. *Res. Policy* **2010**, *39*, 495–510. [CrossRef]
21. Disterheft, A.; Caeiro, S.; Filho, W.L.; Jabbour, C.; Azeiteiro, U.M. *Sustainability Assessment Tools in Higher Education Institutions: Mapping Trends and Good Practices Around the World*; Springer International Publishing: Cham, Switzerland, 2014.
22. Liedtka, J.; Hold, K.; Eldridge, J. *Experiencing Design: The Innovator's Journey*; Columbia University Press: New York, NY, USA, 2021.
23. Stock, K.L.; Bucar, B.; Vokoun, J. Walking in another's shoes: Enhancing experiential learning through design thinking. *Manag. Teach. Rev.* **2018**, *3*, 221–228. [CrossRef]
24. Avsec, S. Design thinking to enhance transformative learning. *Glob. J. Eng. Educ* **2021**, *23*, 169–175.
25. Kioupi, V.; Voulvoulis, N. Education for Sustainable Development: A Systemic Framework for Connecting the SDGs to Educational Outcomes. *Sustainability* **2019**, *11*, 6104. [CrossRef]
26. Kemp, R.; Rotmans, J.; Loorbach, D. Assessing the Dutch Energy Transition Policy: How Does it Deal with Dilemmas of Managing Transitions? *J. Environ. Policy Plan.* **2007**, *9*, 315–331. [CrossRef]
27. Seatter, C.S.; Ceulemans, K. Teaching Sustainability in Higher Education: Pedagogical Styles that Make a Difference. *Can. J. High. Educ.* **2017**, *47*, 47–70. [CrossRef]
28. Carew, A.L.; Mitchell, C.A. Teaching sustainability as a contested concept: Capitalizing on variation in engineering educators' conceptions of environmental, social and economic sustainability. *J. Clean. Prod.* **2008**, *16*, 105–115. [CrossRef]
29. Mezirow, J. Transformative Learning as Discourse. *J. Transform. Educ.* **2003**, *1*, 58–63. [CrossRef]
30. Wilkinson, R.; Cary, J. Sustainability as an evolutionary process. *Int. J. Sustain. Dev.* **2002**, *5*, 381–391. [CrossRef]
31. Wiek, A.; Withycombe, L.; Redman, C.L. Key competencies in sustainability: A reference framework for academic program development. *Sustain. Sci.* **2011**, *6*, 203–218. [CrossRef]
32. Décamps, A.; Barbat, G.; Carteron, J.-C.; Hands, V.; Parkes, C. Sulitest: A collaborative initiative to support and assess sustainability literacy in higher education. *Int. J. Manag. Educ.* **2017**, *15*, 138–152. [CrossRef]
33. Warren, A.; Archambault, L.; Foley, R.W. Sustainability Education Framework for Teachers: Developing sustainability literacy through futures, values, systems, and strategic thinking. *J. Sustain. Educ.* **2014**, *6*, 23–28.
34. Cohen, M.; Wiek, A.; Kay, B.; Harlow, J. Aligning public participation to stakeholders' sustainability literacy—A case study on sustainable urban development in Phoenix, Arizona. *Sustainability* **2015**, *7*, 8709–8728. [CrossRef]
35. VanWynsberghe, R.; Herman, A.C. Education for social change and pragmatist theory: Five features of educative environments designed for social change. *Int. J. Lifelong Educ.* **2015**, *34*, 268–283. [CrossRef]
36. Dlouhá, J.; Heras, R.; Mulà, I.; Salgado, F.P.; Henderson, L. Competences to Address SDGs in Higher Education—A Reflection on the Equilibrium between Systemic and Personal Approaches to Achieve Transformative Action. *Sustainability* **2019**, *11*, 3664. [CrossRef]
37. Rodríguez Aboytes, J.G.; Barth, M. Transformative learning in the field of sustainability: A systematic literature review (1999–2019). *Int. J. Sustain. High. Educ.* **2020**, *21*, 993–1013. [CrossRef]
38. Kolb, A.Y.; Kolb, D.A. Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. *Acad. Manag. Learn. Educ.* **2005**, *4*, 193–212. [CrossRef]
39. Taimur, S.; Onuki, M.; Mursaleen, H. Exploring the transformative potential of design thinking pedagogy in hybrid setting: A case study of field exercise course, Japan. *Asia Pac. Educ. Rev.* **2022**, *23*, 571–593. [CrossRef]
40. Rauth, I.; Köppen, E.; Jobst, B.; Meinel, C. Design thinking: An educational model towards creative confidence. In Proceedings of the DS 66-2: 1st International Conference on Design Creativity (ICDC 2010), Kobe, Japan, 29 November–1 December 2010.
41. Beaty, R.E.; Benedek, M.; Barry Kaufman, S.; Silvia, P.J. Default and Executive Network Coupling Supports Creative Idea Production. *Sci. Rep.* **2015**, *5*, 10964. [CrossRef] [PubMed]
42. Saggar, M.; Quintin, E.-M.; Bott, N.T.; Kienitz, E.; Chien, Y.-H.; Hong, D.W.C.; Liu, N.; Royalty, A.; Hawthorne, G.; Reiss, A.L. Changes in Brain Activation Associated with Spontaneous Improvization and Figural Creativity After Design-Thinking-Based Training: A Longitudinal fMRI Study. *Cereb. Cortex* **2017**, *27*, 3542–3552. [CrossRef] [PubMed]
43. Pirolli, P.; Youngblood, G.M.; Du, H.; Konrad, A.; Nelson, L.; Springer, A. Scaffolding the mastery of healthy behaviors with fittle+ systems: Evidence-based interventions and theory. *Hum.-Comput. Interact.* **2021**, *36*, 73–106. [CrossRef]
44. Reiser, B.J.; Tabak, I. Scaffolding. In *The Cambridge Handbook of the Learning Sciences*, 2nd ed.; Sawyer, R.K., Ed.; Cambridge University Press: Cambridge, UK, 2014; pp. 44–62. [CrossRef]
45. Liedtka, J. Perspective: Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction. *J. Prod. Innov. Manag.* **2015**, *32*, 925–938. [CrossRef]
46. Dell'Era, C.; Magistretti, S.; Cautela, C.; Verganti, R.; Zurlo, F. Four kinds of design thinking: From ideating to making, engaging, and criticizing. *Creat. Innov. Manag.* **2020**, *29*, 324–344. [CrossRef]
47. Matsuo, M.; Nagata, M. A revised model of experiential learning with a debriefing checklist. *Int. J. Train. Dev.* **2020**, *24*, 144–153. [CrossRef]

