Irish Journal of Management • 43(1) • 2024 • 39-58
DOI: 10.2478/ijm-2024-0013

Irish Journal of **Management**

The impact of climate entrepreneurship education in higher education institutions: a university-wide climate entrepreneurship programme

Research Article

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Received: 15 February, 2024; Accepted: 22 January, 2025

Abstract: Scholars are grappling with what educational and pedagogical approaches are needed to create sustainable entrepreneurs able to cope with sustainability challenges. This paper explores the impact of a student-focused climate entrepreneurship education initiative (CEE) in Technological University Dublin (TU Dublin). The paper draws on models and frameworks in the literature that integrate programme objectives and pedagogical methods with impact. The paper addresses two key questions. Firstly, how are students impacted by CEE in terms of the affectedness, skills development and the intention to start a climate enterprise. The second question asks how different types of interventions in CEE influence student impact. The study contributes to the emerging body of literature on sustainability enterprise education (SEE) by firstly, showing interventions needed to embed climate impact into a customer value proposition; secondly, suggesting a simplicity paradox for stronger SEE impact; and thirdly, offering insights for designing CEE programmes for university-wide impact.

Keywords: *Sustainability entrepreneurship education; entrepreneurial intentions and behaviour; climate*

INTRODUCTION

Universities across the world are now important partners in the achievement of the United Nation's (UN) Sustainable Development Goals (SDGs). In many universities, supporting the SDGs has become a pillar of university strategy (Leal Filho *et al.*, 2019). Corresponding to the UN's call to action through the SDGs, the European Commission (EC) has communicated clearly on the need for more entrepreneurial higher education institutions (HEIs) (EC-EIT, 2021). The importance of entrepreneurship in addressing social, environmental and economic hurdles is central to achieving the SDGs (Gyimah *et al.,* 2023). Globally, for more than a decade there has been growing recognition of the potential for entrepreneurship to provide solutions to societal and environmental challenges, drawing together an innovative enterprise sector that is dynamic and focused on sustainable development (Anand *et al.*, 2020; Klapper *et al.,* 2021; Muñoz and Cohen, 2018; Shepherd *et al.*, 2021).

Despite growing interest in sustainability enterprise education (SEE), the lack of integration of sustainability aspects in entrepreneurship education is often criticised (Rosário and Raimundo, 2024; Hörisch *et al.,* 2019; Kickul *et al.,* 2018). Several key challenges emerge from the literature. The change towards recognising the contribution of entrepreneurial or enterprising education approaches to solving sustainability problems is happening predominantly in business schools (Jones *et al.,* 2013; Wyness and Jones, 2019). This gives rise to a 'silo mentality' whereby

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other faculties are reluctant to effectively engage, embed and collaborate with this agenda. Wyness and Jones (2019) highlight that sustainability educators have mixed but predominantly negative or absent attitudes towards entrepreneurship and its perceived value towards sustainability, creating an additional barrier for SEE. For HEIs to fulfil their role as sustainability models and leaders, a strong organisational culture needs to be established (Leal Filho *et al.*, 2019). For this to happen, substantial changes towards developing a new set of values and behaviours are critical (Adams *et al.*, 2018) and to effect change, sustainability principles (e.g. curricula, modus operandi) need to be at the heart of these changes (Žalėnienė and Pereira, 2021; Niedlich *et al.,* 2020). Educator capacity is required to cross disciplines and collaborate to achieve organisational goals. Thus, universities require a cultural shift involving growth in the number of sustainability educators within the field of Education for Sustainable Development (ESD) to embrace entrepreneurial concepts.

A further challenge is that there is no consensus on what capabilities education should provide to create sustainable entrepreneurs able to cope with sustainability challenges (Rosário and Raimundo, 2024). SEE differs from conventional entrepreneurship at the level of both values and praxis in the need to emphasise not only profit maximisation, but also society and the natural environment (Klapper and Fayolle, 2023). Studies show that the link between students' entrepreneurial intentions and orientation towards sustainability could be negative or insignificant (Kuckertz and Wagner, 2010; Wagner, 2012; Baber *et al.,* 2024). This debate highlights the more complex and considered approaches needed to create impact on economic, social, and environmental dimensions (Muñoz and Cohen, 2018; Gimenez-Jimenez and Harc, 2024). Lastly, context, social factors and pedagogical approaches are important to understand impacts of SEE when considering studies within different geographic contexts. Notably, SEE is not always shown to shape attitudes and intentions to start a green business (Prabowo *et al.*, 2022; Rosário and Raimundo, 2024; Baber *et al.,* 2024). Thus, adopting sustainable behaviours is challenging because it involves culture in terms of values and attitudes (Johnson and Hörisch, 2021; Wyness *et al.,* 2015).

These challenges lead us to the current study, which explores a climate entrepreneurship programme (CEP) in a technological university, Technological University Dublin (TU Dublin). The studied CEP involved multiple interventions for students between July 2021 and June 2023. The programme responds principally to UN SDG4 Quality Education and UN SDG13 Climate Action. CEP was part of a larger European consortium project (Inno-EUt+) funded by the EC through EIT Climate-KIC. The overarching objective of the CEP was '*to develop inclusive joint formal and informal entrepreneurial curricula to encourage our students (Undergraduate and Postgraduate - UG/PG) and researchers to think like entrepreneurs and seek to find value propositions to local and societal challenges in a sustainable way*'. Drawing on frameworks that link objectives and pedagogy to impact (Aadland, 2023, Nabi *et al.*, 2017, Kirkpatrick, 1996), the study sets out to answer two main questions. Firstly, how are students impacted by CEE in terms of the affectedness, skills development and the intention to start a climate enterprise. The second question asks how different types of interventions in CEE influence student impact. Findings from the study make several contributions. The study contributes to the emerging body of literature on SEE by firstly, showing interventions needed to embed climate impact into a customer value proposition; secondly, by suggesting a simplicity paradox for stronger SEE impact; and thirdly, by offering insights for designing CEE programmes for university-wide impact. Recommendations for educators and policy makers are also developed.

The next section presents the context for the case study of TU Dublin explaining a sustained period of cultural change over the period from 2019-2024. This is followed by our literature review, the methodology section and the findings. The paper finishes with a discussion outlining the theoretical and practical contributions, concluding with limitations and possibilities for future research.

CREATING A CULTURE OF SUSTAINABLE DEVELOMENT AND ENTREPRENEURIAL MINDSETS IN TU DUBLIN

TU Dublin has publicly stated its aim to become one of the world's most sustainable universities. With around 30,000 students, TU Dublin is Ireland's first and largest technological university. It was formed on 01 January 2019 through the Technological Universities Act 2018. Coinciding with its creation, TU Dublin appointed a new President and within one year, a transformational strategy was launched (Strategic Intent 2030). This strategy was developed through the lens of the UN SDGs with particular focus on SDG4 Quality Education, SDG13 Climate Action, and SDG3 Good Health and Wellbeing. In 2022, TU Dublin launched its Sustainability Statement outlining plans to

embed sustainability into all plans, strategies, policies and everyday operations, as well as within wider eco-system engagement. In March 2023, TU Dublin published its Climate Action Roadmap, with a further iteration issued in June 2024. TU Dublin has committed to be fully decarbonised by 2040 and become Net Zero by 2050. TU Dublin's transformation toward a culture of sustainability is showing success, and the university ranked 29th globally for SDG 13: Climate Action, in the Times Higher Education 2024 impact rankings.

