



Entrepreneurship education for sustainable development: A design-driven approach

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Abstract

Entrepreneurs for sustainable development are needed to achieve SDGs. However, there is a lack of professional training that enables learners to become sustainable entrepreneurs. This study proposes the integration of Education for Sustainable Development (ESD) with Design-Driven Entrepreneurship Education (DDEE), which could influence sustainable entrepreneurial intentions. Two hundred and seventy-seven vocational college students completed the online questionnaire. The results show that course design, teachers' competencies, and peer interactions influence students' sustainable entrepreneurial intention through the perceived benefits of learning. Additionally, students' environmental consciousness impacts their sustainable entrepreneurial intentions. This study extends the theoretical contribution by connecting the sustainability and entrepreneurship constructs. It also provides a practical framework for Teachers of Education for Sustainable Development (TESD) to influence students to become sustainable entrepreneurs.

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Introduction

Sustainable Development is the plan of action for people, the planet, and prosperity. Over the next 15 years, all countries will act collaboratively to implement the plan in pursuit of the 17 Sustainable Development Goals (SDGs). Governments and policymakers around the world are embracing this agenda and initiating national policies to drive countries toward these goals. In response to this trend and government policies, entrepreneurs need to focus on advancing not only economic sustainability

but also social and environmental sustainability. Despite the UN SDGs leading to an era that requires entrepreneurs for sustainable development, there is a lack of professional training and development of existing academics to cultivate a sustainability mindset and skills for entrepreneurs (Eichler & Schwartz, 2019; Moon, 2017; Rashid, 2019). Educational institutions play an important role in producing entrepreneurs who strive for sustainability, as education can influence learners' value system, which impacts their evaluation of learning related to sustainability (Lourenço et al., 2012).

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Teachers have been identified as key enablers of all Sustainable Development Goals (SDGs) as they can deliver courses designed to promote sustainable development (Fischer et al., 2022). Teachers of Education for Sustainable Development (ESD) pedagogy should act as facilitators and guide the learning journey (McGuigan, 2016; Strachan, 2018). ESD teachers should establish four common competencies: dispositions related to the view of education, personal and professional attitudes, skills for professional practice, and core knowledge and understanding (Strachan, 2012). Besides teachers' competencies, the teaching approach is also crucial in influencing students' mindsets and intentions to become entrepreneurs for sustainable development.

Previous research shows that entrepreneurship education (EE) could be used as an instrument for sustainable development, as it can inspire and promote sustainable business. A common goal of EE is to strengthen entrepreneurs with value orientations for a sustainable society (Lindner, 2018). Teachers should promote moral obligations and encourage social and environmental responsibility as a means of developing future entrepreneurial potential (Lourenco et al., 2012). Engaging young people in a form of sustainable entrepreneurship education could contribute to initiating a change in business practices (Strachan, 2018). Therefore, combining ESD with EE could potentially shape learners' intentions to engage in sustainable business. The questions are what teaching approach should teachers use and how should they teach?

The current study proposes Design-Driven Entrepreneurship Education (DDEE) as a teaching approach that could help teachers of ESD influence students' intentions to become sustainable entrepreneurs. DDEE has emphasis on actions and relies on a learning framework such as Design Thinking (DT), which is increasingly used in EE (Iandoli, 2023). DT is broadly defined as 'the combination of tools, processes, and mindsets that designers utilize to solve problems' (Sarooghi et al., 2019). DT offers a possible approach to tackle complex socio-ecological problems and foster the development of sustainability-oriented innovation (Buhl et al., 2019). An online Design Thinking-Based EE has been found to increase learners' entrepreneurial intentions (Woraphiphat & Roopsuwankun, 2023). Hence, teachers could potentially integrate ESD with Design Thinking-Based EE as a strategic plan to inspire and influence learners' intentions to become entrepreneurs that promote sustainable development. Peer interactions need to be considered for the Design Thinking-Based approach.

Collaboration and discussion within teams allow the incorporation of diverse perspectives and experiences, which helps foster new ideas and solutions. Teachers should encourage peer interactions among learners. We believe that teachers' competencies, the ESD-DDEE, and peer interactions could enhance learners' sustainable entrepreneurial intentions.

