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Entrepreneurship Education for Sustainable Development Goals: A Systematic Review and Future Directions

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ABSTRACT

Entrepreneurship education (EE) is important for achieving the United Nations' Sustainable Development Goals (SDGs). It provides students with the knowledge and skills to solve social and environmental problems through innovative business ideas. This review examines how EE helps reduce poverty, promote gender equality, protect the environment and grow the economy. This highlights the need to include sustainability in EE courses, focusing on hands-on learning, working across different fields, and involving the community. Universities are seen as places that create solutions to global problems and support business ideas that help achieve sustainable development. However, challenges remain in fully integrating sustainability into university activities and courses. The review also highlights the need to study the cultural and psychological aspects of EE and how to use new technologies. EE has the power to help achieve the SDGs, and this review offers advice for teachers to use EE for positive social, environmental, and economic results. Suggestions include conducting more research, making EE more accessible, using educational technology, and promoting a sustainable mindset. Future research should examine the cultural and psychological aspects of EE, find a balance between making money, being socially responsible, and caring for the environment, and explore how new technologies can be included in EE programs.

INTRODUCTION

The Sustainable Development Goals (SDGs) constitute a framework established by the United Nations through the "2030 Agenda for Sustainable Development." This global initiative, effective since 2016, includes 17 goals and 169 targets that address social, economic, and environmental challenges worldwide (Huck, 2022). The SDGs serve as a universal roadmap for sustainable development, guiding various levels of governance, including international organizations such as the European Union (EU), ASEAN, and CARICOM, which incorporate these goals into their policies (Huck, 2022). Within the EU, the SDGs have been integrated into a strategic framework for sustainable growth, using regional indicators to monitor progress (Lella *et al.*, 2024). The framework requires adaptation to regional contexts, as seen in the Arctic, where the indicators account for unique demographic challenges and indigenous rights (Nilsson & Larsen, 2020). In Europe, a dedicated monitoring framework balances the standardization and regional customization (Lella *et al.*, 2024).

Despite progress in gender equality (SDG 5), climate action (SDG 13), and life on land (SDG 15), Africa faces considerable challenges in achieving the SDGs by 2030 (Türkeş 2024). These challenges are intensified by irrelevant educational systems and weather events that impact food security, health, and communities (Codjoe & Atiglo, 2020). Governance remains a critical obstacle, with corruption and weak institutions hindering progress (Oppong, 2025). Effective governance and accountability are crucial for achieving the SDGs. Local efforts in agriculture and technology can drive progress, with Climate-Smart Agriculture being implemented in Kenya, Tanzania, Ethiopia, and Rwanda (Newell *et al.*, 2019). Digital tools present opportunities for achieving the SDGs, although Africa's digital infrastructure needs to be enhanced (Zindi & Ndhlovu, 2024). Governments must improve Internet accessibility and ICT infrastructure. Innovative approaches, such as mycelium composite production, can enhance agricultural productivity and employment (Akromah *et al.*, 2023). Although Africa faces challenges, opportunities exist for improved governance, local initiatives, and technology. Strategic actions and political will are essential for sustainable development by 2030 (Odey *et al.*, 2021). This necessitates the introduction of relevant education systems that integrate local insights, challenges, and opportunities into broader global efforts to achieve these goals by 2030 (Szetey *et al.*, 2021).

Entrepreneurship Education

Entrepreneurship education (EE) is essential for achieving Sustainable Development Goals (SDGs), including poverty alleviation, gender equality, environmental sustainability, and economic growth (Patricia, 2024). EE equips individuals with the skills to create innovative solutions to societal and environmental issues while promoting economic development. The goal is to help students identify sustainable business

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opportunities (Diepolder *et al.*, 2024). EE promotes responsible entrepreneurship aligned with environmental conservation and enables female economic participation, which is crucial for gender equality (Miralam *et al.*, 2025). Sustainable development meets present needs while safeguarding future generations' needs, emphasizing environmental preservation and poverty reduction (Kariyapperuma & Collins, 2021). Incorporating sustainability into EE programs promotes eco-friendly business practices (Uvarova *et al.*, 2021). EE's role in addressing social, environmental, and economic challenges significantly contributes to the SDGs (Uvarova *et al.*, 2021; Tripathi *et al.*, 2016; Alao *et al.*, 2023).

