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Technology and Entrepreneurship in Development: Bibliometric Analysis

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ABSTRACT

This study performs a bibliometric analysis to examine global research networks in entrepreneurship, emphasizing the changing collaborations among countries and regions. The study illustrates the pivotal importance of countries such as the United States, Germany, and the United Kingdom in research through the mapping of co-authorship networks from academic papers, while also acknowledging the growing impact of rising economies like China, India, and Brazil. The findings highlight the interdisciplinary character of entrepreneurship research, connecting it to economics, technology, and sustainable development. The study underscores the significance of entrepreneurial education, advocating for the incorporation of global viewpoints and technological innovations inside academic courses. The study provides useful insights into global research trends but acknowledges limitations, such as dependence on indexed databases and the omission of non-collaborative contributions. This analysis offers actionable insights for politicians, educators, and researchers aiming to promote innovation and entrepreneurship, highlighting the necessity of international cooperation to tackle global issues.

Keywords**: **Entrepreneurship; Bibliometric Analysis; Co-authorship Networks; Global Collaboration; Innovation; Sustainable Development; Emerging Economies; Entrepreneurship Education; International Research.

INTRODUCTION

The convergence of technology and entrepreneurship has emerged as a significant subject in modern development studies. In recent decades, technology improvements have transformed the global corporate environment, fostering new opportunities for innovation, economic expansion, and employment generation (Fritsch, 2017). Consequently, entrepreneurship, in its conventional definition, has transformed into a more expansive and dynamic notion, incorporating diverse areas including fintech, biotechnology, e-commerce, and digital platforms. The incorporation of technology into entrepreneurship has generated novel business models and facilitated the rise of new industries, promoting a more equitable and sustainable economic growth paradigm. Furthermore, technology has enabled entrepreneurs to reach new markets, engage with global consumers, and utilize advanced tools that promote innovation (Huang et al., 2024).

Entrepreneurship fundamentally acts as a catalyst for economic development by fostering innovation, generating employment, and optimizing resource utilization (Shams et al., n.d.). The integration of technology into this equation has dramatically altered the dynamics. Currently, technology-driven entrepreneurship significantly contributes to global economic growth, especially in emerging economies, where technological advances solve local issues such as poverty, unemployment, and environmental degradation. Countries such as India, China, and other African nations have experienced significant entrepreneurial growth driven by technical advancements. These nations have utilized digital platforms, mobile technology, and e-commerce to empower local enterprises and facilitate access to global markets,

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thereby improving their economic competitiveness and sustainability (Bergenholtz et al., 2023).

Moreover, technology-driven entrepreneurship is crucial for promoting social and environmental advancement. Innovations include renewable energy technologies, sustainable agriculture solutions, and health technology have tackled some of the globe's most urgent issues, delivering both economic and social benefits. Technology is becoming vital in advancing sustainable development goals (SDGs), with entrepreneurs crucially addressing environmental and social issues through new technical solutions (Rashid & Ratten, 2020). With the ongoing rapid technological breakthroughs, entrepreneurship's role in fostering the development of green technology, social companies, and digital inclusion programs will become increasingly vital.

An increasing volume of study has aimed to investigate the diverse intersections between technology and entrepreneurship and their contributions to sustainable development. Bibliometric analysis, as a robust research methodology, enables scholars to delineate the progression of academic literature within the area and discern pivotal trends, seminal works, and deficiencies in current study. This study utilizes bibliometric techniques to delineate the evolution of literature on technology and entrepreneurship in development, providing insights into the progression of this dynamic relationship and its potential contributions to sustainable development in the future (Fritsch, 2017; Shams et al., n.d.).

The domain of technology and entrepreneurship in development has been characterized by the emergence of entrepreneurial ecosystems, which entail the engagement of diverse stakeholders, including governmental bodies, investors, academic institutions, and startups. These ecosystems are essential for promoting innovation and facilitating the expansion of technology-driven firms. As technological entrepreneurship expands, the demand for a conducive environment that fosters the flow of knowledge, resources, and opportunities also increases. Entrepreneurial ecosystems, when properly fostered, can give entrepreneurs with the resources they need to succeed, including access to funding, mentorship, networks, and market prospects. This has resulted in the creation of technology hubs and innovation clusters in prominent cities globally, underscoring the significance of technology in fostering entrepreneurship and development (Shams et al., n.d.).