Sustainable entrepreneurship is based on the idea that business enterprises have the ability to create social value as well as wealth (Lourenco et al., 2012). The curriculum could be designed to influence learners' intentions to engage in businesses related to sustainable development by showing them the opportunities of sustainable entrepreneurship. In other words, if learners perceive the benefits of learning related to sustainable entrepreneurship, they will exploit such learning. Teachers should provide content that is easy for learners to comprehend and apply to increase their perception of learning benefits. Besides the educational factors, learners' environmental concerns could be an individual driver of sustainable entrepreneurial intention. Previous studies show that individuals' environmental concerns influence sustainable entrepreneurs to start sustainable businesses (Schaltegger & Wagner, 2011). We expect that learners' environmental concerns could influence their intention to become sustainable entrepreneurs.

In sum, this research investigates how teachers' competencies, course design, and peer interactions influence learners' sustainable entrepreneurial intentions. We believe that these factors influence learners' intention to become entrepreneurs for sustainable development through the perceived benefits of learning. To our knowledge, only a few research studies link EE with sustainable development (Rashid, 2019). This research addresses the gap by connecting the ESD and EE constructs and examines how educational programs that integrate ESD and DDEE could impact learners' intentions to become entrepreneurs for sustainable development. Additionally, we look at learners' environmental concerns as individual factors that contribute to their inclination to become sustainable entrepreneurs. The research questions were: (1) What is the influence of ESD-DDEE course design, teachers' competencies, and peer interactions on learners' intentions to become entrepreneurs for sustainable development?; (2) How do the perceived benefits of learning mediate those relationships?; and (3) What is the influence of learners' environmental concerns on their intentions to become sustainable entrepreneur?

Cultivating youth with entrepreneurship for sustainable development knowledge, skills, and intentions can help address many of the social and environmental challenges we face in the 21st century. Ultimately, this research will provide practical implications for policymakers and teachers in the 21st century to deliver effective courses that promote sustainable development. The current research also addresses the need for teachers' training for ESD and how to design courses that integrate ESD with EE to promote sustainable entrepreneurship for young learners.

Literature Review

Sustainable Entrepreneur for Sustainable Development

The most widely used definition of sustainable development comes from the Brundtland Report, which defines sustainable development as development that meets the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on Environment Development, 1987). Later, researchers on sustainability focused on the concept introduced and developed by Elkington (1998), known as the triple bottom line (TPB), which suggests balancing the three dimensions of sustainability: social sustainability, environmental sustainability, and economic sustainability (Kamaludin et al., 2021; Greco & Jong, 2017). In 2015, the United Nations set out the broader topics of sustainability and the Sustainable Development Goals (SDGs) to be achieved by 2030. Achieving a sustainable and desirable future has become a shared vision among governments, non-governmental organizations, and corporations around the world. The UN's 17 SDGs address a wide range of issues related to both social and environmental fields. "Sustainable entrepreneurship," a recognized branch of the wider field of entrepreneurship, is seen as a means of addressing some of the sustainability challenges of the 21st century (Strachan, 2018).

Sustainable entrepreneurship is recognized as a sub-division of entrepreneurship literature (Ploum et al., 2017). It refers to engaging in sustainable business practices related to environmental, social, and economic sustainability (Strachan, 2018); balancing economic health (profit), social equity (people), and environmental resilience (planet) through entrepreneurial behavior (Hockerts & Wüstenhagen, 2010); and discovering, creating, evaluating, and exploiting opportunities to create future goods and services consistent with

the Sustainable Development Goals (Pacheco et al., 2010). It also involves the discovery, creation, and exploitation of entrepreneurial opportunities that contribute to sustainability by generating social and environmental gains for others in society (Greco & De Jong, 2017).

Sustainable entrepreneurs act as change agents as they integrate sustainable development criteria into their entrepreneurial activities and transfer a vision of sustainability to society (Ploum et al., 2017). Strachan (2018) explores the relationship between Education for Sustainable Development (ESD) and entrepreneurship education to encourage young people to change business practices for sustainable development. The current study extends this knowledge by investigating if integrating ESD and entrepreneurship education could enhance learners' intentions to become sustainable entrepreneurs. While sustainable entrepreneurship has different branches, including social and environmental entrepreneurship (Dean & McMullen, 2007), previous researchers propose that entrepreneurship could be a solution to counteract climate change, reduce environmental degradation, and address deforestation (Dhahri & Omri, 2018). The current study focuses on the environmental component of sustainability. We examine the educators' role in producing graduates who could be entrepreneurs willing to tackle environmental issues in the future.

