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Bibliometric Study on the Relationship between Entrepreneurship Education and Business Sustainability

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ABSTRACT

Entrepreneurship education has emerged as a crucial driver of innovation and business sustainability, equipping individuals with the necessary skills to navigate complex market environments while fostering responsible and sustainable business practices. This study conducts a bibliometric analysis using Scopus database and VOSviewer to map the evolution of research at the intersection of entrepreneurship education and business sustainability. The analysis identifies key research trends, influential authors, collaborative networks, and emerging thematic areas, providing insights into how scholarly discourse in this field has developed over time. The findings reveal that entrepreneurship education research has expanded from individual behavioral studies to encompass pedagogical advancements, sustainability integration, and digital transformation through artificial intelligence and big data applications. While the study highlights strong international collaborations, it also uncovers regional disparities and limited interdisciplinary research, suggesting the need for more cross-country comparative studies and integration of sustainability-focused educational models. This study contributes to the academic discourse by identifying research gaps and proposing future directions for enhancing entrepreneurship education's role in sustainable business development.

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1. INTRODUCTION

Entrepreneurship education has emerged as a pivotal element in modern business curricula worldwide, reflecting a paradigm shift from traditional management instruction toward fostering innovative mindsets and proactive problem-solving skills. As economies become increasingly dynamic and competitive, academic institutions and policymakers recognize that nurturing entrepreneurial competencies—such as creativity, risk management, and opportunity recognition—is essential for sustaining economic growth and social development [1]. By integrating real-world challenges into classroom settings,

entrepreneurship education not only enhances the technical skills of individuals but also encourages adaptive thinking in uncertain environments. In doing so, it creates a fertile ground for the development of innovative business models and ventures that can drive socio-economic progress [2]. Moreover, the global diffusion of entrepreneurship education programs underscores its role as a catalyst for empowering future business leaders and equipping them with the tools necessary to navigate complex market landscapes. This transformation in educational approaches has, in turn, spurred interest among scholars to explore its broader implications for business performance and sustainability [3].

Business sustainability, on the other hand, has become a critical focus for both industry practitioners and researchers amid growing concerns over environmental degradation, social inequality, and economic instability. Traditionally viewed as an adjunct to profitability, sustainability is now recognized as an integral component of long-term business strategy [4]. Modern enterprises are increasingly expected to adopt sustainable practices that balance economic objectives with environmental stewardship and social responsibility [5]. This shift is reflected in global initiatives and regulatory frameworks that emphasize sustainable development goals, compelling businesses to rethink operational models and stakeholder engagements. The notion of sustainability extends beyond environmental management to include ethical considerations, corporate governance, and community involvement. As such, the evolution of business sustainability has prompted organizations to innovate in product development, supply chain management, and corporate social responsibility, ensuring that they remain viable and competitive in a rapidly changing global market [6].

The intersection of entrepreneurship education and business sustainability represents a burgeoning area of academic inquiry and practical significance. Scholars argue that the entrepreneurial mindset—characterized by innovation, resilience, and adaptability—can be a driving force behind the adoption of sustainable business practices [7]. Entrepreneurship education equips individuals with not only the technical know-how but also the visionary approach required to integrate sustainability into the core business model. This integration is critical because sustainable business practices, when rooted in entrepreneurial innovation, can lead to the creation of competitive advantages that transcend conventional market boundaries [8]. Furthermore, entrepreneurial ventures are often at the forefront of developing novel solutions to environmental and social challenges, making them ideal vehicles for promoting sustainability. The synergy between these two domains holds promise for transforming traditional industries and fostering a new wave of responsible, resilient, and growth-oriented enterprises.

