



Online Green Entrepreneurship Education: Exploring Competencies, Intentions, and Learning Barriers

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Abstract: This study aims to explore students' green entrepreneurial competencies, entrepreneurial intentions, and learning barriers within the implementation of Online-Based Green Entrepreneurship Education (GEE) in higher education. This study conducted a preliminary qualitative exploration of the model implementation through semi-structured interviews with lecturers and open-ended questionnaires administered to students in an online Bioentrepreneurship course. Thematic analysis was conducted to assess entrepreneurial competencies, learning barriers, and entrepreneurial intentions. To ensure the credibility of the findings, source triangulation was employed by comparing and cross-validating themes derived from lecturer interviews and student open-ended questionnaire responses. The results indicate that students possess adequate basic knowledge and sustainability values; however, practical skills, systems-thinking abilities, and real-world entrepreneurial experience remain limited due to the characteristics of online learning and restricted access to hands-on activities. The main barriers include financial constraints, lack of green facilities, limited understanding of markets and policies, and insufficient mentoring support. Although students demonstrate positive green entrepreneurial intentions, a gap between intention and actual behavior persists, influenced by low self-efficacy and weak structural support. These findings highlight the importance of improving the implementation of online GEE to better support students' green entrepreneurial competencies, intentions, and entrepreneurial readiness in higher education.

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Introduction

Global warming and environmental degradation have increased the importance of Green Entrepreneurship (GE) as a strategy that integrates environmental, economic, and social sustainability through innovative business practices (Yasir et al., 2023; Sarra & Abdellah, 2023). In higher education, Green Entrepreneurship Education (GEE) has emerged as an important approach to developing students' sustainability-oriented entrepreneurial competencies and mindsets to support a sustainable society (OECD, 2022; Nguyen et al., 2025; Nuringsih et al., 2022). Along with digital transformation, GEE is increasingly implemented through online learning, which presents both opportunities and challenges for competency development.

However, despite its growing adoption, online-based Green Entrepreneurship Education (GEE) often emphasizes theoretical understanding while providing limited opportunities for hands-on projects, mentoring, and authentic entrepreneurial experiences

(Soonsan et al., 2025; UNESCO, 2020). Consequently, students may develop positive environmental attitudes and entrepreneurial intentions but still lack the practical skills, self-efficacy, and institutional support needed to implement sustainable business practices. This condition contributes to the persistence of the intention–behavior gap, particularly in developing countries with limited entrepreneurial ecosystems (Ng et al., 2022).

GEE contributes to the development of Green Entrepreneurial Competency (GEC), which supports students' ability to develop sustainable entrepreneurial solutions (Planck et al., 2024). These competencies also support Green Entrepreneurial Intention (GEI) toward sustainable business practices (Ali et al., 2023). Based on the Theory of Planned Behavior, competencies may strengthen perceived behavioural control and influence entrepreneurial intentions and behaviour. This study adopts a three-dimensional framework consisting of competencies, barriers, and entrepreneurial intention to explore the implementation of online-based GEE in higher education (Liu et al., 2021).

However, competencies and intentions are often constrained by financial, organizational, regulatory, and technical barriers (Makki et al., 2020; Sarvari et al., 2024). These barriers are structurally interconnected and can significantly hinder the transformation of competencies and intentions into actual green entrepreneurial behaviour, particularly in developing contexts where access to resources, technology, and infrastructure remains limited (Tweve & Masaluu, 2024). This issue becomes more complex in online learning contexts, where limited interaction, practical experience, facilities, and institutional support reduce students' entrepreneurial readiness and self-efficacy (Soonsan et al., 2025; Minh & Cuong, 2025).