Entrepreneurship Education (EE) furthers the United Nations' sustainable development goals (SDGs) by fostering skills for sustainable economic development, similar to digital government initiatives and Multinational Enterprises (MNEs) (Alao *et al.*, 2023). The textile sector's focus on SDGs shows that EE can guide entrepreneurs towards poverty alleviation and inequality reduction. This is reinforced by the connections between Micro, Small, and Medium Enterprises (MSMEs) and SDGs (Miralam *et al.*, 2025), faith-based organizations (Tripathi *et al.*, 2016), and green building criteria (Alao *et al.*, 2023). Entrepreneurship education creates job opportunities for SMEs and drives inclusive economic growth and innovation (Rădulescu *et al.*, 2020). Governments must implement sustainable policies to create a conducive business environment that considers long-term impacts. Although entrepreneurship education offers innovative approaches to address these challenges (Rosário & Raimundo, 2023), knowledge gaps remain regarding the integration of digital technology into entrepreneurship programmes. This study addresses this gap in the literature.

Addressing obstacles in entrepreneurship education (EE) is imperative, particularly for integrating sustainability into business school curricula (Uvarova *et al.*, 2021). Comprehensive EE approaches are essential for developing entrepreneurial abilities and skills (Baggen *et al.* 2021). The multifaceted nature of EE is influenced by digital technologies that facilitate green transitions and entrepreneurial role models in tertiary education (Diepolder *et al.*, 2024; Uvarova *et al.*, 2021). Various disciplines have introduced the concepts of sustainable development and entrepreneurship (Ma, 2023). Sustainable entrepreneurship considers both sustainability and economic objectives (Rosário & Raimundo, 2023), whereas traditional entrepreneurship emphasizes economic value creation (Moșteanu, 2023; Hossain, 2024). According to Rosário and Raimundo (2023), sustainable entrepreneurship involves recognizing opportunities to develop innovations that address environmental, social, and economic challenges of sustainability. An educational framework that integrates people, the environment, and profit is essential (Diepolder, 2024; Mbore, 2021).

Despite extensive research on entrepreneurship education (EE), knowledge gaps remain regarding the effectiveness of current EE programmes in incorporating sustainability and digital technologies into the Sustainable Development Goals (SDGs) (Okuogume & Toledano, 2024). Creating specific learning environments is crucial for educating sustainable entrepreneurs (Mbore, 2021). Reviews have highlighted EE's innovative aspects of sustainable development, while examining education for sustainable entrepreneurship. Previous literature reviews have focused on sustainable entrepreneurship education (SEE) learning mechanisms and their links to innovation (Rădulescu *et al.*, 2020). Studies have explored the incorporation of SDGs into sustainable entrepreneurship education in developing countries and the impact of social entrepreneurship. Research has emphasized tracking progress in higher education regarding entrepreneurship and sustainable development (Oribu, 2022; Rădulescu, 2020). Current EE and SDGs research focuses on quantitative urban evaluations, leaving gaps in understanding EE's effects of EE on SDGs in rural regions through qualitative or mixed-methods research. This study systematically reviewed the literature to explore EE's contributions of EE to the SDGs.

Statement of the Problem

Entrepreneurship education centered on sustainable development goals (SDGs) integrates sustainability principles throughout the curriculum. Students would learn to identify business opportunities that address global issues while creating value. The curriculum emphasizes systems thinking to understand the connections between social, environmental, and economic factors. Students gain practical experience through hands-on projects and through case studies. Partnerships between communities, NGOs, and businesses present sustainability challenges for the future. Advanced technology can help students measure their entrepreneurial impact. Graduates will gain the skills and mindset to launch businesses that contribute to achieving the SDGs.