A bibliometric study serves as a powerful methodological tool for mapping and evaluating the evolution of scholarly research in complex fields. Bibliometrics involves the quantitative analysis of academic literature, allowing researchers to assess publication trends, citation networks, and collaborative patterns among authors and institutions [9]. This approach is particularly useful in fields experiencing rapid growth and diversification, as it can reveal underlying structures and emerging themes that might be obscured by traditional literature reviews. By employing bibliometric techniques, researchers can identify influential studies, prominent authors, and key research clusters that have shaped the discourse on entrepreneurship education and business sustainability. Additionally, bibliometric analysis provides an empirical basis for understanding how research areas evolve over time, offering insights into the diffusion of ideas and the impact of policy or educational reforms on scholarly output [10]. Such insights are invaluable for guiding future research agendas and informing strategic decisions in both academia and industry.

The rationale for integrating a bibliometric approach into the study of entrepreneurship education and business

sustainability is grounded in the need for a comprehensive and systematic understanding of the existing literature. Despite the significant growth in research on both topics, the literature remains fragmented, with many studies addressing either entrepreneurship education or sustainability in isolation. A bibliometric study can bridge this gap by collating, categorizing, and analyzing the body of work that explores their interrelationship. This integration is essential not only for academic advancement but also for practical applications. Educators and policymakers require a consolidated view of how entrepreneurial training influences sustainable business practices, particularly in the context of evolving market dynamics and environmental challenges. By mapping the research landscape, the study aims to illuminate patterns of collaboration, identify research clusters, and uncover emerging trends that could inform curriculum development and business strategy. Ultimately, this approach promises to yield a holistic perspective that aligns entrepreneurial innovation with the imperatives of sustainability [11], [12].

Despite the growing body of literature on both entrepreneurship education and business sustainability, a significant gap exists in studies that comprehensively examine their interrelationship using systematic, quantitative methods. Many existing studies tend to focus on one aspect without considering the synergistic potential of integrating entrepreneurial training with sustainable business practices. This fragmentation leads to a disjointed understanding of how educational initiatives can effectively promote sustainability within business operations [13]. The absence of a consolidated, bibliometric analysis that maps the evolution of research, identifies key trends, and clarifies the dynamics between these two domains poses a challenge for both scholars and practitioners. Without a unified framework, efforts to leverage entrepreneurship education for achieving long-term business sustainability remain ad hoc and less impactful, ultimately limiting the effectiveness of policy and educational reforms aimed at fostering resilient and responsible enterprises [14].

The objective of this study is to conduct a comprehensive bibliometric analysis that maps and evaluates the scholarly contributions at the intersection of entrepreneurship education and business sustainability. This study aims to identify emerging trends, influential publications, and collaborative networks within the literature, thereby providing a robust framework for future research and practical applications. By synthesizing the existing knowledge and uncovering critical research gaps, the study seeks to inform educators, policymakers, and business leaders on how entrepreneurial education can be strategically harnessed to promote sustainable business practices in an increasingly complex global environment [15].

2. LITERATURE REVIEW

The academic discourse surrounding entrepreneurship education and business sustainability has expanded significantly over the past few decades, reflecting the evolving demands of a rapidly globalizing economy and an increasingly complex socio-environmental landscape. Researchers have dedicated considerable efforts to understanding how educational initiatives can nurture entrepreneurial mindsets and, in turn, drive sustainable business practices. This literature review examines seminal works and emerging studies that inform the current understanding of both domains. In doing so, it highlights the evolution of entrepreneurship education as a distinct field, the development of business sustainability concepts, the synergies between these two areas, and the utility of bibliometric analysis in mapping these intellectual trajectories.

A substantial body of literature has been devoted to the development and impact of entrepreneurship education. Early studies in this field primarily focused on the transmission of technical business skills and basic management practices [16]. However, as the global economy has evolved, so too have

the educational strategies that prepare students for entrepreneurial endeavors. Researchers such as [17] and [18] argue that modern entrepreneurship education transcends conventional business training by emphasizing creativity, innovation, and opportunity recognition. These programs are designed to foster a proactive attitude toward risk and change, thereby equipping individuals with the capacity to identify and exploit new market opportunities. Moreover, a growing number of studies have highlighted the importance of experiential learning, where real-world challenges and practical projects are integrated into the curriculum to bridge the gap between theory and practice [19]. The literature suggests that such pedagogical approaches not only enhance entrepreneurial skills but also cultivate resilience and adaptability, qualities that are indispensable in today's volatile business environments.