Studies in Indonesia show that understanding of green economics and educational exposure can increase students' intentions to engage in green entrepreneurship (Yanti & Cahyati, 2024). Nevertheless, these studies mainly focus on entrepreneurial intention and do not comprehensively evaluate competencies and barriers within an integrated framework. In addition, studies exploring online-based GEE in higher education remain limited, and few have simultaneously examined competencies, barriers, and intentions within an integrated framework (Prasetio et al., 2025). This study offers several contributions. It examines online-based green entrepreneurship education within the context of bioentrepreneurship in higher education, an area that remains underexplored. It also highlights how structural barriers, including limited facilities, mentoring, institutional support, and practical learning opportunities, influence students' entrepreneurial readiness and intentions. Furthermore, the study provides a comprehensive exploration of competencies, intentions, and learning barriers in online-based GEE.

This study aims to explore students' green entrepreneurial competencies, entrepreneurial intentions, and perceived learning barriers within the implementation of online-based Green Entrepreneurship Education (GEE) in higher education. Conceptually, it contributes by integrating competencies, intentions, and learning barriers in the context of online-based GEE, and practically provides insights for improving its implementation in higher education.

Research Method

This study employed a preliminary qualitative exploration using a decision-oriented evaluation approach to explore the implementation of online-based Green Entrepreneurship Education (GEE) in higher education (Fitzpatrick et al., 2023). The study focused on three dimensions: Green Entrepreneurial Competency (GEC), Green Entrepreneurial Barriers (GEB), and Green Entrepreneurial Intention (GEI), adapted from previous studies (Planck et

al., 2024; Sarvari et al., 2024; Valencia-Arias et al., 2025). A descriptive qualitative approach was used to explore participants' experiences, perceptions, and learning challenges within the context of online-based GEE (Creswell & Creswell, 2018).

Purposive sampling was employed to select participants with direct experience in online-based green entrepreneurship learning. Participants consisted of eight students enrolled in or having completed the online Bioentrepreneurship course and two lecturers teaching entrepreneurship, sustainability, or applied biology courses. Data were collected through semi-structured interviews with lecturers and open-ended questionnaires administered to students. The instruments explored Green Entrepreneurial Competency (GEC), Green Entrepreneurial Barriers (GEB), and Green Entrepreneurial Intention (GEI), adapted from previous studies (Planck et al., 2024; Sarvari et al., 2024; Valencia-Arias et al., 2025). Lecturer interviews focused on learning challenges, instructional barriers, and entrepreneurial readiness, while student questionnaires explored competencies, perceived barriers, and entrepreneurial intentions related to online-based GEE. All data collection procedures were conducted online.

The data obtained from lecturer interviews and student questionnaires were analysed using thematic analysis guided by the three evaluation dimensions: GEC, GEB, and GEI (Liu et al., 2021). Data were coded and categorized into themes related to competencies, barriers, and entrepreneurial intentions. Source triangulation was conducted by comparing themes derived from lecturer interviews and student questionnaire responses to enhance the credibility of the findings. The analysed data were interpreted to identify learning strengths, barriers, and entrepreneurial readiness within the implementation of online-based GEE.

All participants provided informed consent prior to participation and were informed that participation was voluntary. Participants could withdraw at any time without consequences. Confidentiality and anonymity were maintained throughout the study.

Results and Discussion

This section discusses the challenges of online-based Green Entrepreneurship Education (GEE) in the Bioentrepreneurship course from the perspectives of students and lecturers. The findings are analysed through three dimensions: Green Entrepreneurial Competency (GEC), Green Entrepreneurial Barriers (GEB), and Green Entrepreneurial Intention (GEI).

Green Entrepreneurial Competency (GEC)

This study explored students' green entrepreneurial competencies using a framework consisting of ideas and opportunities, resources, action orientation, sustainability values, complexity awareness, future orientation, and sustainable action. The findings in Table 1 show that students generally possess basic sustainability awareness and entrepreneurial motivation; however, these competencies remain largely conceptual and have not yet developed into practical entrepreneurial capabilities.