Innovation capacity building is fundamental to sustainable development as SEE requires systems thinking and capacity for innovation to emerge through the institution (Avila *et al.,* 2017). Coinciding with TU Dublin's new organisation design, and in addition to Sustainability, three major projects were funded in 2021/2022 within the university's Partnerships function. Firstly, the development of a GrowthHub was funded as a collaborative initiative between TU Dublin and South East Technological University (SETU), funded by the Irish Government. The GrowthHub was intended to act as a centre and starting point for all students in TU Dublin to explore and develop growth thinking skills and entrepreneurial behaviours, regardless of their discipline area. GrowthHub also provides training and programme development educator bursaries, lab supports, CPD opportunities for staff institution wide. In addition, a TU Dublin Enterprise Academy was funded and creates a single-entry point for enterprise to partner with TU Dublin. These entrepreneurship and enterprise engagement initiatives are fostering a culture within TU Dublin of entrepreneurial thinking and better ecosystem engagement both formally and informally. On a European level, TU Dublin joined a European University Initiative with eight other partners (the European University of Technology (EUt+)). EUt+ involvement reinforces TU Dublin's intent on becoming a European University that is an "entrepreneurial entity from the outset". TU Dublin is now 3-4 years into all these initiatives. Together, they help transform and foster a solution-oriented SEE capability for the global challenges faced and support technological and innovative advances that will help society to thrive.

LITERATURE REVIEW

Scholars wrestle with theoretical and pedagogical approaches that might lead to successful outcomes from SEE (Rosário and Raimundo, 2024). There is room for investigating the impact of diverse pedagogical approaches and tools and in exploring their effect on learners and the overall impact of such teaching on the wider organisational and societal context (Klapper and Fayolle, 2023). The importance of linking objectives and pedagogical approaches to research outcomes and impact is highlighted in numerous studies on entrepreneurship education as an under researched area (Aaland, 2024; Nabi *et al.*, 2017; Pittaway and Cope, 2007), including those connecting to SEE (Rosário and Raimundo, 2024; Klapper and Fayolle, 2023). While SEE impact studies give important insights (e.g., Baber *et al.*, 2024; Contreras and Rodríguez, 2015; Vuorio *et al.*, 2017), they often have conflicting results in areas such as attitudes on green entrepreneurship, the intention to start a green enterprise, or SEE on sustainability orientation (Gimenez-Jimenez and Harc, 2014; Kuckertz and Wagner, 2010). Transformative learning approaches may be required to better enable students to produce ethical change and to improve innovative teaching and learning, yet there remains relatively little research on SEE implementation and impact (Klapper and Fayolle, 2023). Both Aaland (2024) and Nabi *et al.* (2017) remind us that most studies on impact have unclear and vaguely described goals and definitions. Moreover, educational designs influence outcome measures differently (Walter and Dohse, 2012). When studying impact on SEE participants, researchers should consider context, objectives and pedagogical approaches in impact evaluation, so that insight can be gleaned from studying, 'what do we do and why do we do it?' (Aaland, 2024; Nabi *et al.*, 2017).

Defining Sustainability Entrepreneurship Education

Mainstream entrepreneurship education is moving towards a broader perspective that targets all students to foster their entrepreneurial skills, regardless of their study discipline or their future employment (Varghese *et al.,* 2016). SEE represents an evolution of entrepreneurship that differs from other concepts of entrepreneurship in that it combines both sustainable and economic goals (Ploum *et al.,* 2017). The main objective of SEE is to provide entrepreneurs with the capabilities to seize business opportunities by considering sustainability issues (Kirby *et al.,* 2022). Adopting sustainable behaviours is challenging because it involves cultural shifts in values and attitudes (Wyness and Jones, 2018; Gimenez-Jimenez and Harc, 2024). It also requires capabilities to deal differently with novel situations where prior experience may not apply (Deets *et al.,* 2020; Ploum *et al.,* 2017). SEE

therefore requires the summoning of the existing entrepreneurial culture and sustainability, while interplaying with environmental, economic, and social disciplines (Rosário and Raimundo, 2023, p. 4).

Innovative pedagogical approaches for SEE in HEIs

O'Flaherty and Liddy (2018) take the view that there is room in SEE research for alternative pedagogical approaches, emphasising that different learning outcomes need to be matched with correspondingly different evaluation criteria and educational methods. Studies on SEE tend to focus on, or have a combined focus on, pedagogical approaches drawing heavily on modern entrepreneurship education that emphasises experimentation and inclusion (Siqueira *et al.,* 2015; Obrecht, 2018). The literature reveals diverse models for SEE including; problem solving case studies (Contreras and Rodríguez, 2015), active innovation methods (Deets *et al.,* 2020), institutional design of entrepreneurship curricula towards embedding sustainability (Wyness and Jones, 2018), whole of society participatory approaches (Hörisch *et al.*, 2019), international and inclusion design features and contexts (McQuillan, 2024), transformative learning pedagogies (Klapper *et al.,* 2024), and progression model approaches (Klucznik-Törő, 2021). These are not entirely distinct from Nabi *et al.*'s (2017) synthesis of pedagogical methods for teaching EE more generally involving reproduction methods, demand and participative methods, and competence building methods. However, SEEs innovative pedagogical features draw on the peculiarities and whole-society demands that need more careful attention to context, ecosystems, participatory and interdisciplinary approaches. For example, SEE problem solving case studies help create learner-centred and problem-based learning in authentic scientific, social, and technological contexts. They can help identify driving factors of sustainable entrepreneurship and social entrepreneurship including leadership characteristics, challenges to start-up sustainable enterprises, and the development of business models involving expansion of the value proposition to include social, environmental, and multi-stakeholder partnerships (Krige *et al.,* 2019; Contreras and Rodríguez, 2015). In addition, active innovation methods that may involve design thinking, experiential learning, effectuation combined with the concepts of sustainability, entrepreneurship, and innovative education (Rosário and Raimundo, 2024) can entice SE perspectives. With active innovation methods, students are encouraged to address social and environmental issues in complex business situations (Siqueira *et al.*, 2015).

Including sustainability in the entrepreneurship curricula enables students to gain early knowledge about UN SDGs and to develop a sense of self-efficacy that they can make a difference through entrepreneurship (Hörisch *et al.*, 2019; Sharma *et al.*, 2024). Design thinking principles are particularly useful for SE educators to facilitate student learning in, for example, the development of social ventures, by invoking consideration of innovation, impact, and sustainability (Kickul *et al.*, 2018). Encouraging a whole-society response through participatory approaches can help students understand the interplay of the ecosystem and the application of theory-based frameworks in a diversity of social contexts, and through learning from real life (Hörisch *et al.*, 2019).