In recent years, entrepreneurship education aimed at achieving development goals has gained considerable momentum as a strategy for tackling global challenges while promoting economic growth. Educational institutions and policymakers increasingly acknowledge the necessity of equipping students with entrepreneurial skills that align with the United Nations' Sustainable Development Goals (SDGs). This approach seeks to cultivate a new generation of business leaders capable of devising innovative solutions to urgent environmental and social challenges. Curricula have been revamped to integrate sustainability principles, ethical business practices and social entrepreneurship. However, challenges persist in standardizing these educational programmes and ensuring their effectiveness in various cultural and economic contexts. As the world faces complex sustainability issues, the integration of entrepreneurship education with the SDGs continues to evolve, offering a holistic approach to business education and sustainable development.

The intersection of entrepreneurship education and Sustainable Development Goals (SDGs) poses a

considerable challenge to the promotion of sustainable business practices. Traditionally, entrepreneurship education has emphasized business creation, innovation, and profit maximization, often falling short of fully integrating sustainability principles aligned with the UN's SDGs. This gap may lead to entrepreneurs who do not fully grasp or prioritize the environmental and social impacts of their ventures. Consequently, many business models fail to address urgent global issues, such as climate change, poverty, and inequality. To address this, disconnect, entrepreneurship curricula must be restructured to incorporate sustainability concepts and highlight the importance of creating value beyond financial returns. This approach equips future entrepreneurs with the knowledge and skills needed to develop innovative solutions that contribute to achieving the SDGs while ensuring their economic viability.

Objective of the Study

This study aims to assess the impact of entrepreneurship education by focusing on its role in sustainable development, technological advancements in sustainable entrepreneurship, and challenges and limitations faced in entrepreneurship education for sustainable development.

LITERATURE REVIEW

Odeyemi *et al.* (2023) emphasized the importance of entrepreneurship education in achieving a balance between economic growth and ecological responsibility. This study endeavors to evaluate eco-friendly business practices and their ecological consequences. It delves into the incorporation of environmental elements into business tactics, shedding light on the implementation of green techniques owing to heightened awareness of planetary environmental issues. This study scrutinizes environmentally responsible business models, including circular economy frameworks, eco-innovative strategies, and sustainable supply chain management (SCM). Case studies and empirical evidence have demonstrated advantages such as lower carbon emissions, enhanced resource efficiency, and minimized waste. This study also addresses the obstacles faced by sustainable entrepreneurs, including market acceptance, regulatory challenges, and financial implications, underscoring the need to create a supportive environment for sustainable entrepreneurship. This study further explores how technology and innovation contribute to sustainable entrepreneurship, with an emphasis on renewable energy, advanced materials, and data analytics as key factors. These findings suggest that ongoing investment in R&D is crucial for improving the efficiency and scalability of eco-friendly and sustainable solutions in the fashion industry.

Rădulescu *et al.* (2020) conducted a study highlighted the importance of Entrepreneurial Education in the critical development of sustainable business. This study aims to improve future entrepreneurship programs by examining current curricula to identify educational deficiencies and ascertain the skills that students need for sustainable-business development. Additionally, this study aims to determine the skills students need to promote sustainable business development. The researchers undertook a comprehensive critical review of the methodological literature, and the results suggested that by sharing ideas and facilitating collective learning, entrepreneurial trainers can improve their practices and researchers can gain insights into the future directions of education. These findings indicate that a focused examination of current entrepreneurship education on an international scale, coupled with the formulation of recommendations for its advancement as a tool for future development, can yield beneficial results.

Patricia (2024) examined university entrepreneurship education as a means of achieving sustainable development. Businesses that focus on sustainability can drive innovation, seize opportunities, mitigate risks and build resilience. This study examines the connection between sustainable entrepreneurship education (SEE) and the United Nations' Sustainable Development Goals (SDGs) in higher education, focusing on how universities can leverage SEE to promote sustainable development. This study examines the impact of SEE on the SDGs by exploring its effects on poverty reduction, gender equality, environmental preservation, and economic development. The findings highlight the significant role of Social and Environmental Entrepreneurship (SEE) in equipping students with the essential knowledge, skills, and mindsets necessary to address social and environmental challenges through future entrepreneurial initiatives. This study proposes strategies for integrating sustainability principles into entrepreneurship education programs that emphasize experiential learning, interdisciplinary collaboration and community engagement. Furthermore, this study examines the role of universities as innovation hubs in developing solutions to global challenges and fostering entrepreneurial ecosystems that support sustainable development. This study underscores the transformative potential of university entrepreneurship education in advancing Sustainable Development Goals (SDGs), offering valuable insights for educators aiming to leverage entrepreneurship education to generate positive social, environmental, and economic impacts.