Table 1. Competence from the Perspective of Lecturers and Students

Main Competencies	Sub-indicators	Results	Reason	Evidence
1) Ideas and Opportunities	Valuing Sustainability	Students understand sustainability values, but implementation remains limited.	Sustainability values are understood but not implemented.	No laboratories or prototyping facilities are available.
	Supporting	The understanding	There are no field	Learning is presentation-



Main Competencies	Sub-indicators	Results	Reason	Evidence
	Fairness	of social justice is conveyed but has not been internalized.	activities/local case studies.	based with limited MSME/community interaction.
	Promoting Nature	Students understand the concept but have no practical experience.	No field projects/outdoor learning available.	Online learning makes for minimal hands-on experience.
	Systems Thinking	Students understand the concept but cannot yet apply in business models.	The curriculum is not integrated across subjects.	General courses do not yet include an ecological perspective.
	Critical Thinking & Problem Framing	Critical thinking skills are not yet developed; tasks are still descriptive.	There is no PBL or complex case analysis.	Independent assignments with monotonous learning.
	Futures Literacy	Students have not been trained to predict future trends.	There is no material on future scenarios	No climate change or future market content.
2) Resources	Adaptability & Exploratory Thinking	Adaptation is understood in concept but not practiced.	No project requires a change in strategy.	Limited facilities → students only create concepts.
	Individual Initiative	Initiatives emerged but were limited to completing assignments.	Lack of mentoring and practice space.	Students are confused about the initial steps to start a green business.
3) Into Action	Political Agency	Understanding of public policy is still shallow.	Policy materials are not presented systematically.	Students do not know about fiscal incentives, EPR, green industry.
	Collective Action	Collaboration only on simple group assignments.	There are no cross-group/industry projects.	Students hope for MSME collaboration; there is no industry network yet.
4) Embodying Sustainability Values	Ethical & Sustainable Thinking	Ethical awareness exists, but implementation is weak.	There are no ethical dilemma simulations or long-term impact analyses.	The proposal was made without considering ecological risks.
5) Embracing Complexity	Ethical and sustainable thinking	Students understand the issue from several sides but are not yet able to integrate it into a business plan.	Minimal multidisciplinary case studies.	The study program does not yet have a cross-course integration model.

Main Competencies	Sub-indicators	Results	Reason	Evidence
6) Envisioning Sustainable Futures	Spotting Opportunities, Creativity, Vision	Opportunities can be identified, but product creativity is low.	No lab/prototyping.	Students want to make natural products, but the tools are not available.
	Valuing Ideas & Motivation	Motivation builds but quickly declines due to a lack of real support.	The intention–behavior gap arises due to non-applicative learning.	Students are hesitant and confused about starting a green business.
	Planning, Management & Coping with Uncertainty	Basic planning exists, but coping with uncertainty is still weak.	No business simulations, pitching, mentoring.	Students do not understand green market risks and capital uncertainty.
7) Acting for Sustainability	Ethical and sustainable thinking	Students want to act but don't have the means.	No labs, green technology, real projects.	Lecturers & students consider the facilities to be very limited.

Table 1 shows that although students demonstrated basic sustainability awareness and entrepreneurial motivation, these competencies remained largely conceptual and had not yet translated into practical entrepreneurial capabilities. The dominance of theoretical instruction, limited facilities, lack of applied projects, and weak institutional support constrained the development of higher-order competencies, particularly systems thinking, futures literacy, and sustainable action. Such competencies are difficult to develop in online learning environments because they require authentic interaction, interdisciplinary collaboration, iterative experimentation, and experiential reflection beyond presentation-based learning (Carmi et al., 2015; Planck et al., 2024).

In this study, students generally understood sustainability concepts cognitively, yet they struggled to operationalize the environmental, social, and economic dimensions into actionable business models because learning activities rarely involved authentic entrepreneurial practice or real-world sustainability problem-solving. This finding suggests that the limitations of online-based GEE are not merely pedagogical but also structural, as the absence of entrepreneurial ecosystems, mentoring systems, and experiential learning opportunities weakens the transformation of sustainability knowledge into entrepreneurial capability. Compared with previous studies that primarily emphasize the positive contribution of entrepreneurship education to sustainability awareness and competency development (Álvarez-García et al., 2015; Carmi et al., 2015), the present study indicates that awareness alone is insufficient to foster sustainable entrepreneurial readiness in online learning environments without institutional and practical support structures.