Studies also show inequalities that exist globally that impact on SDGs (Gyimah *et al.*, 2023), and the OECD (2023) identifies groups of 'Missing Entrepreneurs' as groups who have challenges that are a barrier to entrepreneurship. Contextual and inclusion approaches to SEE that include international dimensions or non-traditional groups, support student understanding of the effects of under-representation, interculturality and intersectionality in entrepreneurship. This method may be disseminated through communities of practice turning educators into agents of collaboration and interaction (Wyness *et al.*, 2015). Collectively, innovative pedagogical approaches for SEE in HEIs offer the potential for transformative learning; this paradigm-shifting approach enables learners to critically reflect on their existing frames of reference and beliefs and transform them into new ways of understanding and problem solving through a reframing of issues (Mezirow, 2000). SEE adopts transformative learning approaches that seem to particularly draw on the heuristic framework of Sipos *et al.* (2008), and the Head, Hands and Heart (HHH) framework (Klapper *et al.*, 2024; Klapper and Fayolle, 2023). Drawing on these and other insights, Klucznik-Törő (2021) advances a new progression model approach for entrepreneurship education integrating sustainability. This model envisages student learning in phases, starting with a broad definition of entrepreneurship and a narrower definition in subsequent phases. The progression model approach encourages more active and experiential pedagogies, with subsequent phases emphasising skills development focused on behaviour (Lackéus, 2015). This model guides the current study.

Impact of Sustainability Entrepreneurship Education

A review of the SEE literature on impact reveals a broad and fragmented range of insights on impact including; impact to start a business or intention to start a business (Baber *et al.,* 2024), transforming mindsets

(Klapper and Fayolle, 2023), impact on sustainability orientation (Kuckertz and Wagner, 2010), improving ecological impacts (Rosário and Raimundo, 2024), impact of extrinsic and intrinsic rewards (Vuorio *et al.*, 2017). Our literature review identified 57 impacts from SEE initiatives that consider individuals and their broader education and environment. The lack of a cohesive framework that can facilitate sense making and demonstrate successful student outcomes within higher education initiatives is missing, leading us to the current study.

Impact can be measured in a myriad of ways as both pedagogical and methodological issues underpin impact in terms of outcomes. For example, the impact of EE on students can be short term (e.g., subjective measures, such as measures on entrepreneurial attitudes and intentions) or long term, such as venture creation behaviour and business performance (Nabi *et al.,* 2017). The impact on attitudes and behaviours can have positive and negative outcomes (Dickson *et al.,* 2008; Martin *et al.,* 2013). The nature and context of pedagogical interventions as well as contextual factors can be linked to impact outcomes (Pittaway and Cope, 2007). Nabi *et al.* (2017) identify the main types of impacts for EE to be firstly in a group of personal change involving attitude including; emotion and mindset, skills and knowledge, feasibility and entrepreneurial intention. These can be classified as lower-level impacts (Shinnar *et al.* 2014). At best, these kinds of impacts increase the chances of entrepreneurial endeavours later in a student's life, but these outcome measures show little about how students' progress towards starting up a venture. Nevertheless, expecting that EE meets a high rate of contemporaneous start-ups during or soon after educational inventions is perhaps unrealistic (Aadland, 2023). Entrepreneurship often occurs later in a student's career (Marshall and Gigliotti, 2020), so attitude change may be of value (Nabi *et al.,* 2017).

A second (higher level) impact group relate to business impact, and they include business start-up and performance and socioeconomic impacts. Aadlund (2023) attempts to address the dearth of research on longer-term impacts of EE and focuses on post-graduation activities of alumni. He addresses the question around the design of a well-working practice and the impact of the education. Like Nabi et al. (2017), Aadland (2023) stresses the need to consider the objectives of the effort in focus, taking EE goals into account, in order to understand impact. Introducing Kirkpatrick's (1996) model for evaluating education in the context of EE, Aadland (2023) presents a framework that spans multiple levels of evaluation (reaction and learning plus behaviour and results), with clear guidelines for each level. In Aadland's framework, the first set of objectives of EE are affective, and can include behavioural goals in terms of student activities, or can include results-based activities to help measure impact on student performance. The second set of objectives seeks to meet skills-based objectives, while the final set of objectives are start-up objectives, with measures and activities that can again be behavioural or results based. Notably, we know from Kuckertz and Wagner (2010) that sustainability orientations can wane over time as individuals get more business experience, reinforcing the value of setting sets of objectives that are both behavioural and results based.

METHODOLOGY

Research design – exploring impact from innovative CEP pedagogies

The aim of this research is to explore the impact of CEE on student's behaviours and results. Objectives of educational interventions need to be clear to identify appropriate outcome measures to fully explore impact (Aadland, 2023). Further, different pedagogical or educational approaches supporting such objectives might influence the learning outcomes have on students (Hagg and Gabrielsson, 2020; Klapper *et al.,* 2024; Nabi *et al.*, 2017). As discussed in the literature review, Aadland (2023) proposes consideration of impact based on behaviours or activities and results or performance within three evaluation levels of affective objectives. One limitation of this framework is that it is intended to give insights into long term entrepreneurial behaviours and results from registry data. Nabi *et al.*'s (2017) model complements the framework by emphasising levels of impact indicators, including during an educational intervention and pre/post intervention. Their model underpins pedagogy to impact, focussing on describing pedagogies being tested and appropriate levels of indicators depending on time. Thus, this paper adapts the models and frameworks of Aadland (2023) and of Nabi *et al.* (2017) to explore the impact of CEE on student's behaviours and results. This helps to explore the multiple interventions that formed the CEP adding a more constructivist aspect to the study.

Evidence base and sample

The evidence base is essentially that of a single case study, with the case being the CEP. Single case studies can be a person, a group, a programme, an institution or even a policy (Ellinger *et al.*, 2005; Merriam and Tisdell, 2015).

As with most case studies, the purpose of the design is to provide an in-depth, detailed account of the processes in question, rather than to definitively generalise from the specifics of those processes. Scholars underscore that case study research is methodologically eclectic and open to various approaches of data collection beneficial to address a broad range of issues and for triangulation (Merriam, 1998; Ellinger *et al.,* 2005). To eliminate data collection bias, we used multiple sources for each training intervention in the CEP. For example, on pitch presentations we listened to the recorded pitches, but also collected questionnaire data after completion plus testimonials. It was possible to capture multiple sources of data collection from the 9 C/EE interventions that formed part of the CEP (Fig. 1).