Parallel to the evolution of entrepreneurship education, research on business sustainability has undergone significant theoretical and empirical development. Initially, sustainability was primarily associated with environmental conservation and corporate social responsibility [20]. Over time, scholars such as [9] expanded this perspective to include economic viability and social equity, thereby framing sustainability as a multidimensional construct. Contemporary research emphasizes that for a business to be truly sustainable, it must integrate the triple bottom line—economic, social, and environmental considerations—into its core strategies. This broader perspective has led to the development of new models and frameworks that guide organizations in implementing sustainable practices, from green supply chain management to corporate governance reforms. Empirical studies have documented the benefits of adopting sustainable practices, including enhanced brand reputation, improved stakeholder relationships, and long-term financial performance. However, the literature also acknowledges the challenges associated with balancing profitability with ethical and environmental considerations, particularly in industries where traditional business models are deeply entrenched.

A growing segment of research has begun to explore the intersection of entrepreneurship education and business sustainability, suggesting that these fields are not mutually exclusive but are, in fact, deeply interconnected. Scholars such as [21] contend that entrepreneurial education can serve as a catalyst for sustainable innovation. The entrepreneurial mindset—characterized by flexibility, creativity, and a willingness to embrace risk—can be instrumental in reconfiguring traditional business practices toward more sustainable models. This integrated approach is evident in studies that highlight how entrepreneurial ventures are often at the forefront of developing eco-friendly technologies and sustainable business practices [11]. Furthermore, research indicates that incorporating sustainability into entrepreneurship curricula can enhance the social and environmental impact of new ventures, thereby fostering a generation of business leaders who are not only profit-oriented but also socially and ecologically responsible. Despite these insights, the literature on the convergence of entrepreneurship education and business sustainability remains relatively fragmented, with few studies offering a holistic view of how these domains interact over time.

In recent years, bibliometric analysis has emerged as a robust methodological approach for synthesizing the extensive literature on entrepreneurship education and business sustainability. Bibliometric studies utilize quantitative techniques to analyze publication trends, citation patterns, and collaborative networks, offering a macro-level perspective on the evolution of academic fields [22]. Researchers such as [10] have demonstrated the efficacy of bibliometric methods in identifying key research clusters, influential authors, and emerging trends within complex domains. By mapping citation networks and analyzing co-authorship patterns, bibliometric studies reveal the intellectual structure and developmental trajectory of research areas.

This approach not only highlights dominant themes and methodologies but also uncovers potential gaps and future research directions. In the context of entrepreneurship education and business sustainability, bibliometric analysis can serve as an invaluable tool for integrating disparate strands of literature, thereby offering a comprehensive overview of how educational practices and sustainable business models have co-evolved.

3. METHODS

The present study employed a systematic bibliometric methodology to investigate the evolving relationship between entrepreneurship education and business sustainability using data exclusively sourced from Scopus. A comprehensive search strategy was implemented on Scopus, incorporating keywords such as "entrepreneurship education," "business sustainability," "sustainable entrepreneurship," and "innovative business practices" to retrieve relevant scholarly outputs published between 2000 and 2024. Only peer-reviewed articles, review papers, and conference proceedings written in English were included to ensure the quality and relevance of the dataset. After data extraction, a meticulous cleaning process was undertaken to remove duplicates and standardize author names and keyword variations. The refined dataset was then analyzed using VOSviewer, a specialized tool for bibliometric analysis that facilitated the mapping of influential publications, authors, and collaborative networks, as well as the identification of emerging trends and research clusters within the field [23].