Baggen *et al.* (2021) studied the fostering of entrepreneurial mindsets through educational programs. This study aimed to identify approaches beyond defining entrepreneurial competencies to include activities that further develop these competencies. The researchers conducted a critical literature review. Their findings suggest that developing an educational program to enhance value-creation learning in students can cultivate an entrepreneurial mindset and address pressing issues such as climate change. This study identified the need for principles to guide the design of comprehensive entrepreneurship education (EE) programs. Entrepreneurship education has gained traction as a holistic approach to nurturing an entrepreneurial mindset across educational stages, often

called "wide approaches to EE." This study formulated 11 design principles for EE programs, aiming to enhance educational practices and research by drawing on core entrepreneurship theories, such as experiential learning, social constructivism, and effectuation theory. These principles cover the entrepreneurial process, tasks, context and relationships within EE programmes. Their application was demonstrated through three European case studies at different educational levels, highlighting their importance in EE. The findings suggest that these principles can facilitate evidence-based discussions among educators, curriculum designers, policymakers, and researchers regarding the design, implementation, and evaluation of EE programs. Future research should focus on examining diverse social and environmental entrepreneurship education (SEE) programs for various purposes and educational levels before exploring the connection between the design and impact of these programs.

Diepolder *et al.* (2024) contended that transitioning to a sustainable economy is crucial for achieving the United Nations Sustainable Development Goals by 2030. Sustainable entrepreneurship is crucial for such changes. They find and follow business opportunities to solve problems, such as the loss of biodiversity. Recognizing these opportunities is the first step in sustainable entrepreneurship. Sustainable entrepreneurship education (SEE) teaches the skills and knowledge required for sustainability. In schools, SEE uses role models to help students learn. This study examined how role models help students identify opportunities for sustainable development (SD). A total of 136 secondary school students participated in a program designed to teach sustainable entrepreneurship. Of these, 68 worked with role models who provided support and feedback. In groups–3-5, the students developed ideas for sustainable development (n=35). The quality of these ideas was checked and differences between the groups were studied. This study showed that role models help students generate better ideas for sustainable development. These results can help teachers plan and improve their SEE.

Uvarova *et al.* (2021) focused on nurturing a green entrepreneurial mindset through contemporary entrepreneurship education. This study explores how ecological and sustainability themes are integrated into entrepreneurship education programmes to develop an entrepreneurial mindset that emphasizes environmental stewardship and encourages the adoption of green business practices. The study's empirical basis involved the evaluation of a survey of 657 undergraduate Business Administration students. The findings reveal that the COVID-19 pandemic intensified various sustainable development challenges and that decisions made during the recovery phase significantly influenced future sustainable development paths. Digital technologies are pivotal in achieving green transitions. This study holds significant practical, social, and scientific relevance as it examines the influence of the green movement on entrepreneurship education curricula and its role in fostering a green entrepreneurial mindset among students.

Alao *et al.* (2023) highlight the curriculum's pivotal role in promoting green entrepreneurship, aligning with the central theme of our systematic review. This study investigated policies and innovative instructional practices that can empower undergraduate Business Education students in Nigeria to achieve optimal social, economic, and environmental sustainability. Through a comprehensive literature search methodology followed by a narrative review, the study employed search terms such as "entrepreneurial skills," "Nigerian business education students," "sustainability," "policy," and "practice" which are frequently explored across databases such as PubMed, Google Scholar, Scopus, and Web of Science. The results revealed that Nigeria's business education curriculum policies and practices have not yet incorporated green entrepreneurship. These include waste management and recycling, commercialization of eco-friendly products and involvement in agribusinesses. This study underscores the urgent need to scrutinize entrepreneurship education in higher learning to achieve developmental goals.