The CEP's main student intervention was an eight-step multinational Climate Start-up Pitch programme that equated to 12 educator- contact hours and 38 hours self-directed learning. This was complimented with formal and informal opportunities that helped to attract students onto the program. This approach also facilitated interventions that helped to progress students' climate start-up ideas beyond the programme (Fig. 1). The CEP involved a number of qualitative data collection opportunities. These included online and in-person focus groups with students at the end of each international student event, review of reflective journals maintained by students travelling, review of meeting minutes with staff at the beginning and end of each intervention, student storyboards on ideation, recorded video pitches of business ideas, video recordings by students of their international experiences to share with peers, photographs with detailed narratives on climate awareness. Data was collected and stored on a password protected computer with a codebook developed to list and describe all codes used. Individuals were given codenames aligned to their gender, storyboards were photographed and coded numerically, video pitches were given code names consistent with themes. Photographs from the Climate Awareness Competition were publicly exhibited with the permission of participants, and code names that are used are aligned to gender in the presentation of the narratives.

The Climate Start-up Pitch CEP Programme - CSPC

The studied CEP education programme draws heavily on ClimateLaunchpad (https://climatelaunchpad.org/), the world's largest green business ideas competition which is part of Climate-KIC, a large-scale initiative focused on climate innovation. The ClimateLaunchpad workbook was developed by Blazer *et al.* in 2020 to help support participants entering the global ClimateLaunchpad competition. The programme adopts active innovation pedagogical approaches including experiential learning to create a recorded 6-minute climate start-up pitch by a team of students. Each team must conceptualise a product and value proposition for a defined target market, undertake customer research and embed feedback, formulate a financial plan and assess climate impact as a core value proposition of the product. Tools and templates are provided throughout the programme to assist students develop their pitch presentation. The programme objectives are listed in Table 1 (below).

In this programme, the climate impact requirement emerges from the beginning. In module 1, a climate impact 'dream' of each founding individual is translated into a target (e.g., reduce plastic in ocean by 10% by 2024), with the potential to produce revenue. The emphasis on climate impact in subsequent modules becomes more implicit. In module 3 - Market Segmentation - the focus becomes one of meeting the needs of the customer while recognising

Figure 1: Formal and informal student curricula of the Climate Entrepreneurship Programme

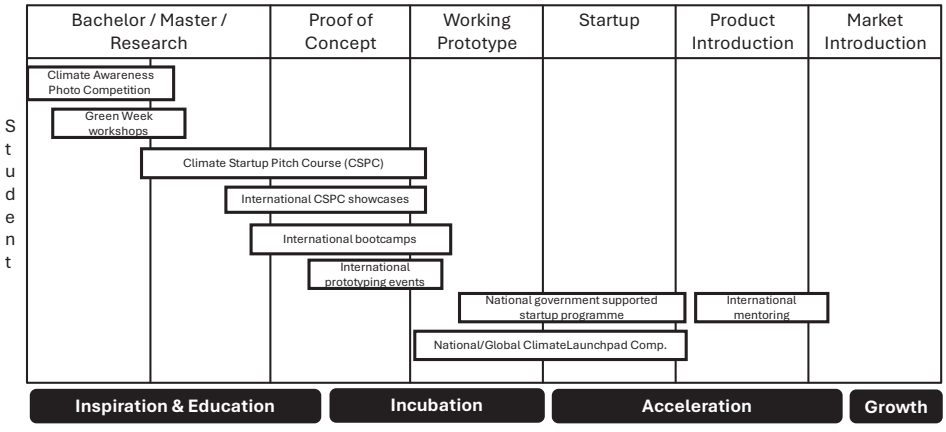

Figure 1: Climate entrepreneurship programme data.

Table 1: CEP interventions, participations, means, objectives, progression phase

Intervention	Participants	Means	Objectives	pre/post program
Climate awareness photo competition	38 photos from students and staff and 100+ attendants at exhibition.	Awards evening and exhibition.	Building climate change awareness. Promoting CSPC.	Foundation
Green week workshops	87 students attended in 2022; 40 students attended in 2023	Two-hour workshop during green week with follow up to complete CEP pitch (2022)	Learn to describe and communicate climate enterprise ideas. Explore synergies between complementary and similar business ideas to form founder teams. Communicate and negotiate own green enterprise start-up skills and those that might need to be acquired from others.	Foundation
CSPC rollout for students	410 students trained on the CEP programme	8 modules over semester leading to video recorded climate start-up 'pitch'	Learn the fundamentals of successfully starting a business. Build a basic start-up business case for a climate enterprise. Pitch the climate enterprise start-up business case in a professional and convincing manner to participants, trainers, and coaches.	CSPC
International showcase events for CSOC students (x 2)	6 students involved in two international showcase events in Spain (online) and Latvia	2 x 2-day events with 8 other international partners	Grow international mindset. Advance climate start-up pitching skills. Intercultural and transdisciplinary team learning and competency development.	Progression
International boot camps	11 students travelled for 10-day boot camp in Romania. 4 students and one staff attended Netherlands	10-day boot camp and 2 day bootcamp	Intercultural and transdisciplinary team learning and competency development. Advance innovation and entrepreneurship knowledge and skills. Develop entrepreneurial mindset.	Progression
International prototyping event	6 students over two international events (Latvia and Cyprus)	2 x 2-day international events	Develop prototyping skills. Intercultural and transdisciplinary team learning and competency development. Meet and listen to the experiences of entrepreneurs and site visits. Learn about entrepreneurial failure.	Progression
Global ClimateLaunchpad Competition	2 CSPC student pitches	Competitions held once per year in 2022 and 2023	Developing and refining the green business idea. Coaching support and mentoring to perfect green business pitch, value proposition, and develop the business model.	Progression
National government supported start-up programme	1 start-up from CEP	3 phase programmes over 6 months	Equip start-ups with the right connections, the right skills, and the right route to capital to grow and sustain a successful business.	Progression
International mentoring	1 start-up from CEP	6 hours international mentoring each.	Start-up support to bring business to next level.	Progression

that “ethical criteria might be part of the buying decisions of customers” In module 4 - Customer Value Proposition – students are advised that “one of the first tests of customer value proposition is emotions”. While this approach is common to all EE start-up training, this programme implicitly encourages students that opportunities might exist to create customer value with climate impact.

A full module is dedicated to the consideration of Climate Impact (Module 8). Here, students are reminded of the competitive nature of business and relatively weak position of the student’s start-up. They are encouraged to identify and assess the foregrounding of customer needs, stating that “the only truly crucial thing you really need for a business is a paying customer” (ClimateLaunchpad Workbook, p. 74). Two approaches guide the low carbon features of a product or service into the customer value proposition: firstly, highlighting to customers that the student product is much more environmentally friendly than the product of its substitutes. Secondly, highlighting to customers that the use of the student’s product by the customer is more environmentally friendly than the solution the product it replaces (for example, if a customer replaces a diesel-powered jeep with an electric one). Students are encouraged to show these differences in calculated CO2 emissions savings, or the carbon dioxide equivalent, by working through the customer value chain using each option.