Education for Sustainable Development (ESD)

Education for Sustainable Development (ESD) focuses on a new vision of education that empowers learners to acquire knowledge, skills, and values, and assume responsibility for creating and enjoying a sustainable future (UNESCO, 2002). To ensure the achievement of the UN Sustainable Development Goals (SDGs) by 2030, teachers must equip learners with the knowledge and skills needed to promote sustainable development. Thus, it is crucial to examine how curricular and pedagogical inputs related to sustainable development can impact learners' attitudes, behaviors, and intentions to become sustainable entrepreneurs.

Previous studies show that ESD teachers employ a diversity of teaching approaches and content to build learners' knowledge and awareness of sustainable development and environmental issues. O'Flaherty and Liddy (2018) reviewed literature related to ESD published between 2000 and 2014 and found that teachers use a variety of content and themes, utilizing active learning methodologies, including multi-media approaches,

problem-based learning (PBL), discussion forums, role-play, concept mapping, and measuring the positive impact of ESD interventions, such as awareness of global issues, knowledge, and understanding of environmental interdependence and global responsibility. However, there is no consensus on what and how teachers should teach young learners, and there is an absence of activism for global change as a learning outcome.

In recent years, a number of scholars investigated Entrepreneurship Education (EE) as a pedagogy that could impact learners' awareness and understanding of sustainable development. EE teaching methods are still evolving; the current study explores a Design-Driven Entrepreneurship Education (DDEE) as a means that leads to students' sustainable entrepreneurship intentions. DDEE teaching methodologies are discussed next.

Design Driven Entrepreneurship Education - Online Design Thinking Approach

Entrepreneurship Education is defined as any pedagogical program or process of education aimed at developing entrepreneurial attitudes and skills (Fayolle & Klandt, 2006). Previous studies have identified six key components that distinguish EE programs: audiences, goals, pedagogies, content, educators, and assessment (Ndou et al., 2018). The current study focuses on vocational college students in Thailand as the target audience, intending to promote entrepreneurial intentions for sustainable development. The course was designed to integrate ESD with DDEE using a 'through' learning approach. EE teaching pedagogies could be classified into three methods: (1) learning to understand entrepreneurship, (2) learning to become an entrepreneur by focusing on skills required to implement a business idea, and (3) learning to become an entrepreneur by gaining experience from the real world and reflecting on it. The latter is known as the 'through' approach, with the main goal of strengthening the entrepreneurial mindset and entrepreneurial intention. Several scholars have suggested that educators should employ more of the 'through' teaching approach.

Nowadays, a design-driven approach, such as Design Thinking, has been integrated into the teaching of entrepreneurship education. Design-driven entrepreneurship education (DDEE) draws from action-based pedagogic approaches, emphasizing the primacy of action, situated knowledge, effectuation, and exponential learning (Iandoli, 2023). This approach

relies on the experience of 'making', allowing learners to learn 'through' things rather than simply learning 'from' things. Design thinking can be categorized under this design-driven entrepreneurship education (DDEE). It prepares students to be designers, enabling them to consider problems and opportunities from the user's perspective while engaging in collaboration to identify potential solutions and test them before making implementation decisions (Kickul et al., 2018). The five steps of design thinking include empathy, define, ideate, prototype, and test. Empathy allows learners to observe problems from the users' perspectives. By taking a people-first approach, learners can imagine solutions that are inherently desirable and meet explicit needs (Brown, 2008). After identifying the problem, students can generate ideas or solutions to solve it. Then, they can build a prototype and test their solutions. The assessment of this approach focuses on the learning process of students. Hence, the design thinking approach enables students to study entrepreneurship 'through' experiences and reflections on the learning process.

With the advancement of technologies, this approach has been applied in the context of online learning. Online collaborative tools, such as video conferences, allow students to share ideas, interact, and collaborate with their peers. A previous study shows that an online Design Thinking approach increases learners' inclination to become entrepreneurs (Woraphiphat & Roopsuwankun, 2023). The impact of entrepreneurship education on entrepreneurial intention is well-documented, but the impact of entrepreneurship education on sustainable entrepreneurial intention is not well understood. Little research connects entrepreneurship education literature with sustainable development (Rashid, 2018). The current study aims to extend the knowledge in this field by examining the influence of integrating an online Design Thinking approach for entrepreneurship education with education for sustainable development on students' sustainable entrepreneurial intentions. The DDEE for a vocational college student in Thailand is chosen as a reference program as it has incorporated the 'through' Design Thinking approach in an online classroom setting, as well as, environmental challenges for learners to promote sustainable development. The comprehensive steps that enable the practical implementation of these concepts in the online classroom setting are described along with the literature review.