4. RESULTS AND DISCUSSION

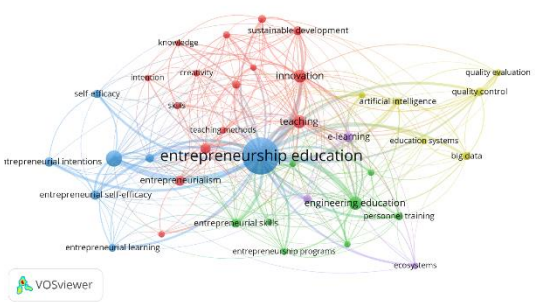

Figure 1. Network Visualization
Source: Data Analysis, 2025

The bibliometric visualization presents a network of interconnected research themes related to entrepreneurship education, with key clusters denoting various focal areas of scholarly interest. The largest node, representing "entrepreneurship education," signifies its central role in the network, acting as the primary subject of research. The size of this node suggests that it has received significant attention in the academic literature. Various other nodes and their interconnections indicate emerging and established research directions. The network is color-coded, reflecting distinct thematic clusters, each of which corresponds to a specific area of research that complements or intersects with entrepreneurship education. By analyzing these clusters, it is possible to discern how different research strands contribute to the broader discussion on entrepreneurship education and its implications for business sustainability and innovation.

The blue cluster, which appears prominently on the left side of the visualization, focuses on entrepreneurial self-efficacy, entrepreneurial intentions, and entrepreneurial learning. This cluster suggests a strong interest in understanding the psychological and behavioral aspects of entrepreneurship education. The presence of terms like "self-efficacy" and "intentions" indicates that much of the research in this domain examines how entrepreneurship education fosters confidence and motivation among learners, ultimately influencing their likelihood of pursuing entrepreneurial ventures. The interconnections between these terms imply that studies in this cluster explore the effectiveness of different teaching methodologies in shaping entrepreneurial mindsets, particularly through experiential learning approaches that emphasize real-world application. This cluster highlights a crucial area of entrepreneurship education, as self-efficacy and intention are often considered strong predictors of entrepreneurial success.

The red cluster, centered around terms such as innovation, teaching, sustainable development, creativity, and knowledge, underscores the role of entrepreneurship education in fostering innovative capabilities and sustainability-driven business practices. The strong linkage between "teaching," "innovation," and "sustainable development" suggests that researchers have investigated how entrepreneurial education equips students with the creative problem-solving skills needed to develop sustainable business solutions. The emphasis on "creativity" and "skills" reinforces the idea that entrepreneurship education is not merely about business planning but also about cultivating an innovative mindset that aligns with sustainable economic models. The presence of "sustainable development" in this cluster indicates that there is a growing recognition of the need to integrate sustainability into entrepreneurship curricula, further supporting the argument that entrepreneurship education can play a pivotal role in addressing global challenges such as climate change, social inequality, and resource depletion.

The green cluster, which includes engineering education, entrepreneurial skills, entrepreneurship programs, and personnel training, reflects the increasing interdisciplinarity of entrepreneurship education. The connections between "entrepreneurial skills" and "engineering education" suggest that entrepreneurship is being integrated into STEM (science, technology, engineering, and mathematics) fields, a trend that aligns with the rising demand for technological innovation in business. The inclusion of "personnel training" in this cluster further indicates that entrepreneurship education is not solely confined to formal academic settings but is also being applied in corporate training programs to enhance employees' entrepreneurial capabilities. This finding suggests that entrepreneurship education is expanding beyond traditional business schools and being embraced by other disciplines and industries, reflecting its growing importance in fostering innovation-driven economies.

The yellow cluster, containing terms like artificial intelligence, big data, education systems, quality control, and quality evaluation, highlights the role of technology and data analytics in entrepreneurship education. The presence of "artificial intelligence" and "big data" suggests that researchers are exploring how digital tools and technological advancements can enhance entrepreneurial learning and decision-making processes. The connections to "education systems" and "quality evaluation" imply a focus on assessing the effectiveness of entrepreneurship education programs and identifying best practices for their implementation. This cluster underscores the increasing role of digitalization in education, with artificial intelligence and big data analytics being used to improve teaching methodologies, personalize learning experiences, and measure student outcomes in entrepreneurship education. Additionally, it suggests that technology is shaping not only how entrepreneurship is taught but also how entrepreneurs operate in a data-driven business landscape.