Programme Participants

In total, 410 students completed the programme over two years, involving 310 undergraduate students, 95 master’s students and 5 PhD students. 179 of these students were female and 231 were male. 94% were between 18-24 years old. 23% of students were from Engineering and Construction; 14% were from Sustainability Management Programmes; 25% were from Entrepreneurship/General business programmes; 9% were from finance and economics programmes; 19% were from product design and media programmes; and 9% were pharmaceutical students.

The programme was delivered in a variety of different ways across different faculties in TU Dublin. Many undergraduate students completed the programme as part of a mandatory assessment embedded into disciplinary and multidisciplinary entrepreneurship modules as part of degree programmes over a one semester. A small number of students, including 5 PhD students, completed the programme through extra-curricular participation supported through online seminars, regular weekly drop-ins and mentoring from TU Dublin’s GrowthHub. Other students completed the programme through block delivery over a two-day period as a co-curricular activity where multidisciplinary teams were created to complete the programme and develop the pitch.

Foundational interventions to attract students onto, and roll out the program

The programme was developed and agreed as a deliverable within the Inno-EUt+ initiative. The first ‘Train the Trainer’ session for the delivering the programme was organised in October 2021 where partners including TU Dublin recruited individuals that might voluntarily be interested in the adoption of the programme within their school, faculty, or department. Within the obligations of Inno-EUt+, TU Dublin was committed to train 385+ students over two years. Cohorts included all levels of undergraduate, postgraduate and research students. This recruitment process involved extensive networking and discussions with staff across faculties, schools and innovation centres to promote the student and staff training programs.

To help raise awareness about the importance of climate start-up training and to inspire students to participate in the programme, two inspiration and education interventions were developed for students (See Table 1). Firstly, a Climate Awareness Photo Competition that was open to students and staff. An exhibition and awards night was held in January 2023 attended by over 100 students and staff, and 39 photo contributions were displayed. This provided good networking opportunities across the university faculties and different campuses. The second set of interventions was the development of workshop events during TU Dublin’s ‘Green Weeks’ in March 2022 and March 2023. 87 students attended the Green Week workshops in 2022 and 40 students attended in 2023. These events were delivered across campus and involved a ‘Founders Dream’ event in March 2022 that helped students map ideas and build team collaboration. A similar ‘Green Dragon’ event was held in March 2023 with similar objectives. These were foundational workshops that helped students to cover groundwork related to the programme and to inspire educators to consider using the programme within their modules.

Progression opportunities for students following programme completion

To inspire and motivate students to progress on their climate start-up journey, the CEP involved a number of customised interventions that were open to all members of the Inno-EUt+ consortium across Europe. These

involved international showcase events and whereby the winning teams' from local programme pitches each semester had the opportunity to travel to present their pitch and to engage in a programme of green entrepreneurship focused events, supported by Inno-EUt+. International bootcamps and prototyping workshops were also created. Students were exposed to national opportunities, including introductions to New Frontiers, Ireland's national entrepreneur development programme that provides a range of supports, including mentoring, masterclasses, networking opportunities, and funding, all aimed at helping participants build and grow their companies. Students with a pitch could also enter the global Climatelaunchpad competition, where they could hone their skills. Preparation for this competition was further facilitated through TU Dublin's GrowthHub as National Lead for ClimateLaunchpad since 2022. A summary of those progression opportunities, objectives, participations and means is outlined in Table 1 below.

FINDINGS

The findings link the research objective; *to explore the impact of a student-focused climate entrepreneurship education initiative*). Table 2 (below) summarises the CEP objectives, pedagogies and impact. Illustrative quotes enrich our understanding and interpretation of the phenomena (Jick, 1979) and offer thematically description and conceptual interpretation of the data. They give participants a voice while contributing to the credibility and transparency of the research (Morrow, 2005).

Foundational interventions to attract students onto the CSPC

Climate Awareness Photo Competition - This Competition was designed with a hybrid transformative learning approach involving artistic and reflective writing methods and a 'whole society' approach, with guest talks and expert attendance at the exhibition. Permission was requested for further exhibition of the photos in different formats. This intervention was found to be inspirational and motivational for students to progress to other interventions (Table 2), as illustrated in quotes included in student and faculty submissions:

> "This picture was taken at Sorrento Hill Park, Dalkey. It shows the obvious beauty surrounding that area, but the isolated bench and moody clouds above bring a feeling of apprehension, which can relate to the current feelings brought by climate change. The other title I wanted to give this photo was "you're late, the show's already begun" to also explain how, although climate change isn't obvious in areas like this, sit long enough and it will absolutely be apparent in time. This photo would fall into the category of Community, as beauty spots bring people together and really show, at a base level, why we should ALL be caretakers of our surrounding lands. It's our habitat as much as the wild flora and fauna; we're one big community." (Jane)

> "Our seas, our pollution, our Fish, their habitat. I shot this video in Howth Harbour last July. I was stunned at the vivid colours of the jellyfish, then I noticed what they were swimming in. This is something that can be fixed, not just in Howth but all around our beautiful Island. Let's do it." (Ed)

Green Week workshops - These interventions helped students to quantify and communicate their ideas and to create diverse teams. Feedback highlights the benefit of cross-discipline engagement, *"a great event. Personally, I was delighted to be involved and especially the experience of working with another discipline." (Ade).*

CEP innovative pedagogical approaches applied in these foundational interventions resulted in significant affective, skills based and start-up objectives impact, as summarised in Table 2.

The impact from the Green Week workshops emerged from the creative expression by students of their ideas, both verbally and through multimedia storyboards. Inspiring students to progress to CPSC was more successful in the second year of the programme, thanks to more carefully crafted supports by educators.

CSPC pitch competition outcomes

The objectives and pedagogical approaches for CSPC are detailed in Table 1 and Table 2. Several common themes emerged in the ideation process from the 38 pitches reviewed.