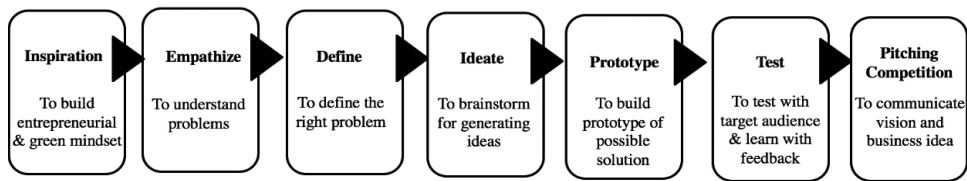


Figure 1 DDEE-ESD Integrated Course Design

Design Thinking is a way of describing a set of principles that can be applied by diverse people to a wide range of problems. In recent years, Design Thinking concept has been added to business school's curriculum in responding to the shifting of business landscape from traditional focus on the pure analytical skills to a new paradigm that focuses on problems and an entrepreneurial journey (Sarooghi, et al., 2019). The Design Thinking process delineates different stages of a problem-solving effort; (1) empathizing, (2) defining, (3) ideating, (4) prototyping, and (5) testing. However, the focus of the problems should not just be on business such as companies in search of new products, but could be on tackling more complex problems like climate change (Brown, 2009). This current DDEE course design focuses on providing learners with environmental challenges to solve using the Design Thinking approach, as well as, cultivating learners' mindsets, knowledge and skills for achieving sustainable development goals (SDGs). It focuses on the zero-waste project, specifically addressing waste-related problems. Learners are divided into teams to develop business ideas that can transform waste into products for sale in the market. The target

audience for this course is teenagers. It begins with an inspiration session, aiming to create green awareness, promote a sustainable entrepreneurial mindset, and instill a sustainable development perspective. Teachers introduce the concepts of sustainable entrepreneurship and sustainable development to the students. Throughout the course, teachers serve as facilitators, guiding students in each team through the design thinking process. This approach allows students to interact with their team members and test their prototypes with friends from other teams to facilitate an iterative process.

Prototyping plays a crucial role in helping designers enhance mutual understanding and coordination among team members by discussing and refining an actual artifact, rather than just talking about it (Iandoli, 2023). To visualize the products or services, students can create prototypes easily and at a low cost using simple materials and drawings. These quick prototypes allow learners to obtain valuable feedback from users for further development (see Figure 2). Teachers promote the iteration process by asking learners in each team to present their prototypes to other teams. A non-linear learning process enables learners to receive feedback for development.

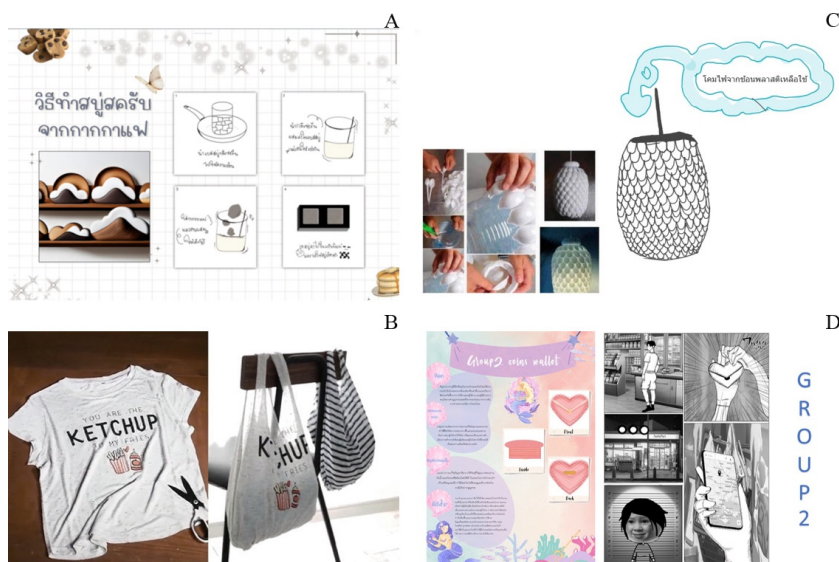


Figure 2 Prototype from the Zero Waste project (A) Soap from coffee grounds (B) Tote bag made from a T-shirt (C) Lamp made from plastic spoons (D) Wallet made from fabrics