Despite the rising volume of literature on technology and entrepreneurship in development, there remains a gap in understanding how these two forces interact to create sustainable progress across diverse industries and geographies. Academic discourse frequently neglects to encompass the complete range of technical advancements that can facilitate economic progress and social inclusion. Moreover, the contribution of entrepreneurship to promoting environmental sustainability and achieving the Sustainable Development Goals through technology is yet inadequately examined. Although numerous studies have explored the connection between technology and entrepreneurship, limited research has provided a thorough bibliometric analysis that consolidates essential trends, deficiencies, and the theoretical frameworks that underpin this dynamic interaction. This study seeks to address this gap by delivering a comprehensive bibliometric analysis of the literature, pinpointing the most significant publications, and proposing recommendations for future research trajectories. The main aim of this study is to perform a bibliometric analysis of the correlation between technology and entrepreneurship within the framework of development. This study will analyze a diverse array of academic articles, conference papers, and scholarly publications to chart the progression of this

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subject, emphasizing significant trends, the impact of technology on entrepreneurship, and the wider implications for sustainable development. The study seeks to identify deficiencies in existing literature, suggest prospective research domains for future inquiry, and provide recommendations for policymakers, entrepreneurs, and researchers to harness the synergy between technology and entrepreneurship to promote inclusive and sustainable economic growth.

METHOD

This study utilizes bibliometric analysis to systematically assess the correlation between technology and entrepreneurship within the framework of development. Bibliometric analysis is a quantitative approach utilizing statistical methods to examine academic literature, aiming to detect significant trends, influential publications, and research deficiencies (Zupic & Čater, 2015). The principal data source for this analysis comprises academic articles, conference papers, and other scholarly publications indexed in prominent databases like Scopus, Web of Science, and Google Scholar. The selection procedure entailed finding pertinent research published between 2010 and 2025, concentrating on the nexus between technology and entrepreneurship and their benefits to sustainable development (Pathak et al., 2022). The bibliometric data was obtained using keywords including "technology entrepreneurship," "digital innovation," "entrepreneurial ecosystems," and "sustainable development," which facilitated the refinement of the search to studies that particularly examine the convergence of these subjects.

The study utilized various bibliometric methods, such as citation analysis, co-citation analysis, and keyword co-occurrence analysis, to investigate the literature's structure (Aria & Cuccurullo, 2017). Citation analysis was employed to determine the most impactful papers and authors in the area, whereas co-citation analysis facilitated the identification of clusters of related research and principal themes within the literature (Garfield, 2006). A keyword co-occurrence analysis was performed to identify the changing trends and new subjects in technology and entrepreneurship research (Callon et al., 1991). This technique offers insights into the predominant themes, elucidating the evolution of the discipline and underscoring areas necessitating additional research. These methodologies were executed utilizing bibliometric software, specifically VOSviewer (Van Eck & Waltman, 2017) and CiteSpace (Chen, 2016), facilitating the visual depiction of citation networks, theme clusters, and research trends.

The bibliometric analysis results were analyzed and synthesized to offer a thorough picture of the area. This study delineates the principal authors, journals, and institutions that have influenced the discourse on technology and entrepreneurship in development, providing insights into the progression of research trends and the theoretical frameworks employed to investigate this relationship (Rashid & Ratten, 2020). The analysis identifies deficiencies in the literature, especially on technological advancements for social inclusion, environmental sustainability, and their effects on the sustainable development goals (SDGs) (Bergenholtz et al., 2023). The report offers recommendations for future research and practical applications aimed at politicians, entrepreneurs, and researchers who wish to utilize technology to promote sustainable economic growth and development.