48. Viegas, C.V.; Bond, A.J.; Vaz, C.R.; Borchardt, M.; Pereira, G.M.; Selig, P.M.; Varvakis, G. Critical attributes of Sustainability in Higher Education: A categorisation from literature review. *J. Clean. Prod.* **2016**, *126*, 260–276. [CrossRef]

49. Elsbach, K.D.; Stigliani, I. Design Thinking and Organizational Culture: A Review and Framework for Future Research. *J. Manag.* **2018**, *44*, 2274–2306. [CrossRef]

50. Bryant, J.; Ayers, J.; Missimer, M. What transforms?—Transformative learning in a sustainability leadership master's program. *Int. J. Sustain. High. Educ.* **2023**, *24*, 231–251. [CrossRef]

51. Wright, N.; Wrigley, C. Broadening design-led education horizons: Conceptual insights and future research directions. *Int. J. Technol. Des. Educ.* **2019**, *29*, 1–23. [CrossRef]

52. Barth, M. Many roads lead to sustainability: A process-oriented analysis of change in higher education. *Int. J. Sustain. High. Educ.* **2013**, *14*, 160–175. [CrossRef]

53. Liedtka, J. Putting technology in its place: Design thinking's social technology at work. *Calif. Manag. Rev.* **2020**, *62*, 53–83. [CrossRef]

54. Frantzeskaki, N.; Wittmayer, J.; Loorbach, D. The role of partnerships in 'realising' urban sustainability in Rotterdam's City Ports Area, The Netherlands. *J. Clean. Prod.* **2014**, *65*, 406–417. [CrossRef]

55. Auernhammer, J.; Roth, B. The origin and evolution of Stanford University's design thinking: From product design to design thinking in innovation management. *J. Prod. Innov. Manag.* **2021**, *38*, 623–644. [CrossRef]

56. Debebe, G. Creating a Safe Environment for Women's Leadership Transformation. *J. Manag. Educ.* **2011**, *35*, 679–712. [CrossRef]

57. Kwon, C.-k.; Han, S.-h.; Nicolaides, A. The impact of psychological safety on transformative learning in the workplace: A quantitative study. *J. Workplace Learn.* **2020**, *32*, 533–547. [CrossRef]

58. Kelley, T.; Kelley, D. *Creative Confidence: Unleashing the Creative Potential within Us All*; Currency: New York, NY, USA, 2013.