Table 2: CEP pedagogical approaches and impact

		Affective objectives impact		Skills based objectives impact		Start-up objectives impact	
Intervention	Pedagogical approaches	Behavioural	Result	Behavioural	Result	Behavioural	Result
Climate awareness photo competition	Transformative learning: use of art (photo) method. Reflective statements on photos. Whole society approach: Keynote talk, exhibition with invited guests, meeting entrepreneurs. Progression model: introduction of CSPC and previous winning pitches to encourage progression.	Inspired conversations on climate awareness, photo representation and context. Requests to use / exhibit photos in other places.	Participants identified for Green Week workshops. 2 students intentions to join CSPC	Entering climate competitions.	5 students won photo prize with financial reward.	None	None
Green week workshops (x2)	Active innovation methods: team formations, quantifying ideas. Transformative learning: use of art methods in multimedia storyboarding. Inclusion designs: universal design for learning principles to storyboarding, gender considerations in teams. Progression model: introduction of CSPC and encouragement to join.	Mapped out storyboard of individual climate enterprise dreams. Engaged in trading exercise to develop teams. Presented outcomes to peers and guests.	Each participant has a storyboard and a team formed to progress to CSPC. 8 students (2022) and 40 students (2023) progressed to CSPC.	Quantifying climate enterprise ideas. Communicating ideas verbally and through mixed media.	Students have foundational aspects of CSPC course (Module 1)	None.	None.
CSPC rollout for students (x8)	Active innovation methods: team formations, quantifying ideas, customer discovery, financial planning. Whole society approaches: customer discovery, real world validation. Progression model: to international events or CLP global competition.	Quantified main areas of interest in CE (board games, waste management, transport, building efficiency, energy, low carbon manufacturing)	Improved Attitudes: 3.94 (EI survey). 50% of groups submitted pitches for the chance to progress to international showcase. Two groups progressed to global CLP competition.	Refining The Deal. Converting climate idea into alternative business model. Embedding climate impact into customer value proposition. Basic financial modelling. Designing and delivering customer discovery research. Identifying and calculating CO2 savings for customers. Pitching a climate start-up idea.	Improved Skills: 3.85 (EI survey)	Entrepreneurial intentions.	Overall EI score: 3.74.

(*Continued*)

Table 2: Continued

Intervention	Pedagogical approaches	Affective objectives impact		Skills based objectives impact		Start-up objectives impact	
		Behavioural	Result	Behavioural	Result	Behavioural	Result
International showcase events for CSOC students (x2)	Case study methods: presenting and listening to pitches from other countries. Active innovation methods: working in diverse teams. Whole society approaches: meeting entrepreneurs and policy makers, site visits. Context and inclusion approaches: international context, gender representation, intercultural and transdisciplinary team-based events.	Inspiration and enjoyment of seeing the pitches of other students. Increased awareness of value of transdisciplinary challenge-based team work. Intercultural interest and context awareness.	Students agreed to be ambassadors for the CSPC and shared stories of international experience with peers.	Intercultural awareness. Transdisciplinary team competence building. Advanced pitching skills.	Enhanced knowledge of how to embed climate impact dimension into climate entrepreneurship start-up.	None.	None.
International boot camps (x2)	Active innovation methods: working in cross-country transdisciplinary teams, challenge-based learning on CEE. Whole society approaches: mentoring, co-creating with entrepreneurs, site visits. Context and inclusion approaches: international context, gender representation, intercultural and transdisciplinary team-based events. camping trip. Transformative learning: reflective journalling.	Intercultural interest and context awareness. Increased awareness of value of transdisciplinary challenge-based team work. Building international network.	Students agreed to be ambassadors for the CSPC and shared stories of international experience with peers.	Advanced knowledge and skills measuring climate impact for customers. Intercultural and transdisciplinary team competence building. Development of alternate business modelling for CEE, financial planning and customer discovery skills through new pitching competitions.	Awards for CEE pitching competitions.	Attitude and self-efficacy to start a climate enterprise.	One climate start-up created.
International prototyping events (x2)	Active innovation methods: working in cross-country transdisciplinary teams, experimental prototyping challenges. Whole society approaches: site visits, mentoring from entrepreneurs. Context and inclusion approaches: international context, gender representation, intercultural and transdisciplinary team based events.	Intercultural interest and context awareness. Increased awareness of value of transdisciplinary challenge based team work. Building international network.	Students agreed to be ambassadors for the CSPC and shared stories of international experience with peers.	Basic prototyping skills for green product development based on simple experimental models. Intercultural and transdisciplinary team competence building.	Awards for prototyping competitions.	None.	None.

(*Continued*)

Table 2: Continued

		Affective objectives impact		Skills based objectives impact		Start-up objectives impact	
Intervention	Pedagogical approaches	Behavioural	Result	Behavioural	Result	Behavioural	Result
Global CLp Comp.	Active innovation methods: quantifying CE ideas, customer discovery, financial planning. Whole society approaches: customer discovery, real world validation, mentoring. Progression model: to national, regional, global finals.	Learning, coaching and mentoring from international experts and sponsors in CLP global ecosystem.	Inspiration from expert mentors and companies. Positive attitude towards green value proposition.	Refining The Deal. Converting climate idea into alternative business model. Embedding customer value proposition. Basic financial modelling. Designing and delivering customer discovery research. Identifying and calculating CO2 savings for customers. Pitching a climate start-up idea.	National, Regional, Global awards in CLP.	None.	None.
National government supported start-up programme	n/a	n/a	n/a	n/a	n/a	Training, mentoring, funding and coaching.	One start-up created.
International mentoring	Whole society approaches: expert mentoring. Context and inclusion approaches: international context	International mindset development	Attitude towards looking international for new markets.	Intensive coaching to support skills to move from start-up to acceleration to growth phase.	Knowledge of internationalisation process. Knowledge of accelerating climate start-up.	Progressing from incubation to acceleration.	Inspiration and knowledge to grow and seek international customers.

- *Board Games:* Although the development of new board games has received little attention in SEE, the usefulness of games in the broader literature on sustainable development is recognised (Miller *et al.,* 2019; Tsai *et al.*, 2021). Board games have been found to increase incentives for students to learn and reduce resistance to learning (Lauren *et al.,* 2016). They foster critical thinking and problem solving on complex system concepts (Goon, 2011). A board game creates a small virtual society in which students can learn by trial and error in different scenarios and experiences within a virtual world (Tsai *et al.*, 2021), fostering competitive and collaborative relationships (Cheng *et al.*, 2020). In essence the development of board game concepts allowed students to imagine a complex coevolutionary world that fosters experimentation and creative thinking needed for SE, despite limited resources and experience. For undergraduate students in particular this approach was encouraged. Eight groups developed low-cost board games aimed mainly at players within their own age group or younger. 'The Deal' goal was to encourage environmentally friendly and sustainable daily habits of the players. The customer value proposition tended to focus on low cost and simplicity. Including education in the market, a couple of groups also highlighted learning skills of tackling problems in a multitude of ways (for example, thinking outside the box, critical thinking and problem-solving debate skills), all of which are valuable skills for challenge-based learning and SEE. Table 3 summarises one of the board games as an exemplar, highlighting how students developed their pitch. 'House Hero' is a board game involving a dice and categories of cards, developed to avoid harmful environmental habits and encourage more sustainable habits that can save money and reduce their carbon footprint.
- *Waste management products and services:* Waste management products were a popular group for climate enterprise start-up with six products recorded. Mainly they related to community waste but in a business sense. For example, one group's battery powered garbage surveillance equipment monitors when garbage bins are full and need collection. The Climate Impact of this product is a solar powered system that will reduce carbon footprint through more efficient waste collection journeys. Additional power can be sent back to the Grid.
- *Transport products and services:* Themes for more climate impactful transport also featured strongly, including a rental business for e-scooters and helmets in partnership with Dublin City Council and other cities. The customer discovery process suggested the e-scooters could be rented on 30-minute blocks and located through GPS tracking. The Climate Impact for the e-scooter business was suggested to be saving emissions through a battery-operated product and by considering the use of recycled materials in the production and disposal processes. Students identified companies in Belgium and France that could support this proposal.
- *Building efficiency products and services:* Two retrofitting consultancy business ideas were developed for both commercial and residential premises. The customer value proposition is proposed as a lower cost option because the fee will be charged to the retrofitters and not the consumer.
- *Energy saving products and services:* A few projects, especially those that included students from those countries, did consider climate impact projects targeting people in the global south. These students showed foresight on the inequalities and disproportional problems that climate change brings to poorer countries. Products included a solar powered electricity generating system for sub-Saharan Africa and a water purifying system for Pakistani households.
- *Low carbon supply chain products:* One product pitch claimed to reduce waste and improve efficiency in the cardboard manufacturing industry. Customers are small and medium sized businesses in the e-commerce and retail sector that have a high demand for packaging. Small businesses are selected as the beachhead market because they are more resource constrained. This product reduces the need for pre-made boxes because of its cutting and folding mechanism that includes a camera and cutting mechanism that moves to appropriate need. The product is available for sale or rental including maintenance and support services.