Finally, this course concludes with the pitching day, during which a representative from each team showcases their final prototype and presents their business idea. The pitching day allows learners to reflect on what they learn related to sustainable development and how they use Design Thinking approach to tackle the challenge. Moreover, it fosters learners’ self-efficacy to work on each step of the process toward the end, which is the pitching day. The entire course was designed for online learning, utilizing Google Meet as the platform for learning, collaborating, and pitching. We posit that the course design, which integrates Education for Sustainable Development (ESD), online design thinking, and Entrepreneurship Education (EE), will significantly enhance learners’ intention to become sustainable entrepreneurs.

H1: The ESD-DDEE course design significantly influences learners’ sustainable entrepreneurial intention.

Teacher’s Competencies

Ploum et al. (2017) define competencies as consisting of knowledge elements, skills, and attitudes that enable the successful performance of tasks and problem-solving. Teachers’ competencies as ESD educators refer to their complex knowledge and awareness about sustainability issues and their ability and willingness to plan and organize learning activities that develop students’ capacities to understand and act on sustainability issues (Qudsia & Naima, 2021). This includes knowledge of sustainability issues, skills in designing effective teaching and learning formats, and adequate willingness and motivation to teach for ESD. Overall, ESD educators’ competencies refer to knowledge, skills, and attitudes related to sustainability and how to design and deliver ESD courses effectively. To teach an integrated ESD-DDEE course, teachers require not only knowledge and understanding of sustainable and entrepreneurship education to design the ESD-DDEE course but also the ability to deliver this course effectively.

In the current context, the Train the Trainer program is implemented by the vocational college. The training was structured to equip teachers with the necessary knowledge and skills as facilitators for the current online course. The training comprised: (1) the Designing Thinking training to share teaching material and teaching technique with teachers teaching the same course; (2) the ESD training to provide teacher knowledge related to sustainable development and to define sustainable development challenges to tackle in the current course; and (3) online teaching training for teachers who are not familiar with technology for education to ensure the smooth delivery of the online course (Please see the Train the Trainer program in Table 1).

We propose that teachers’ competencies significantly influence learners’ sustainable entrepreneurial intention.

H2: Teachers’ competencies significantly influence learners’ sustainable entrepreneurial intention.

Peer Interactions

Peer interactions refer to two-way reciprocal communication among learners. Learners can learn more when participating in group discussions and constructive dialogues. They can exchange ideas with and get feedback from each other (Moore, 1989). The interaction process can trigger ideas, reflection, and critical thinking, which are at the center of innovation success. Moreover, design thinking principles concentrate on diversity, which involves collaboration in multidisciplinary innovation teams. The combination of different skills and personalities enables the incorporation of diverse perspectives and experiences throughout the innovation development process (Buhl et al., 2019). In the current study, students work together as a team to come up with a business idea for sustainable development using a VDO conference (Google Meet) to interact with their peers. Advanced technologies enable smooth collaboration and discussion. We posit that peer interactions will increase learners’ sustainable entrepreneurial intentions.

H3: Peer interactions significantly influence learners’ sustainable entrepreneurial intentions.

Table 1 Train the trainer program

Topics	Key concepts for implementation
ESD	Promote students understanding of SDGs. Provide students with ‘challenges’ in the context of sustainable development.
Design Thinking	Explain the Design Thinking approach to students and lead them through each step. Promote students’ interactions. Team should consist of students from diverse background. Encourage the iteration process to receive feedback for development.
Online Learning	Facilitate the collaboration by using collaborative tools in online learning platforms such as break-down meeting, discussion boards, etc.

Perceived Benefits of Learning

Lourenco et al. (2012) propose that learners' intentions to exploit learning related to sustainable entrepreneurship are influenced by their perceptions of learning benefits. The perceived ease of learning the content could lead to perceived benefits, which, in turn, influence students' intentions to exploit their learning. We believe that teachers' competencies, a well-designed ESD-DDEE course, and the level of peer interactions could help learners gain an understanding of the benefits related to sustainable business. When learners perceive that the teacher's competency is high, the course is well-designed, and peer interactions are strong, their perception of learning benefits will increase. If learners perceive the benefits of learning related to sustainable entrepreneurship, they will be more likely to exploit such learning, which will influence their intention to become sustainable entrepreneurs.