59. Royalty, A.; Oishi, L.N.; Roth, B. Acting with Creative Confidence: Developing a Creative Agency Assessment Tool. In *Design Thinking Research: Building Innovation Eco-Systems*; Leifer, L., Plattner, H., Meinel, C., Eds.; Springer International Publishing: Cham, Switzerland, 2014; pp. 79–96. [CrossRef]

60. Ilgen, J.S.; Eva, K.W.; de Bruin, A.; Cook, D.A.; Regehr, G. Comfort with uncertainty: Reframing our conceptions of how clinicians navigate complex clinical situations. *Adv. Health Sci. Educ.* **2019**, *24*, 797–809. [CrossRef]

61. von Thienen, J.P.A.; Weinstein, T.J.; Meinel, C. Creative metacognition in design thinking: Exploring theories, educational practices, and their implications for measurement. *Front. Psychol.* **2023**, *14*, 1157001. [CrossRef] [PubMed]

62. Kijima, R.; Yang-Yoshihara, M.; Maekawa, M.S. Using design thinking to cultivate the next generation of female STEAM thinkers. *Int. J. STEM Educ.* **2021**, *8*, 14. [CrossRef]

63. Roth, K.; Globocnik, D.; Rau, C.; Neyer, A.K. Living up to the expectations: The effect of design thinking on project success. *Creat. Innov. Manag.* **2020**, *29*, 667–684. [CrossRef]

64. Yin, R.K. *Case Study Research: Design and Methods*, 4th ed.; Sage: Thousand Oaks, CA, USA, 2009.

65. Flick, U. *The Sage Handbook of Qualitative Data Collection*; Sage: Thousand Oaks, CA, USA, 2017; pp. 1–736.

66. Walshe, N. Exploring and developing student understandings of sustainable development. *Curric. J.* **2013**, *24*, 224–249. [CrossRef]

67. Gioia, D.A.; Corley, K.G.; Hamilton, A.L. Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. *Organ. Res. Methods* **2013**, *16*, 15–31. [CrossRef]

68. Miles, M.B.; Huberman, A.M.; Saldaña, J. *Qualitative Data Analysis: A Methods Sourcebook*, 3rd ed.; Sage: Thousand Oaks, CA, USA, 2014.

69. Saldaña, J. The coding manual for qualitative researchers. *Qual. Res. Organ. Manag. Int. J.* **2016**, *12*, 169–170.

70. Strauss, A.; Corbin, J. *Principles of Qualitative Research Methods: Basic Theory, Procedures and Methods, Translated by Beuck Mohammadi. Tehran*; Institute of Humanities and Cultural Studies: Tehran, Iran, 2014.

71. Miles, M.B.; Huberman, A.M. *Qualitative Data Analysis: An Expanded Sourcebook*; Sage: Thousand Oaks, CA, USA, 1994.

72. Zsóka, Á.; Ásványi, K. Transforming students' behaviour preferences: Achievable changes by a sustainability course. *Int. J. Sustain. High. Educ.* **2023**, *24*, 141–159. [CrossRef]

73. Ade, V.; Schuster, C.; Harinck, F.; Trötschel, R. Mindset-Oriented Negotiation Training (MONT): Teaching More Than Skills and Knowledge. *Front. Psychol.* **2018**, *9*, 907. [CrossRef]

74. Schumacher, T.; Mayer, S. Preparing Managers for Turbulent Contexts: Teaching the Principles of Design Thinking. *J. Manag. Educ.* **2018**, *42*, 496–523. [CrossRef]

75. Shrivastava, P.; Ivanaj, S.; Persson, S. Transdisciplinary Study of Sustainable Enterprise. *Bus. Strategy Environ.* **2013**, *22*, 230–244. [CrossRef]

76. Hoggan, C. A typology of transformation: Reviewing the transformative learning literature. *Stud. Educ. Adults* **2016**, *48*, 65–82. [CrossRef]

77. Becken, S.; Coghlan, A. Knowledge alone won't "fix it": Building regenerative literacy. *J. Sustain. Tour.* **2022**, *32*, 1–17. [CrossRef]

78. Hennessey, E.; Mueller, J. Teaching and learning design thinking (DT). *Can. J. Educ./Rev. Can. De L'éducation* **2020**, *43*, 498–521.