The VOSviewer visualization reveals a multi-dimensional research landscape, illustrating that entrepreneurship education is a diverse and rapidly evolving field with connections to psychology, sustainability, engineering, and technology. The presence of multiple interconnected clusters suggests that entrepreneurship education is not a siloed discipline but one that interacts with various academic domains to produce a holistic understanding of entrepreneurial competencies. The network also highlights the increasing focus on sustainability and technological innovation, indicating that future research in entrepreneurship education is likely to delve deeper into these areas. Furthermore, the visualization reveals opportunities for further exploration, such as the potential integration of artificial intelligence in sustainable entrepreneurship and the role of interdisciplinary education in fostering innovative business practices. By mapping these key research areas, the

bibliometric analysis provides valuable insights into the current state and future directions of entrepreneurship education research.

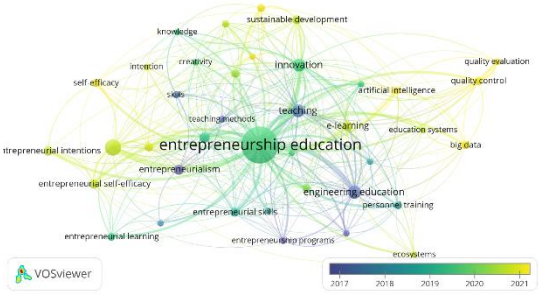

Figure 2. Overlay Visualization
Source: Data Analysis, 2025

The VOSviewer bibliometric visualization illustrates the evolution of research themes within entrepreneurship education, with a focus on key concepts, interdisciplinary connections, and temporal trends. The central node, "entrepreneurship education," is the most prominent, indicating its dominant presence in the literature and extensive interconnections with various research domains. The color gradient (from blue to yellow) represents the temporal evolution of research, where older topics (2017–2018) are shown in blue and more recent topics (2020–2021) in yellow. This suggests that while fundamental themes like entrepreneurial skills, self-efficacy, and learning have been well-established for years, newer topics such as big data, artificial intelligence, and quality control in education are emerging as contemporary research priorities.

The left side of the network, characterized by entrepreneurial intentions, self-efficacy, and entrepreneurial learning, reflects a long-standing research focus on psychological and behavioral aspects of entrepreneurship education. This area, which predominantly appears in blue-green hues, suggests that these themes have been widely explored since 2017–2019. The connections between entrepreneurialism, creativity, and skills indicate that past research has emphasized the role of education in shaping entrepreneurial mindsets and competencies. Meanwhile, the middle of the network, which remains green and transitions into yellow, focuses on teaching methods, innovation, and sustainable development, indicating that the integration of sustainability and creativity into entrepreneurship education has gained scholarly attention in recent years.

The right side of the visualization, dominated by big data, artificial intelligence, e-learning, and quality evaluation, appears in yellow, reflecting recent research trends (2020–2021). This suggests that scholars are increasingly examining the role of technology in entrepreneurship education, particularly the impact of AI-driven learning systems, digital transformation, and quality assessment frameworks in enhancing educational outcomes. The presence of engineering education and ecosystems highlights interdisciplinary approaches, emphasizing the growing importance of integrating STEM fields with entrepreneurship training. The strong connection between sustainable development and innovation further indicates that sustainability is becoming a crucial component of entrepreneurial education, reinforcing the idea that future entrepreneurs must incorporate ethical and environmental considerations into their business ventures.