Green Entrepreneurial Barriers (GEB)

This study examined Green Entrepreneurial Barriers (GEB) from the perspectives of both lecturers and students. The analysis focused on five major barrier categories: financial and economic constraints, government policies and regulations, organizational limitations, market conditions, and gaps in technical and entrepreneurial capabilities. The results are presented in Table 2, which systematically summarizes the dominant barriers, their underlying causes, and supporting evidence derived from field data.

Table 2. Barriers from the Perspective of Lecturers and Students

GEB	Results	Reason	Evidence
1) Financial & Economic Barriers (High Cost, Lack of Funding)	Capital is the main obstacle because students do not know funding strategies.	The course does not address funding sources, grants, crowdfunding, or business incubation.	- Students do not know the first step in finding capital - There was no discussion of fiscal incentives or green financing.
2) Government Policy & Regulations	Students' understanding of government policies on the green economy is very limited.	Environmental regulation and policy material is not included in the curriculum.	- Students are not aware of government programs. - Not familiar with EPR (Extended Producer Responsibility) or green industry standards.
3) Organizational Barriers	Institutional support is minimal; there are no green labs, business incubators, or MSME networks.	The study program is still in the early stages of building a green entrepreneurship ecosystem.	The lecturer stated that support was only in the form of curriculum documents, not supported by facilities.
4) Market Conditions	Students do not understand green market conditions, export opportunities, or trends in the need for green products.	There is no green marketing material or market analysis in the course.	Students are doubtful about the future sustainability prospects of green products.
5) Technical Barriers & Entrepreneurial Capabilities	Students' technical skills are very limited; there is no training, R&D, or access to technology.	The curriculum and facilities do not support technical exploration of green products/technologies.	- Students feel that their technical skills are still "very lacking". - No facilities for technical training or product research are available.

The findings indicate that barriers in online-based Green Entrepreneurship Education (GEE) are not only pedagogical but also structural and institutional. Limited funding, inadequate facilities, weak policy literacy, lack of mentoring and industry networks, and insufficient technical training restricted students' opportunities to transform ecological knowledge and entrepreneurial intentions into practical green business initiatives. These barriers appear to be interconnected rather than independent constraints, as the absence of institutional support weakened students' confidence, entrepreneurial readiness, and capacity to engage in sustainability-oriented innovation. This finding suggests that green entrepreneurial readiness depends not only on individual motivation but also on the availability of supportive entrepreneurial ecosystems that facilitate experimentation, collaboration, and practical engagement.

Students experienced limited access to sustainability laboratories, green technology, business incubation, and industry collaboration, resulting in sustainability-oriented learning remaining largely theoretical rather than practice-oriented. Financial and structural limitations hinder green business development (Hu & Gan, 2025), while inadequate technical facilities and training reduce opportunities for sustainability-based experimentation and innovation (Ayarkwa et al., 2022). In online learning environments, these barriers became more significant because students had limited opportunities for mentoring, collaborative experimentation, and interaction with authentic entrepreneurial contexts. As a result, sustainability knowledge tended to remain cognitive and difficult to operationalize into real

entrepreneurial practice. Unlike previous studies that primarily discuss green entrepreneurial barriers from economic or industrial perspectives (Makki et al., 2020; Sarvari et al., 2024), the present study highlights that educational structures themselves may reproduce entrepreneurial barriers when online sustainability learning is implemented without adequate experiential and institutional support. In addition, a weak understanding of environmental policies and green market mechanisms further reduced students' perceived behavioral control and entrepreneurial readiness toward sustainable business practices.