Although there was some variation in the quality of the pitches, students demonstrated a baseline understanding of the customer needs and value proposition process, and this extended to the embedding of CO2 reduction opportunities in the value proposition. Pitches also included many uncertainties and assumptions. Notwithstanding, one student group reached the regional finals of ClimateLaunchPad in 2022, with further intense work and coaching offered through that forum. Findings suggest that to achieve more impact and enhance start-up intentions or behaviour, other interventions are needed that involve progression through stages (Fig. 1).

After completing the programme, students were asked to answer a seven-item questionnaire to identify if this training has had an impact on student's capability, attitude, desires and likelihood of engaging in the business start-up process. This was based on a five-point Likert Scale from 1 (totally disagree) to 5 (totally agree), in part adapted

Table 3: Exemplar of CSPC board game pitch – House Hero

CSPC module	Student pitch content
The Deal	- Encourage environmentally friendly and sustainable daily habits.
Target	- Families and young children < 15 years - Marketed across Ireland
Value proposition	- Changing daily habits - Save money and reduce carbon footprint through positive behaviour
Product	- Board / cards / dice / instruction manual - Social / transport / household / chance card questions
Customer discovery	- Users enjoyed aesthetics - Interesting to learn how daily habits impact environment
Financial	- E18.50 - Consideration of shipping
Climate impact	- Educates user - Rewards environmentally positive behaviour and repercussions for negative behaviour - Change daily lives of user
Founders dream	- Create environmentally friendly game that becomes household name - Positive impact on growing climate crisis.)

from Liñán and Chen's 2009 questionnaire on entrepreneurial intentions (EI). Questions included "My attitude towards entrepreneurship has improved" and "I am more aware of the steps to follow to become an entrepreneur". The overall score of 3.74 suggests a mildly positive impact from the training.

Progression opportunities for students from CSPC

To activate progression opportunities, templates were developed to ensure consistency and transparency in scoring. Judging panels were created involving individuals from diverse backgrounds. Several techniques were applied to mitigate potential selection bias in progression opportunities. Opportunities to participate in CEP were promoted widely within TU Dublin through university-wide news forums, transversal departments, and offering staff 'train-the-trainer' opportunities. Pitches were scored together each semester by the panel, irrespective of degree programme or level. There were also opportunities to participate in international bootcamps and prototyping events. These events offered students the opportunity to spend time in a different geographic location, meeting entrepreneurs and other experts and working on transdisciplinary and diverse team challenge-based competitions. The bootcamps involved an intensive multi-day programme of workshops, site visits, mentoring and competitive team events. Students showed clear signs of entrepreneurial intentions upon completion of the bootcamp. They kept reflective journals during the process.

- *International showcase interventions:* Winning teams could attend these events. Students increased their knowledge and skills through sharing winning pitches (cases) and also gained intercultural awareness and team competencies (Table 2). The benefits were articulated by participants, *"I really enjoyed this. It was great to see everybody's ideas and meet people from different programmes." (Carrie).* Upon return these students became ambassadors for the programme, creating videos, sharing stories and experiences.
- *International bootcamp interventions:* This bootcamp was open to students that completed CSPC, but also some students that did not. Insights from the Cluj 10-day Bootcamp showed the value in meeting people from different countries, *"A highlight for me was the diverse teams and meeting new people from different countries" (Sid)*, and enhancement of intent to start a business, *"After I got the chance to travel to Cluj, I developed a start-up with an international team from all around the world" (Leo).* The Leewarden bootcamp exhibited greater understanding of whole society approaches: *"We will definitely continue working on all the feedback received throughout this experience in order to bring our business idea to the next step." (Lana),* and of networking benefits, *"The knowledge, skills, and network gained from this programme will continue to benefit me in my future endeavours in the field of climate entrepreneurship." (Raine)*
- *International prototyping interventions:* The international prototyping event provided students with the opportunity to engage in low fidelity prototypes and simulations. Participants also visited sites and meeting entrepreneurs in whole-society approach. Students gave feedback about getting to know people from different cultures and working in transdisciplinary teams,

"I thought the trip was a very good learning experience for me. The idea generation was very good as well as the simulation. It was also great to meet likeminded people." (Sam)
"What stood out for me was the approaches from people on your team from different programmes, but it all helped in the end" (Mariam)

- *International mentoring:* Just one group progressed to this stage and utilised mentoring opportunity for their start-up. The experience opened opportunities for growth planning and advice about new markets from experienced entrepreneur, *"I was delighted ... I have just had a patent published ... and wanted to explore options to develop. [Mentor] was excellent" (Sig)*

For students, the international experiences afforded the opportunity to build international connections and to work in intercultural and transdisciplinary environments. Many of the students drawn to these international opportunities were from non-traditional ethnic backgrounds and already had an international outlook. More encouragement was needed for students from more traditional Irish backgrounds to engage with these opportunities. Feedback includes recognition of the value of transdisciplinary learning and the value of diverse insights. Through these international activities, students developed SEE competencies and skills and became more vocal about their interests and intentions to start-up a business.