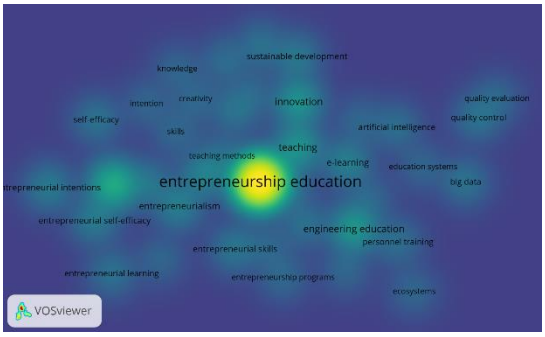

Figure 3. Density Visualization
Source: Data Analysis, 2025

The VOSviewer heatmap visualization highlights the density and intensity of research focus within the field of entrepreneurship education. The brightest yellow region, centered on "entrepreneurship education," indicates the most heavily studied topic, suggesting that it serves as the core research area with numerous interconnected subfields. The gradual transition from yellow to green and blue represents a decrease in

research density, meaning that while related topics such as "teaching," "innovation," and "entrepreneurial skills" have received considerable attention, they are less frequently studied compared to the central theme. The moderate intensity surrounding "entrepreneurial intentions," "self-efficacy," and "entrepreneurial learning" suggests that researchers have explored psychological and motivational factors in entrepreneurship education, reflecting an interest in understanding how educational programs influence entrepreneurial behavior and decision-making.

The outer regions of the heatmap, appearing in darker blue shades, contain emerging and less frequently studied topics, such as "big data," "artificial intelligence," "quality evaluation," and "ecosystems." These terms indicate that technology-driven advancements and assessment metrics in entrepreneurship education are gaining traction, though they remain relatively underexplored compared to traditional pedagogical and psychological themes. The presence of "sustainable development" and "engineering education" suggests that interdisciplinary approaches—combining entrepreneurship, sustainability, and technical education—are beginning to shape the research landscape. The heatmap thus provides a comprehensive overview of research intensity and emerging frontiers, highlighting the established core areas and potential future directions in entrepreneurship education research.

Co-Authorship Visualization

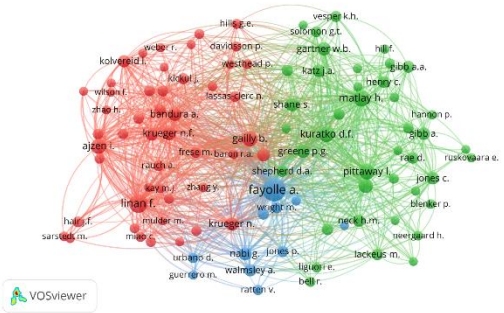

Figure 4. Author Visualization
Source: Data Analysis, 2025

The VOSviewer co-authorship network visualization represents key authors and their collaborative relationships in entrepreneurship education research. The three distinct color-coded clusters (red, green, and blue) indicate different research communities that have shaped the field. The red cluster, which includes influential scholars such as Ajzen, Krueger, Bandura, Linan, and Rauch, focuses heavily on entrepreneurial intentions, self-efficacy, and psychological determinants of entrepreneurship. This suggests that this group of researchers has significantly contributed to understanding the cognitive and behavioral aspects of entrepreneurship education. The green cluster, featuring authors such as Gibb, Matlay, Pittaway, and Kuratko, is more oriented toward entrepreneurship pedagogy, business incubation, and curriculum development, reflecting research on educational frameworks and institutional support for entrepreneurship. The blue cluster, which includes Fayolle, Nabi, Ratten, and Jones, appears to bridge psychological and pedagogical research, emphasizing educational interventions, policy implications, and the broader societal impact of entrepreneurship education. The central position of Fayolle A. and his strong interconnections across clusters suggest that his work has played a significant integrative role, linking different strands of research.

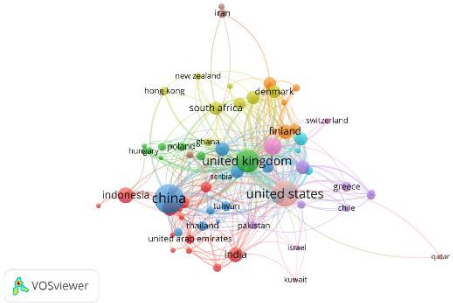

Figure 5. Country Collaboration
Source: Data Analysis, 2025

The VOSviewer co-authorship network visualization maps international collaboration in entrepreneurship education research, with node sizes representing publication volume and links indicating collaboration strength between countries. The United States, United Kingdom, and China