Green Entrepreneurial Intention (GEI)

This section analyses students' Green Entrepreneurial Intention (GEI) through indicators of environmental values, intrinsic and extrinsic motivation, attitudes toward sustainable entrepreneurship, social norms, perceived behavioral control, and sustainable entrepreneurial intention. Table 3 shows that students generally demonstrate positive intentions toward green entrepreneurship; however, these intentions have not yet translated into actual entrepreneurial behavior.

Table 3. Intentions from the Perspective of Lecturers and Students

GI Category / Indicator	Results	Reason	Evidence
1) Environmental Values (EV)	Environmental awareness is increasing but has not yet led to concrete action.	There are no activities that allow students to act on environmental issues.	Students understand environmental issues but are unable to initiate solutions.
2) Intrinsic Reward (IR)	Students enjoy the process of learning green ideas, but satisfaction decreases due to lack of practice.	Without direct experience, creativity and satisfaction do not develop.	Students want to practice, but the facilities are not available.
3) Extrinsic Reward (ER)	Students are starting to see career opportunities but are not yet convinced.	Lack of market information and examples of green industry practices.	Lecturers do not have a green industry network to provide a real picture.
4) Attitude Toward Sustainable Entrepreneurship (ATSE)	Positive attitudes are formed, but not strong enough to encourage real action.	Lack of mentoring and field experience.	Students are still hesitant to choose green business as a career.
5) Social Norm (SN)	Classroom support is quite good, but family/community support is still weak.	There are no collaborative projects that are interesting for the social environment.	Peers encourage ideas, but there is no real collective action.
6) Perceived Behavioral Control (PBC)	Low self-confidence due to lack of technical skills and facilities.	Self-efficacy is not formed without direct experience and mentoring.	Students are confused about starting a business even though they understand the concept.
7) Sustainable Entrepreneurial Intention (SEI)	The intention is there, but it does not develop into real action.	There are no field projects, facilities, funding, or mentors.	Students have never made a prototype or conducted a green product experiment.

The findings indicate that students' green entrepreneurial intentions were generally positive but rarely translated into entrepreneurial action due to a persistent intention-behavior gap. Although students demonstrated environmental awareness and interest in sustainable business ideas, limited practical experience, mentoring, facilities, and structural support

reduced their readiness to implement green business initiatives. This condition suggests that entrepreneurial intention alone is insufficient to encourage sustainable entrepreneurial behavior when students lack opportunities for experiential learning and authentic entrepreneurial engagement. In online learning contexts, entrepreneurial intention tended to remain at a cognitive level rather than become actionable because students had limited opportunities for experimentation, collaboration, and interaction with entrepreneurial role models. Similar findings were reported by (Gao & Zhao, 2026; Owunna et al., 2024; Yesmin et al., 2024), emphasizing the importance of self-efficacy, social support, and practical experience in transforming entrepreneurial intention into behavior. From the perspective of the Theory of Planned Behavior, the findings indicate that limited mentoring, facilities, and entrepreneurial exposure weakened students' perceived behavioral control, thereby reducing their confidence to initiate sustainable business practices. Structural support and perceived behavioral control, including access to mentors, facilities, and market opportunities, therefore play important roles in strengthening entrepreneurial action (Al Issa et al., 2025; Melese et al., 2025; Saraswati et al., 2021; Vera et al., 2024). Unlike previous studies that primarily examine entrepreneurial intention as an individual psychological construct, this study highlights that online-based GEE may unintentionally reinforce the intention–behavior gap when experiential learning and institutional support are insufficient. In addition, limited authentic experience reduced students' confidence in managing uncertainty and entrepreneurial risks, supporting previous studies highlighting the importance of experiential learning and role-model interaction in strengthening entrepreneurial readiness (Xuan & Yankai, 2025).

Implications for the Design of the GEE Learning Model

These findings provide a basis for designing a more applicable, context-specific online Green Entrepreneurship Education (GEE) model, as summarized in Table 4.