DISCUSSION

Embedding Climate Impact into the Customer Value Proposition

Authors show concern that a positive impact of SEE influencing sustainability orientation or an intention to set up a sustainable enterprise wanes once a student gains business experience (Kuckurtz and Wagner, 2010; Cheng and Adejumo, 2021) and that context is important for SEE in terms of attitudes towards setting up a sustainable enterprise (Prabowo *et al.*, 2022; Baber *et al.*, 2024). While scholars confirm that entrepreneurs need to embed sustainability dimensions (in our case, climate impact) together with cost and other needs into a customer value proposition drawing on real- world discovery and evidence, our experience within the training interventions shows that this approach needs multiple different types of interventions and pedagogical approaches. Students may be introduced to various concepts and tools for combining start-up and sustainability through early training, but building skills to apply in practice is a more gradual process. Sharma *et al.* (2024) alludes to this problem about the need for early understanding about UN SDGs and SEE among students and the importance of university support to influence attitudes and outcome expectation. Levels of impact on climate and possibly other environmental and social dimensions of a product or service need to include carefully phased measures on developing a customer value proposition at different levels (Nabi *et al.*, 2017). The study also highlights new skills needed to develop customer value propositions responding to customer 'pain' through low carbon substitute or alternative products or services (Blazer *et al.*, 2020). Aadland (2023) recognises the skills objectives in EE impact, but in addition to business modelling, customer discovery, pitching and other traditional start-up skills needed, translating sustainability impact such as calculating CO2 reductions for a customer value proposition needs a distinctive skillset on gathering and interpreting complex data that is not emphasised in the literature. Not only students but SEE educators may need expert training and support based on these findings.

A simplicity paradox for Sustainability Entrepreneurship Education

Promoting CEP across different faculties, departments and programmes within TU Dublin allowed some interesting findings to emerge by comparing and evaluating the 8 iterations of the CSPC over the two-year period. CSPC was the core component of the climate entrepreneurship programme and was an intervention that was delivered in different ways to different groups of students whether undergraduate/postgraduate/research, through mandatory and voluntary options and through classroom and hybrid forms of delivery. The development of board game products was an innovative approach, primarily for the simplicity rather than for technological sophistication. It afforded students earlier in their degree programmes the ability to engage in more real-life learning and to reduce the number of assumptions and guesswork needed for the pitch. With board games, peers could be relied on for customer discovery, products are developed as learning tools that complements their current curricula, materials

involved in the manufacture are kept to a minimum and are low tech. Furthermore, products can progress easily to proof of concept and for basic prototyping, as they are mainly paper and cardboard based in real-world examples. Paradoxically, the beachhead markets for such products (mainly educational institutions and local adolescents) are likely too small to motivate commercial start-up beyond prototyping, but the potential to conceptualise the product offers a rich learning experience embedding climate impact and start-up learning along multiple dimensions of the CEP. The board game approach benefits earlier students with very limited real-world enterprise knowledge and experience and still some years away from starting a career.

The literature on SEE does not address the importance of the features of the new product or service for more impactful learning experiences at different levels, thus this study offers insight in context. Paradoxically, even if board games can translate to a good quality climate start-up pitch for relatively inexperienced students, it would be unlikely to commercialise. Yet it is impactful even if meeting start-up objectives for those students in the short term is very unlikely (Marshall and Gigliotti, 2020; Aadland, 2023, Nabi *et al.*, 2017). Studies have drawn on paradoxical thinking and paradox theory in sustainable entrepreneurship (Blok, 2018) and more often for social entrepreneurship (Weller and Ran, 2020; Smith *et al.*, 2012). The emerging literature on SEE does not highlight the importance of paradox in pedagogy (Rosário and Raimundo, 2024). Thus, the recognition of a simplicity paradox in ideation within SEE is new. Paradox as "contradictory yet interrelated elements that seem logical in isolation but absurd and irrational when appearing simultaneously" (Lewis, 2000, p. 760) is a popular approach for theorising across various business domains such as managerial cognition (Miron-Spektor *et al.*, 2018) and practice theory (Knight and Paroutis, 2017). For university-wide SEE programs that are multi/transdisciplinary, drawing on different levels of educational and EE experience, educators should be able to improve impact by drawing on this simplicity paradox for guiding student ideation development.

Design and delivery of a university-wide SEE programme

There are recognised challenges for bringing sustainability and EE together beyond business faculties (Jones *et al.* 2013; Wyness and Jones, 2019). CEP is an example of a programme developed with the flexibility to work as a mandatory or voluntary programme with different delivery formats and options across different domains. This facilitated delivery at different educational levels, within different faculties, and even among multi- and trans- disciplinary groups. The findings show how impactful international, intercultural and transdisciplinary teams are for inspiring students and even fostering university-wide climate enterprise intentions. New studies support the importance of international and intercultural experiences in SEE to bridge local and international entrepreneurial ecosystems crucial to maintaining continuity and engagement amid global disruptions (Laine *et al.,* 2024). Our study shows this to be especially evident in the international intervention opportunities that involve multi-day intensive whole-society approaches. In addition, the impact of foundational interventions to prepare students and to inspire students into the CSPC is also a novel insight not heretofore addressed in the SEE impact literature.

RECOMMENTATIONS FOR EDUCATORS

The findings offer recommendations for educators and higher education institutes that want to develop university-wide SEE initiatives. Firstly, linking objectives to pedagogical approaches and embedding the simplicity paradox will create more impact. It is unrealistic that high numbers of students with no prior enterprise experience will start a business, but students may have a richer and more meaningful real-life learning experience where educators apply this simplicity paradox to ideation. Secondly, SEE needs to be accompanied by suitable foundational and progression opportunities, and it is important to build the links and opportunities between SEE stages. Thirdly, fostering international entrepreneurship networking opportunities has proven valuable. The UN SDGs are global and helping students to build intercultural connections and global mindsets as well as exposing them to transdisciplinary experiences is empowering. Erasmus+ Blended Intensive Programmes is one way to help to fund such initiatives. Fourthly, successful university-wide SEE initiatives need flexibility and multiple design options built into modes and forms of delivery, in addition to dedicated points of contact for support and management for both students and educators.

IMPLICATIONS FOR POLICY MAKERS

Policy makers can support initiatives such as CEP through mindset change, funding and supports. This initiative was funded by EIT of the European Commission with the aim of innovation capacity building in higher education institutes. The university-wide rollout ensured that CEP reached a wide number of people, in particular students who had the opportunity for learning and international travel across a consortium of international partners. Thus, policy makers can support initiatives such as CEP through strengthening local ecosystem partnerships at different stages of progression and supporting the bridging of international entrepreneurial ecosystems.

LIMITATIONS AND CONCLUSION

This study is one of the first to explore the objectives, pedagogical approaches and impact of SEE initiatives and to show the interconnectedness of all three elements that can help with programme design and delivery. As with all studies, this work has several limitations. As a single case study, the findings may have limited generalisability. The CEP focuses on climate entrepreneurship start-up. This emphasises mainly UN SDG4 on quality education and UN SDG11 on climate action. Future studies could draw on a greater number of cases and/ or of UN SDGs and include social dimensions into developing alternate business models. The study is underpinned by the progression model of entrepreneurship, adopting a more holistic definition of entrepreneurship in the foundational aspects of the CEP and narrowing this towards starting a business (pitch) in the CSPC. The core of the CEP exhibited in this paper is the CSPC. Future studies could explore impact on other types of SEE programmes, defined by the more holistic approach. Finally, this study does not address calls for investigations on impact of EE involving longer-term outcomes. Recognising that many people start their entrepreneurship careers later in life (Rauch and Hulsink, 2015), future SEE impact studies are needed.

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