appear as the most prominent nodes, suggesting that these countries have made the most significant scholarly contributions and serve as key hubs in global research partnerships. Strongly linked clusters highlight regional and cross-national collaborations, such as China's connections with Indonesia, India, and Thailand, indicating growing research networks in Asia. Similarly, European countries such as the United Kingdom, Finland, Denmark, and Switzerland show dense interconnections, reflecting well-established academic collaborations. The presence of South Africa, Ghana, and Iran suggests that entrepreneurship education research is gaining momentum in emerging economies, albeit with fewer international partnerships compared to Western nations. Notably, countries like Qatar, Chile, and Kuwait appear on the periphery, indicating limited but developing contributions to the field.

DISCUSSION

Evolution of Research Trends in Entrepreneurship Education and Business Sustainability

The bibliometric analysis reveals that entrepreneurship education has been widely studied from multiple perspectives, including teaching methodologies, entrepreneurial self-efficacy, entrepreneurial intentions, innovation, and sustainability. The keyword co-occurrence network illustrates that the field has evolved from a focus on individual entrepreneurial traits (such as motivation, self-efficacy, and risk-taking) to a broader educational and systemic perspective, where institutions, ecosystems, and digital transformations play a crucial role. The strong presence of terms such as "innovation," "teaching," and "sustainable development" indicates that scholars are increasingly recognizing the need to align entrepreneurship education with sustainability-driven business models. This shift is aligned with global calls for responsible entrepreneurship that balances economic performance with social and environmental impact [24].

One key insight from the temporal evolution of keywords is the increasing prominence of technology-related themes in entrepreneurship education. Terms such as "artificial intelligence," "big data," and "e-learning" suggest that digitalization and technological advancements are reshaping how entrepreneurship is taught and practiced. This aligns with contemporary research advocating for blended learning approaches, simulation-based education, and data-driven decision-making in entrepreneurial training [25]. The integration of technology into entrepreneurship education is not merely a trend but a necessity, given the increasing reliance of modern businesses on digital tools and data analytics. However, the bibliometric analysis also indicate that research on technology-enhanced entrepreneurship education is still fragmented, suggesting that future studies should focus on developing comprehensive frameworks for leveraging digital tools to foster entrepreneurial competencies.

Influential Scholars and Research Clusters

The author co-authorship network reveals that a few key scholars have played a central role in shaping the field of entrepreneurship education and business sustainability. Researchers such as Fayolle, Krueger, Nabi, and Gibb appear as highly influential figures with extensive collaboration networks. Their work has significantly contributed to understanding how entrepreneurship education influences entrepreneurial mindset development and business performance [26]. Interestingly, the clusters of authors suggest that there are distinct schools of thought within the field, each emphasizing different aspects of entrepreneurship education:

1) Psychological and Behavioral Perspectives (e.g., Ajzen, Krueger, Linan, Bandura) – This research stream primarily examines entrepreneurial intentions, motivation, and cognitive factors, applying theories such as the Theory of Planned Behavior [27] to explain entrepreneurial decision-making.

2) Pedagogical Approaches and Curriculum Design (e.g., Gibb, Matlay, Kuratko) – This group focuses on entrepreneurship education frameworks, exploring the effectiveness of different teaching methodologies, experiential learning models, and institutional policies.
3) Innovation, Ecosystems, and Sustainability (e.g., Schaltegger, Pittaway, Greene) – This cluster examines how entrepreneurial education contributes to innovation, sustainable development, and ecosystem-building.

The limited interconnections between these clusters suggest that greater interdisciplinary collaboration is needed. Although psychological studies provide valuable insights into individual entrepreneurial behavior, they are often disconnected from discussions on how education systems, technology, and sustainability frameworks influence entrepreneurship outcomes. Future research should aim to bridge these knowledge gaps by fostering collaboration between behavioral scientists, education researchers, and sustainability scholars.