H4: Perceived benefits of learning significantly mediate the influence of the ESD-DDEE course, teachers' competencies, and peer interactions on learners' sustainable entrepreneurial intentions.

Environmental Concerns

Many scholars and practitioners investigate what motivates individuals to engage in sustainable entrepreneurial activities. The main drivers can be categorized into internal and external factors. Internal

factors include beliefs and concerns regarding environmental issues, while external factors include networks, social capital, and public acceptance (Greco & Jong, 2017). However, it is not clear which individual factors yield the most influence on sustainable entrepreneurship outcomes. Previous studies show that many sustainable entrepreneurs start their ventures because of their environmental or social concerns (Schaltegger & Wagner, 2011). The current study examines the influence of learners' environmental concerns as the individual drivers of their intention to become sustainable entrepreneurs.

Individuals' environmental concerns are related to their interest in the biophysical environment and its problems, as well as their concern for consumers and their surroundings (Norazah Mohd, 2013). Previous studies have found that communicating the benefits of a product on the packaging or in advertising can overcome negative perceptions towards the effectiveness of environmentally friendly products, which is related to individuals' environmental concerns (Luchs et al., 2010). We expect that individuals' environmental concerns could be an internal factor that influences their intention to become sustainable entrepreneurs.

H5: Individual environmental concern significantly influences learners' sustainable entrepreneurial intentions.

Figure 3 illustrates the theoretical framework, which provides the linkage between education, entrepreneurship for sustainable development, and intention outcomes. Table 2 summarizes the hypotheses for the current study.

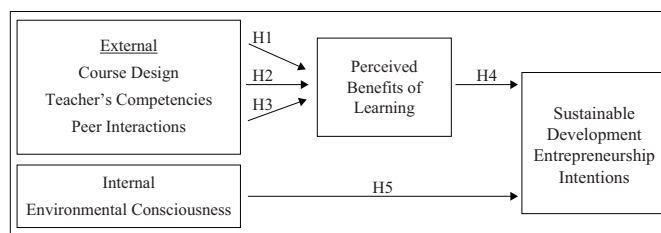


Figure 3 Theoretical framework

Table 2 Hypotheses

No.	Description
H1	Course design positively influences sustainable entrepreneurial intention, and perceived benefits (PB) mediate this influence.
H2	Teacher's competencies positively influence sustainable entrepreneurial intentions, and perceived benefits (PB) mediate this influence.
H3	Peer Interaction positively influences sustainable entrepreneurial intentions, and perceived benefits (PB) mediate this influence.
H4	Perceived benefits of learning have a positive effect on sustainable entrepreneurial intention.
H5	Environmental consciousness has a direct positive effect on sustainable entrepreneurial intention.

Methodology

Participants and Data Collection

A cross-sectional survey was used as an instrument for the current study. The sample consisted of first-year vocational college students who were enrolled in a one-week online summer course on ‘Sustainable Entrepreneurship’. After the course ended, students’ advisors distributed the online questionnaire link to the students and provided a brief overview of the study. Students were asked to answer the questionnaire based on their experience in the summer course. Data collection was conducted for a one-week period in June 2023. Two hundred and seventy-seven vocational college students (138 females, $M_{AGE} = 16.54$, $SD_{AGE} = 0.899$) completed the questionnaire. The sample’s demographic backgrounds are summarized in Table 3

Measurement Variable

The measurement scales were adapted from previous studies. The questionnaire was confirmed and checked by researchers for appropriateness and clarity before being sent out to students. All items were assessed on a 7-point Likert scale (1 = “strongly disagree”, 7 = “strongly agree”). The sustainable entrepreneurial intention scale was adapted from Woraphiphat and

Roopsuwankun (2023), which was previously used to measure the entrepreneurial intention of vocational college students in a similar context. The course design scale was adapted from Woraphiphat and Roopsuwankun (2023). For example, “*The course design allows me to connect my experience with a new concept*”. Teacher’s competency scale was adapted from Brandt et al. (2019). For example, “*The teacher has knowledge of sustainability issues.*” and “*The teacher has adequate willingness and motivation to teach about sustainability*”. The peer interaction scale was adapted from Kuo et al. (2009). For example, “*Group activities in the course give me a chance to interact with my classmates*”. The perceived benefits scale was adapted from Lourenco et al. (2012). For example, “*This course is beneficial for becoming a sustainable entrepreneur*”. Individuals’ environmental consciousness scale was adapted from Norazah Mohd (2013). For example, “*Environmental issues are an urgent concern.*” and “*I am worried about how all of my activities affect the environment*”.