79. Hölzle, K.; Rhinow, H. The dilemmas of design thinking in innovation projects. *Proj. Manag. J.* **2019**, *50*, 418–430. [CrossRef]

80. Dadswell, K.; Sambol, S.; Yager, Z.; Van Dyke, N.; Pascoe, M.; Dallat, C.; Brown, C.; Parker, A.G. Together we grow: Evaluation of a design thinking professional development workshop for outdoor educators indicates improvements in growth mindset. *J. Adventure Educ. Outdoor Learn.* **2022**, 1–13. [CrossRef]

81. Buhl, A.; Schmidt-Keilich, M.; Muster, V.; Blazejewski, S.; Schrader, U.; Harrach, C.; Schäfer, M.; Süßbauer, E. Design thinking for sustainability: Why and how design thinking can foster sustainability-oriented innovation development. *J. Clean. Prod.* **2019**, *231*, 1248–1257. [CrossRef]

82. Loorbach, D.; Frantzeskaki, N.; Avelino, F. Sustainability Transitions Research: Transforming Science and Practice for Societal Change. *Annu. Rev. Environ. Resour.* **2017**, *42*, 599–626. [CrossRef]

83. Wyness, L.; Dalton, F. The value of problem-based learning in learning for sustainability: Undergraduate accounting student perspectives. *J. Account. Educ.* **2018**, *45*, 1–19. [CrossRef]

84. Gaziulusoy, A.İ.; Boyle, C.; McDowall, R. System innovation for sustainability: A systemic double-flow scenario method for companies. *J. Clean. Prod.* **2013**, *45*, 104–116. [CrossRef]

85. Brundtland, G.H. Our common future—Call for action. *Environ. Conserv.* **1987**, *14*, 291–294. [CrossRef]

86. Frantzeskaki, N.; Loorbach, D.; Meadowcroft, J. Governing societal transitions to sustainability. *Int. J. Sustain. Dev.* **2012**, *15*, 19–36. [CrossRef]

87. Rockström, J. A safe operating space for humanity. *Nature* **2009**, *461*, 472–475. [CrossRef] [PubMed]

88. Venkiteswaran, V.; Cohen, M. Digital storytelling and sustainable development goals: Motivating business students to engage with SDGs. *Soc. Bus.* **2018**, *8*, 411–428. [CrossRef]

89. Stibbe, D.; Prescott, D.; Desa, P.I. The SDG Partnership Guidebook. A Practical Guide to Building High Impact Multi-Stakeholder Partnerships for the Sustainable Development Goals. Partnering Initiative and UNDESA 2020. Available online: https://sustainabledevelopment.un.org/content/documents/26627SDG_Partnership_Guidebook_0.95_web.pdf (accessed on 23 October 2023).

90. Olwig, M.F. Sustainability superheroes? For-profit narratives of "doing good" in the era of the SDGs. *World Dev.* **2021**, *142*, 105427. [CrossRef]

91. Winter, J.; Cotton, D. Making the hidden curriculum visible: Sustainability literacy in higher education. *Environ. Educ. Res.* **2012**, *18*, 783–796. [CrossRef]

92. Redman, E. Advancing Educational Pedagogy for Sustainability: Developing and Implementing Programs to Transform Behaviors. *Int. J. Environ. Sci. Educ.* **2013**, *8*, 1–34.

93. Wiek, A.; Iwaniec, D. Quality criteria for visions and visioning in sustainability science. *Sustain. Sci.* **2014**, *9*, 497–512. [CrossRef]

94. Clark, W.C.; Harley, A.G. Sustainability Science: Toward a Synthesis. *Annu. Rev. Environ. Resour.* **2020**, *45*, 331–386. [CrossRef]

95. Miller, T.R.; Muñoz-Erickson, T.; Redman, C.L. Transforming knowledge for sustainability: Towards adaptive academic institutions. *Int. J. Sustain. High. Educ.* **2011**, *12*, 177–192. [CrossRef]

96. Kricsfalusy, V.; George, C.; Reed, M.G. Integrating problem- and project-based learning opportunities: Assessing outcomes of a field course in environment and sustainability. *Environ. Educ. Res.* **2018**, *24*, 593–610. [CrossRef]

97. Jaskyte, K.; Liedtka, J. Design thinking for innovation: Practices and intermediate outcomes. *Nonprofit Manag. Leadersh.* **2022**, *32*, 555–575. [CrossRef]

98. United Nations General Assembly. Transforming our World: The 2030 Agenda for Sustainable Development. UN Doc. A/RES/70/1. 2015. Available online: https://sdgs.un.org/2030agenda (accessed on 23 October 2023).

99. Lotz-Sisitka, H.; Wals, A.E.; Kronlid, D.; McGarry, D. Transformative, transgressive social learning: Rethinking higher education pedagogy in times of systemic global dysfunction. *Curr. Opin. Environ. Sustain.* **2015**, *16*, 73–80. [CrossRef]

100. Evans, T.L. Competencies and pedagogies for sustainability education: A roadmap for sustainability studies program development in colleges and universities. *Sustainability* **2019**, *11*, 5526. [CrossRef]

101. Pawson, R.; Tilley, N. An introduction to scientific realist evaluation. In *Evaluation for the 21st Century: A Handbook*; Sage: Thousand Oaks, CA, USA, 1997; pp. 405–418.