Okuogume and Toledano (2024) investigated co-creation within the context of Sustainable Entrepreneurship Education, specifically focusing on the role of business-university educational partnerships. Their research focused on sustainable entrepreneurship education initiatives at a Northern European university in collaboration with local stakeholders. The program was structured to provide students with the competencies required to formulate innovative solutions to social and environmental challenges while promoting sustainable change through collaborative partnerships. This study employed autoethnography, a qualitative method involving reflection and activity. This study focuses on two main questions: How can students, educators, business experts, and government representatives collaborate to create sustainable entrepreneurial ideas? Furthermore, what are the benefits and drawbacks of co-creation in the context of sustainable entrepreneurship education, and what underscores the need to address global ecological challenges in the future? Policymakers and universities have implemented measures to promote sustainability. These findings suggest that collaborative teaching and learning experiences that address local business problems through knowledge co-creation can facilitate sustainable solutions and experiential learning, thereby contributing to social transformation.

Rosário and Raimundo (2023) highlight the pressing necessity of transitioning to a sustainable economy to address global issues such as climate change. Sustainable entrepreneurs are pivotal in delivering innovative solutions that yield positive environmental, social and economic outcomes. However, there is a lack of consensus on the precise educational skills needed to cultivate sustainable entrepreneurship to address these challenges. This study aimed to identify the factors that lead to successful education for future sustainable

entrepreneurship. An extensive review of the academic literature was performed using an English-language bibliographic database and search engine, which yielded 59 empirical and non-empirical studies on sustainable entrepreneurship education (SEE) published from 2012 to April 2023. The analysis of these studies revealed various educational frameworks for sustainable entrepreneurship (SE) applicable to both higher education institutions and secondary schools. The search did not yield any results that could be used to determine the training data cutoff date or any other specific information regarding the data sources used in this study.

Sreenivasan and Suresh (2023) conducted a bibliometric analysis to examine the influence of sustainable entrepreneurship on the Sustainable Development Goals (SDGs). They reviewed 1,357 publications from 2002 to 2022, with 679 focusing on SDGs, and utilized the Dimensions database to identify significant authors, sources, and influential works. This study sought to elucidate the contribution of sustainable entrepreneurship to the Sustainable Development Goals (SDGs), offer insights into development initiatives, and address gaps in the literature by examining key figures and employing a co-word analysis to uncover relevant themes. The results suggest that studies of sustainable entrepreneurship influence SDG 11 (Sustainable Work and Economic Growth), SDG 12 (Responsible Cities and Communities), and SDG 8 (Decent Consumption and Production). This study underscores "Sustainable Entrepreneurship and Sustainability Innovation: Categories and Interactions" as a critical research area. This study underscores crucial areas such as social entrepreneurship, innovation, impact investing, the plastics sector, the triple bottom line, supply chains, sustainable business practices, business networks, competitiveness, innovative economies, social efficiency, entrepreneurial marketing, and medium-sized enterprises. Furthermore, it explores how Entrepreneurship Education in Higher Education Institutions aids in achieving the Sustainable Development Goals (SDGs).

Al Balushi *et al.* (2023) conducted a study highlight the pivotal role of entrepreneurship education in fostering innovation, economic growth, and job creation. This study explores how higher-education curricula influence entrepreneurship education and student knowledge, success, and attitudes. Utilizing a mixed-methods approach, the qualitative phase involved interviews and focus groups with educators, program directors and entrepreneurs. The quantitative phase comprised a survey of students enrolled in entrepreneurship programs in Brazil. The literature review underscores the importance of factors such as the integration of theory and practice, hands-on learning, collaboration with industry, and the use of real-world case studies in successful entrepreneurial education. These insights have significant implications for policymakers, educators, and curriculum developers aiming to improve entrepreneurial programs in higher education. By identifying successful teaching strategies and curriculum components, higher education institutions can equip students with the essential skills and mindsets required to succeed as entrepreneurs in the competitive landscape of today.