Results and Discussion

SPSS was used for the data analysis. The results of the reliability analysis are shown in Table 4. Environmental consciousness has a coefficient greater than 0.7, while other variables have coefficients greater than 0.9. Thus, the internal consistency and reliability were acceptable (Bagozzi & Yi, 1989).

The correlation analysis results are shown in Table 5. There was a statistically significant correlation between sustainable entrepreneurship intention and external factors: course design ($r = .597$, $p < .001$), teacher’s competencies ($r = .610$, $p < .001$), and peer interactions ($r = .598$, $p < .001$). These results indicate that sustainable entrepreneurship intentions increase with course design, teacher competencies, and the level of peer interactions. There was a strong correlation coefficient between sustainable entrepreneurship intentions and perceived benefits,

Table 3 Descriptive statistics

(n = 277)	
Item	Frequency (Percent)
Age	
Under 15	9 (3.2)
15	147 (53.1)
16	94 (33.9)
17	23 (8.3)
18	1 (0.4)
Above 18	3 (1.1)
Gender	
Male	138 (49.8)
Female	139 (50.2)
Family Monthly Income	
Under 30,000	138 (49.8)
30,000–50,000	94 (33.9)
50,001–70,000	22 (7.9)
70,001–90,000	9 (3.2)
Above 90,000	14 (5.1)

Table 4 Reliability analysis of the instruments.

(n = 277)		
Scales	Number of items	Cronbach’s alpha
Sustainable entrepreneurial intentions	11	0.936
Environmental consciousness	4	0.799
Perceived benefits	5	0.915
Course design	4	0.909
Teacher’s competencies	4	0.902
Peer interactions	6	0.930

Table 5 Correlation analysis

Variable	1	2	3	4	5	6
1. SD Ent Intentions	1.000					
2. Env. Consciousness	.538**	1.000				
3. Perceived Benefits	.716**	.539**	1.000			
4. Course Design	.597**	.560**	.799**	1.000		
5. Teacher Competencies	.610**	.535**	.792**	.792**	1.000	
6. Peer Interactions	.598**	.527**	.748**	.702**	.702**	1.000

Note: **Correlation is significant at the .01 level (2-tailed).

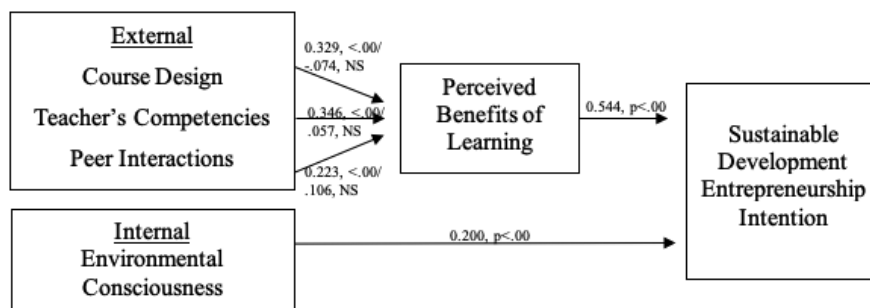
showing that when students' perception of learning benefits increases, their entrepreneurial intention for sustainable development also increases. Moreover, there was a statistically significant correlation between sustainable entrepreneurship intention and the individual factor, environmental consciousness ($r = .538$, $p < .001$). This result shows that when students are highly concerned about the environment, they are more likely to have the intentions to become sustainable entrepreneurs.