Table 4. Implications for Online-Based GEE Design

Perspectives	Learning Challenges (Field Findings)	Strategy / Design Features (Model Recommendations)	Learning Theories	Design Framework
Green Entrepreneurial Competency (GEC)	- Minimal field experience - Green skills have not been formed - Unable to see the economic–social–environmental link	- Ecology Project-Based Learning (PJBL) - Virtual/simulation green lab - Systems-mapping activity	- Experiential Learning - Constructivism	- Direct experience model - Authentic activity framework
Green Entrepreneurial Barriers (GEB)	- Facility & technical constraints (no tools, labs, practice rooms) - Low motivation - Not understanding green markets/policies	- Redesign the learning environment - Green-policy mapping & green market case	- Cognitive Load Theory - Behaviorism (reinforcement) - Self-Determination Theory	- Motivational support design - Environmental design
Green Entrepreneurial Intention (GEI)	Intention does not automatically become behavior	Observational learning through best practices	Theory of Planned Behavior	Observational learning pathways

- | | | | |
|---|--|---|---|
| (intention–behavior gap) | • Peer influence circle / green accountability group | (Ajzen, 1991) | • Reflective journaling & self-monitoring |
| • Minimal role models | • Self-monitoring logbook + green-product trial | • Social Cognitive Theory (Bandura, 1997) | |
| • Weak social support | | • Metacognitive Theory | |
| • Low self-efficacy due to lack of practice | | | |

Based on the findings of Green Entrepreneurial Competency (GEC), Green Entrepreneurial Barriers (GEB), and Green Entrepreneurial Intention (GEI), future online GEE designs should integrate experiential learning, collaboration, and structural support. Project-based learning, virtual green labs, eco-prototyping, mentoring, and green market or policy modules are important to strengthen sustainability competencies, creativity, self-efficacy, and entrepreneurial readiness (Freese et al., 2024; Gegenfurtner et al., 2014; Manzoor et al., 2025). In addition, observational learning, peer support, and reflection-based activities can help reduce the intention–behavior gap by strengthening students' confidence and practical engagement (Prastyaningtyas et al., 2023; Yitshaki, 2025; Sherwood, 2024; Yan et al., 2022). Based on the empirical findings and theoretical analysis, this study proposes a conceptual framework integrating experience-based pedagogy, collaborative learning, and structural support in online learning environments, as presented in Figure 1.