Tripathi *et al.* (2016) conducted research on innovation in sustainable entrepreneurship education in Africa with a focus on strategy and social impact. This study examines contemporary academic perspectives on entrepreneurship and management education and underscores the crucial role of business schools in promoting sustainable development. This study aimed to comprehend and evaluate how entrepreneurship education contributes to fostering sustainable entrepreneurship. This highlights the importance of innovation in entrepreneurship education, with a specific emphasis on analyzing the sustainable entrepreneurship education program implemented by ALTIS in Africa. Furthermore, this study assessed the initial impact of sustainable entrepreneurship cases that emerged from projects developed by ALTIS graduates in Africa. The methodology includes a thorough review of the existing literature. The results suggest that the case analysis provides valuable insights into practical sustainable entrepreneurship models in the African context, ultimately enhancing the understanding of how interventions driven by multiple stakeholders contribute to the progress of sustainable entrepreneurship education, particularly in Africa.

MATERIALS AND METHODS

We employed a narrative review to thoroughly examine existing EE research. This approach was chosen because it is particularly useful for examining topics that have been studied differently by various research groups across various fields (Wong *et al.*, 2013). To conduct a semi-systematic review, several methods similar to those employed in qualitative research can be used to synthesize the findings. Qualitative research entails the examination of descriptive data from individuals, experts, scholars, or phenomena. Previous research has shown the effectiveness of narrative analysis as a technique for conducting literature reviews in business studies, offering a thorough understanding of individuals and organizations' experiences and viewpoints (Walsh, 2014; Cunliffe, 2016; Prayag *et al.*, 2023). As Sarkar and Bhatia (2021) note, narrative reviews offer the narrator's perspective and provide an insightful analysis of the existing literature in the field. To identify key themes, trends, patterns, and gaps in the existing research, relevant literature was collected and analyzed based on established selection criteria. The findings of the literature review were used to develop a coherent narrative summarizing the current state of knowledge on this topic. The synthesis step involves organizing the literature thematically and chronologically or using a theoretical framework. This study followed a four-step process to gather and analyze existing studies on the topic.

• Database search: The study comprised an extensive search of various databases, yielding 629 results from the Web of Science and 5275 results from Scopus, which

served as the principal source of information. Google Scholar was also used, which returned 1,742,000 results. All redundancies were thoroughly checked and removed from the analysis.

• Keyword identification: Keywords 'Entrepreneurship Education (EE), Sustainable Development Goals (SDGs), Sustainable Entrepreneurship, Experiential Learning, Interdisciplinary Approaches, Responsible Entrepreneurship, Entrepreneurial Mindset" were used to guide the search.

• Article review: To determine the relevance of the study articles and abstracts pertinent to the topic, the relevance of the study was assessed.

• Summary and synthesis: The results of the examined articles were consolidated and integrated to attain an overarching comprehension of the extant literature on Entrepreneurship Education.

In the fourth step, thematic analysis was used to synthesize the themes discovered in the literature. Numerous recent studies have employed thematic analysis to explore a range of topics, including mental health (Steira *et al.*, 2024), health behavior change (Kariyapperuma & Collins, 2021), and QoL(Jiang *et al.*, 2021). The results of these studies illustrate the effectiveness of thematic analysis in uncovering rich and in-depth insights into the experiences and perspectives of the authors' ideas. The thematic analysis process typically comprises six steps (Newell *et al.*, 2019) (Figure 1).

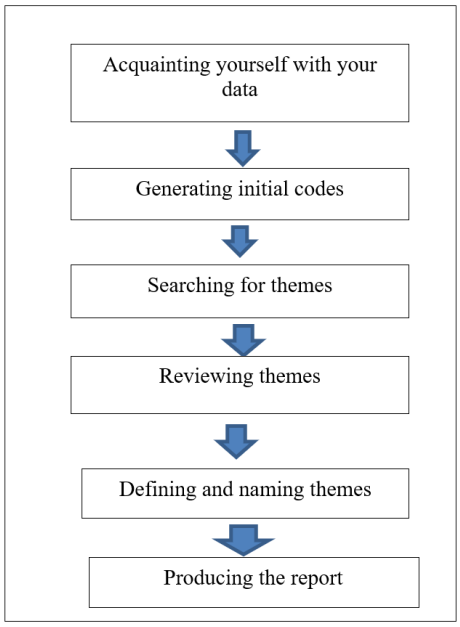

Figure 1: Steps in thematic analysis

In the initial phase, the researchers thoroughly examined the data by reading and rereading them, searching for patterns or themes, and developing a preliminary understanding of the data. In the second phase, preliminary codes were derived from the data by breaking them into smaller units and attaching a code to each unit. In the third phase, themes were recognized by grouping similar codes and identifying the connections between them. In the fourth phase, the themes were assessed, defined, and refined. In the fifth phase, themes were chosen, and the data were rearranged to reflect the chosen themes. The findings were documented, presented clearly, and coherently.