Geographical Distribution and Global Collaboration Trends

The country collaboration network highlights a significant concentration of research in a few dominant regions, particularly the United States, the United Kingdom, and China. These countries appear as central nodes in the global entrepreneurship education research network, with extensive co-authorships and institutional collaborations. This reflects the strong research infrastructure and funding opportunities available in these regions, as well as the prioritization of entrepreneurship education in their policy agendas. However, several emerging economies (e.g., South Africa, Indonesia, Iran, Ghana, and India) are starting to gain visibility in the research landscape. This is a promising development, as entrepreneurship is often seen as a key driver of economic growth and poverty alleviation in developing countries [28]. The presence of these countries in the collaboration network suggests that they are increasingly contributing to scholarly discussions on how entrepreneurship education can address local socio-economic challenges.

Despite these positive trends, the co-authorship analysis also reveals a lack of strong collaboration between developed and developing nations. Many peripheral countries, such as Chile, Kuwait, and Qatar, appear in isolated clusters, indicating limited international partnerships. This suggests that entrepreneurship education research remains highly region-specific, with relatively few cross-border comparative studies. Given the global nature of business and sustainability challenges, future research should focus on building international research collaborations, particularly between high-income and low-income countries, to facilitate knowledge transfer and shared learning.

The Growing Importance of Sustainability in Entrepreneurship Education

One of the most notable trends in the bibliometric analysis is the increasing integration of sustainability into entrepreneurship education research. The keyword co-occurrence network indicates that "sustainable development" and "innovation" are emerging as central themes, suggesting that scholars are moving beyond traditional profit-driven entrepreneurship models toward more sustainable and impact-driven approaches. This aligns with the triple bottom line framework (Elkington, 1997), which emphasizes the need for businesses to create economic, social, and environmental value simultaneously. The connection between entrepreneurship education and sustainability is particularly relevant given the United Nations' Sustainable Development Goals (SDGs), which highlight the importance of education in fostering sustainable economic development. Research suggests that embedding sustainability concepts into entrepreneurship curricula can help future business leaders integrate ethical and environmental considerations into their decision-making [13]. However, the bibliometric analysis also reveals that

research on sustainability in entrepreneurship education is still relatively underdeveloped, indicating an opportunity for scholars to further explore how universities and business schools can effectively incorporate sustainability principles into entrepreneurial training.

Future Research Directions

Based on the findings of this bibliometric study, several key research gaps and future directions emerge:

1) Bridging Psychological and Pedagogical Research – Future studies should integrate behavioral insights (e.g., motivation, risk perception) with pedagogical innovations (e.g., experiential learning, digital tools) to develop more holistic entrepreneurship education models.
2) Exploring the Role of Technology in Entrepreneurship Education – The increasing presence of AI, big data, and e-learning in research suggests a need for further exploration of how technology can enhance entrepreneurial competencies.
3) Expanding Global Research Collaborations – There is a need for more cross-country comparative studies to understand how entrepreneurship education varies across cultural, economic, and institutional contexts.
4) Strengthening the Link Between Entrepreneurship and Sustainability – Future research should investigate how entrepreneurship education can better prepare students to launch sustainable ventures that address social and environmental challenges.

5. CONCLUSION

The bibliometric analysis of entrepreneurship education and business sustainability has provided valuable insights into the evolution, key themes, influential scholars, and global collaboration patterns in this research domain. The findings indicate that entrepreneurship education has shifted from focusing solely on entrepreneurial traits and intentions to embracing broader pedagogical innovations, sustainability integration, and digital transformation. The study highlights the growing role of technology (such as AI, big data, and e-learning) in shaping entrepreneurial training, as well as the increasing recognition of sustainability principles in business education. However, the fragmentation of research clusters and limited cross-border collaborations suggest the need for greater interdisciplinary and international cooperation. Future research should aim to bridge behavioral and pedagogical studies, enhance technology adoption in entrepreneurship education, and strengthen the link between entrepreneurship training and sustainability-driven business practices. By addressing these gaps, scholars, educators, and policymakers can develop more effective educational frameworks that prepare future entrepreneurs to navigate complex economic, social, and environmental challenges while fostering sustainable innovation.

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