Regression analysis was used for the current study. According to the results of the model ($R^2 = 0.542$, $p = .001$), course design ($B = 0.329$, $p < .01$), teacher competencies ($B = 0.346$, $p < .01$), and peer interactions ($B = 0.223$, $p < .01$) have a strong positive effect on entrepreneurial intention (EI). The results suggest that when the course is well-designed, teachers' competencies are high, and the level of peer interactions is increased, students' intention to become entrepreneurs for sustainable development also increases. However, the direct effect of these variables on entrepreneurial intention is reduced and becomes insignificant with the presence of perceived benefits in the model (Course Design: $B = -0.074$, NS, Teacher's Competencies: $B = 0.057$, NS, Peer Interactions: $B = 0.106$, NS). Thus, the mediation analysis shows that these relationships are fully mediated by the perceived benefits of learning, supporting hypotheses H1, H2, and H3. There is a strong positive relationship between the perceived benefits of learning and sustainable development entrepreneurship intention ($B = 0.544$,

$p < .01$). The results support hypothesis H4. Overall, the results suggest that the ESD-EE online design thinking-based course design, teachers' competencies, and peer interactions contribute to the increase in sustainable entrepreneurial intention because students perceive them as beneficial. Finally, environmental consciousness has a strong positive effect on entrepreneurial intention ($B = 0.200$, $p < .01$). The results support hypothesis H5, suggesting that individuals' concern related to the environment greatly leads to an increase in sustainable entrepreneurial intention. Figure 4 shows the summary of the regression analysis and hypothesis testing.

Conclusion and Recommendations

The current study explores the integration of ESD with DDEE as a means to influence learners' intentions to become sustainable entrepreneurs. Eichler and Schwartz (2019) examined entrepreneurship publications in EE related to SDGs and found a limited number of articles that connect EE with SDGs. Moreover, there are only two articles that were conducted in South Asia. This research aims to extend the knowledge in this field by exploring the link between DDEE and ESD in the Southeast Asia region. Specifically, we aim to examine the impact of the ESD-DDEE integration on Thai vocational college learners' intention to become sustainable entrepreneurs.

**Figure 4** Regression analysis and hypothesis testing

The Design Thinking approach has gained more popularity in higher education and has been adopted in vocational education in Thailand. The study findings revealed that integrating environmental challenges with the design-driven teaching pedagogy increases learners' intentions to become entrepreneurs for sustainable development. Learners' perceived benefit of learning appears to be an important factor that impacts their intention to become sustainable entrepreneurs. Hence, this research proposes recommendations to educational institutions and policy makers as follows:

1. Incorporate the challenges related to sustainable development into their entrepreneurship curriculum and use a Design Thinking framework to help foster learners' intentions to start business that helps making the world a better place.

2. Implement the Train the Trainer program to promote teachers' competencies. Teachers need to have the knowledge and skills to deliver the ESD-DDEE course effectively and enhance learners' perceived learning. Teachers should avoid the traditional passive teaching method for sustainable development education. Therefore, continuous professional training on how to become a Design Thinking facilitator that promotes learners' actions is needed.

3. Equip teachers with the necessary technology skills to deliver an online course. As peer interactions enhance learners' entrepreneurial intentions, teachers should be able to use online tools that promote peer interactions in the online learning context.

Limitation and Future Study

In this study, we examined the impact of the DDEE-ESD program on learners' intention to become sustainable entrepreneurs. However, the current research is based on a specific context, specifically vocational students enrolled in a vocational college in Thailand. Thus, the results might not be generalized to other educational contexts in different countries. There is a need for more empirical testing of the integration of design-driven entrepreneurship and education for sustainable development. Future studies could apply this research framework and examine the effectiveness of this program in other contexts. Enterprises can integrate sustainable development challenges into their product design using design-driven concept such as Design Thinking approach. Start with problems, then iterating between DT steps to develop prototype that not only enhances the product design but also creates a sustainable future.

Moreover, the findings in this research indicate that the effectiveness of utilizing the ESD-DDEE approach relies on teachers' competencies. Previous studies show that research-based discussions on sustainability issues helped transform pre-service teachers' classroom practices (Qudsia & Qureshi, 2021). Future research could extend the knowledge of current and existing research by examining approaches to enhance teachers' competencies both in DDEE and ESD to deliver the course and techniques to promote peer interactions.

Finally, technology such as video conferencing enables seamless communication and collaboration among remote teams across the globe. The ESD-DDEE course design could be used for learners from different educational institutions located in different countries. The creation of international virtual project teams to help solving the common sustainable development challenges could help promote global knowledge sharing and accelerates new ideas and solutions to achieve the SDGs, as well as trigger interactions. Hence, future researchers could examine the influence of multicultural teams on learners' intentions to become entrepreneurs for sustainable development.

Conflict of Interest

The authors declare that there is no conflict of interest.

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