RESULTS AND DISCUSSION

Impact Entrepreneurship Education

Sreenivasan and Suresh (2023) found that research on sustainable entrepreneurship has a notable impact on SDG 11 (Sustainable Cities and Communities), SDG 12 (Responsible Consumption and Production), and SDG 8 (Decent Work and Economic Growth). This is further supported by Diepolder *et al.* (2024), who proposed that sustainable entrepreneurial role models positively influence the generation of ideas for sustainable development. Karahan and Stoeckermann (2023) contribute significantly to both research and practice by outlining the iterative development process, explaining the use of the Impact Circle, and offering new insights into bisociation as a phenomenon of entrepreneurial cognition and creativity. Egieya *et al.* (2023) indicated that forward-thinking entrepreneurs could capitalize on future trends, such as technology integration and the adoption of a circular economy, to achieve success. Uvarova *et al.* (2021) observed that the COVID-19 pandemic has intensified various sustainable development challenges, and that decisions made during the recovery phase will greatly influence the future path of sustainable development. Despite these contributions, there remains a lack of comprehensive understanding of how interdisciplinary approaches within EE specifically drive each SDG, especially in less-explored areas such as SDG 14 (Life below Water) and SDG 15 (Life on Land).

Role Entrepreneurship Education Sustainable Development

Alao *et al.* (2023) found that the current curriculum policy and practices for business education in Nigeria are not aligned with teaching green entrepreneurship, which includes waste management, recycling, commercialization of green products, and participation in agribusinesses. Similarly, Rădulescu *et al.* (2020) underscore the importance of sharing ideas and facilitating collective learning to improve entrepreneurial practices, while also providing researchers with insights into potential future directions for education. Rosário and Raimundo (2023) identified several educational frameworks for sustainable entrepreneurship (SE) that are applicable to both higher education institutions and secondary schools. Patricia (2024) highlights the importance of EE in equipping students with the essential knowledge, skills, and mindset required to address complex social and environmental challenges through entrepreneurial ventures. Baggen *et al.* (2021) observed that designing educational programs to stimulate the value-creation learning process can aid students in developing an entrepreneurial mindset

and contribute to solving urgent issues, such as climate change. Al Balushi *et al.* (2023) stress that elements such as balancing theory and practice, incorporating experiential learning, forming industry partnerships, and utilizing real-life case studies are essential for effective entrepreneurship education.

Technological Advancements Sustainable Entrepreneurship

Following the exploration of educational roles, it is crucial to consider the technological advancements that underpin entrepreneurship education. Uwaoma *et al.* (2024) examined the application of artificial intelligence in enhancing energy efficiency, waste management, and sustainable supply chain operation. They highlight their capacity to process extensive datasets and generate actionable insights, thereby optimizing resource utilization and reducing environmental impact. Similarly, Odeyemi *et al.* (2023) highlighted the significance of continuous investment in R&D to improve the efficiency and scalability of environmentally friendly and sustainable entrepreneurship solutions. Okuogume and Toledano (2024) suggest that collaborative learning experiences, which involve addressing real, local business challenges through the co-creation of knowledge, can result in sustainable solutions and experiential learning, thereby contributing to the transformation of societies towards sustainability. Tripathi *et al.* (2016) demonstrate that case analysis provides insights into sustainable entrepreneurship models in practice within the African context, ultimately facilitating an understanding of the role of multi-stakeholder-driven interventions in promoting sustainable entrepreneurship education, particularly in the African context.