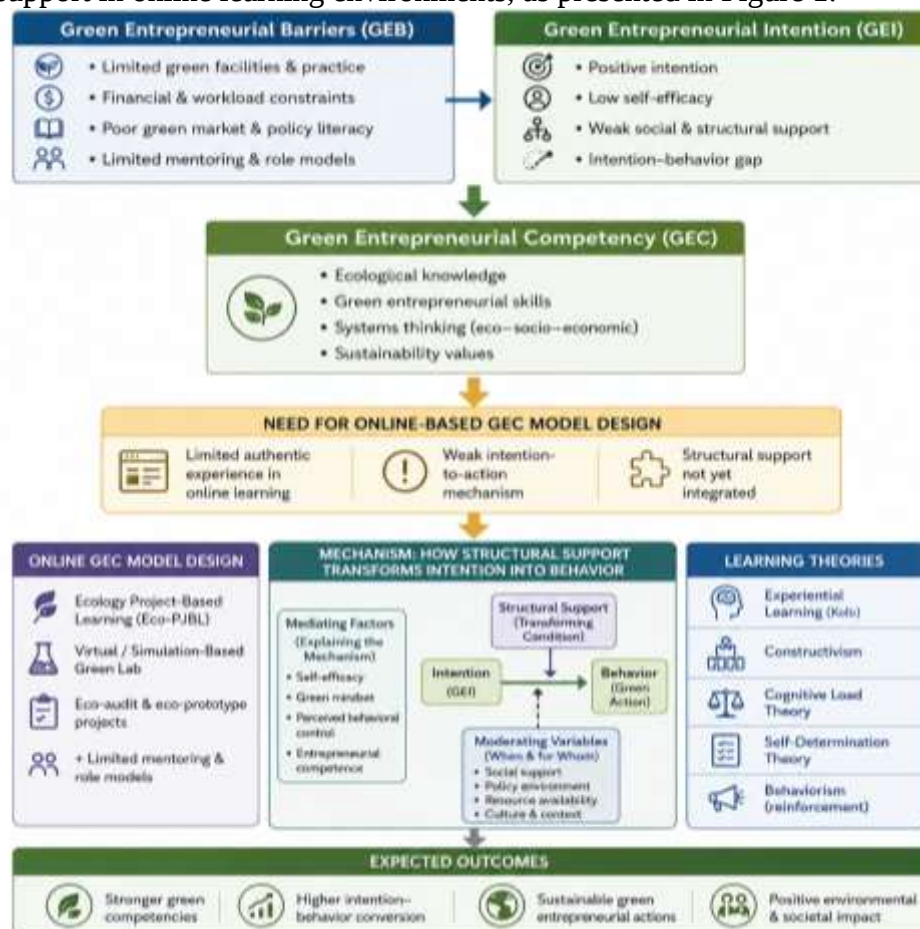


Figure 1. Conceptual Design Framework of Online-Based Green Entrepreneurship Education (GEE)

The framework illustrates that experience-based learning, collaborative processes, and structural support interact dynamically to strengthen competencies, reduce entrepreneurial barriers, and support the transformation of entrepreneurial intentions into sustainable entrepreneurial behavior. Experience-based learning through project-based learning, eco-prototyping, and virtual simulations helps students transform conceptual understanding into practical skills, while collaborative learning through peer interaction, mentoring, and group projects supports both competencies and entrepreneurial intention. Structural support also plays a key role in strengthening perceived behavioral control, self-efficacy, and entrepreneurial readiness through access to digital tools, mentoring systems, green market literacy, and institutional support (Ayed et al., 2026; Yi, 2021; Zhao et al., 2025). In supportive online learning environments, students are more likely to translate entrepreneurial intentions into sustainable entrepreneurial actions, whereas limited support may reinforce the intention–behavior gap. The findings further suggest that higher education institutions should strengthen experiential learning, virtual green labs, mentoring systems, business incubation, and collaboration with industries or MSMEs. Curriculum development should also integrate sustainability competencies, systems thinking, green-market literacy, and understanding of environmental policy to improve students' readiness for sustainable entrepreneurial practice.

Conclusion

This study shows that online-based Green Entrepreneurship Education has the potential to strengthen students' sustainability awareness and green entrepreneurial intentions; however, its implementation remains largely theoretical due to limited practical experience, mentoring, facilities, and institutional support. As a result, students' competencies, particularly in systems thinking and technical skills, have not fully developed, while structural barriers such as financial limitations, a lack of green facilities, and limited industry collaboration persist. The findings indicate that green entrepreneurial readiness depends not only on competencies and intentions but also on supportive structural and contextual conditions that enable authentic entrepreneurial practice. Theoretically, this study contributes by integrating Green Entrepreneurial Competency (GEC), Green Entrepreneurial Barriers (GEB), and Green Entrepreneurial Intention (GEI) into a unified evaluative framework for online-based GEE. Practically, the study highlights the importance of experiential and project-based learning, virtual green labs, mentoring systems, industry collaboration, and sustainability-oriented institutional support to strengthen students' competencies, self-efficacy, and readiness to engage in sustainable entrepreneurial practices in higher education.

Recommendation

Universities should integrate project-based learning, virtual green labs, eco-prototyping, and sustainability case studies into entrepreneurship courses. To overcome facility and technical barriers, institutions should provide digital simulation tools and establish partnerships with MSMEs or green industries. To reduce low self-efficacy and the intention–behavior gap, mentoring programs, peer support groups, and student business incubation should be strengthened. In addition, limited understanding of green markets and environmental policies should be addressed through green financing, market literacy, and sustainability policy modules. Universities and governments can also support student green startups through micro-grants, innovation competitions, and tax incentives for sustainable business initiatives.

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