Challenges Limitations Entrepreneurship Education Sustainable Development

Entrepreneurship education for sustainable development (EESD) faces various challenges, including research limitations in unstable nations and diverse populations, insufficient attention to educational technology and innovative methodologies (Rashid, 2019), and difficulties in comprehensively integrating sustainability into university operations, curriculum content, and research activities (Okuogume & Toledano, 2024). The gradual adaptation of entrepreneurship programs to sustainability and circular economy principles, coupled with the necessity of cultivating an environmentally conscious entrepreneurial mindset among students, presents significant obstacles (Uvarova *et al.*, 2021). Notwithstanding these challenges, the transformative potential of education can foster a generation prepared for a sustainable future, as evidenced by Kazakhstan's initiatives during the COVID-19 lockdown (Yelubayeva *et al.*, 2023) and the Republic of Moldova's alignment of its national strategies with sustainable development objectives (Lukšić *et al.*, 2022). Cultural Heritage Entrepreneurship in Southeast Europe faces financial constraints, market accessibility issues, and innovation barriers (Aliamutu & Mkhize, 2024), whereas African entrepreneurs encounter infrastructure deficiencies, funding challenges, and regulatory complexities (Odeyemi *et al.*, 2024).

Scholarly discourse critiques the profit-oriented paradigm in entrepreneurship education, which may hinder effective sustainability instruction (Adeola, 2024), and identifies obstacles such as financial constraints, educational deficits, and inadequate infrastructure for female entrepreneurs in rural South Africa (Odeyemi *et al.*, 2024). EESD faces challenges in research, curriculum integration, pedagogical methods, and systemic barriers across the environment. Addressing this requires strengthening research, enhancing EET accessibility, using educational technology, and fostering a sustainability mindset in entrepreneurship education (EE). Current EE programs often lack systematic integration of experiential learning, which directly connects students with sustainable development projects in real-world settings. There is a need for curriculum designs that not only teach sustainability principles but also actively involve students in projects that contribute to achieving the SDGs, bridging the gap between theoretical knowledge and practical application. The literature highlights the need for targeted interventions and innovative solutions to overcome these barriers and promote sustainable development through entrepreneurship education (Odeyemi *et al.*, 2024; Rashid, 2019; Uvarova *et al.*, 2021; Yelubayeva *et al.*, 2023).

CONCLUSION

The study shows that integrating entrepreneurial skills with sustainability principles enhances learners' contribution to sustainable development. Entrepreneurship education (EE) develops critical thinking and problem-solving skills aligned with global sustainability challenges. This research highlights experiential learning and interdisciplinary approaches that engage students in real-world sustainability projects. EE designed around Sustainable Development Goals (SDGs) promotes economic growth while instilling social responsibility and environmental stewardship. This approach develops entrepreneurial mindsets by balancing profit with ethical considerations and supporting sustainable business models. Role models and collaborative environments enhance students' ability to recognize sustainable opportunities. Technological advancements, including artificial intelligence, are critical for improving sustainability in EE. However, challenges remain in embedding sustainability into curricula, requiring curriculum reform and enhanced educational technologies.

Recommendations

The study recommends integrating entrepreneurship education into curricula to equip learners with the skills and mindset to address sustainability challenges. It emphasizes the alignment of entrepreneurial competencies with the United Nations Sustainable Development Goals (SDGs), fostering innovation, ethical responsibility, and social

impact awareness among students. This study advocates collaboration among educational institutions, industry stakeholders, and policymakers to establish ecosystems that encourage practical learning experiences, including project-based and community initiatives. This highlights the need for curriculum evaluation and capacity building for educators to ensure relevance in promoting sustainable entrepreneurship. These recommendations aim to cultivate entrepreneurs capable of driving sustainable economic growth and social development.

Contributions of the study to Knowledge

This study makes a unique contribution by thoroughly examining the intersection of emerging technologies and traditional educational practices. By integrating cutting-edge artificial intelligence tools with established pedagogical methods, this study bridges a critical gap in the literature. Unlike previous studies that focused solely on technological advancements or educational theories, this study offers a holistic analysis of their combined impact on students' learning outcomes. Additionally, its innovative methodological approach, which includes both quantitative data analysis and qualitative insights from educators and students, provides a nuanced understanding of the complex dynamics involved. This multifaceted perspective not only deepens our understanding of the potential benefits and challenges of AI integration in education but also offers actionable insights for policymakers and educators aiming to optimize learning environments in the digital age.

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