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RESULT AND DISCUSSIONS

Network Visualization

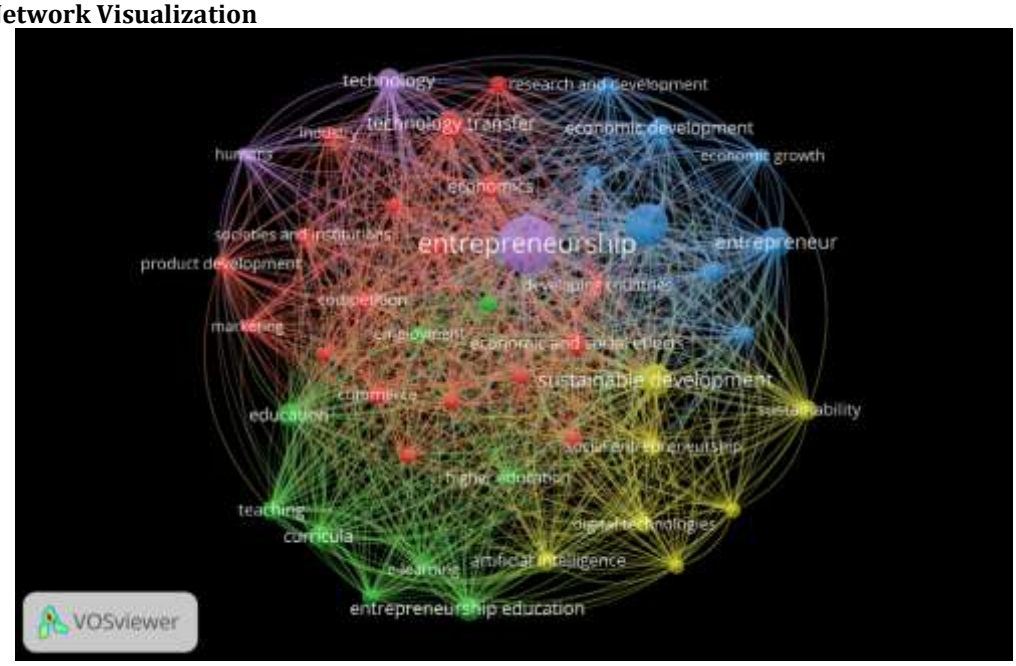

Figure 1. Network Visualization
Source: Data Analysis Result, 2025

The graphic depicts a bibliometric network map created with VOSviewer, illustrating the interconnections among important phrases related to entrepreneurship and technology. The central cluster prominently features the term "entrepreneurship," which is encircled by related concepts including "economic development," "research and development," and "technology transfer." This important positioning underscores entrepreneurship's vital function in fostering economic growth and technical progress, particularly in growing markets and developing nations. The links illustrate how entrepreneurship functions as a conduit between several aspects of economic development, encompassing market rivalry and the implementation of innovative technology.

The terminology associated with "entrepreneurship" exemplifies the extensive breadth of the discipline. The references to "sustainable development," "social entrepreneurship," and "sustainability" indicate that contemporary entrepreneurship is progressively integrated with social and environmental objectives. This transition reflects an increasing focus on enterprises that pursue not only profitability but also societal welfare and the attainment of the Sustainable Development Goals (SDGs). Moreover, phrases such as "social effects," "sustainable development," and "economic growth" underscore the perception of entrepreneurship as a mechanism for tackling global issues, like climate change and inequality.

The upper-right segment of the network emphasizes the impact of technology on entrepreneurship, featuring a distinct cluster of phrases such as "digital technologies," "artificial intelligence," and "technology." This indicates the increasing influence of technical breakthroughs on the entrepreneurial environment, facilitating corporate scalability, innovation, and operational efficiency. The relationship between "entrepreneurship" and these technological words indicates that contemporary entrepreneurs must incorporate advanced technologies to maintain

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competitiveness and relevance. This trend reflects the growing influence of digital transformation in defining the future of commerce.

The lower-left segment of the network emphasizes education-related terminology, including "education," "higher education," and "entrepreneurship education." This cluster emphasizes the significance of cultivating entrepreneurial mindsets and competencies via official and informal educational frameworks. The connections to "e-learning" and "teaching" underscore the significance of contemporary educational platforms in promoting entrepreneurship by enhancing worldwide access to knowledge and resources. This advancement is essential for cultivating a new generation of entrepreneurs capable of addressing the problems of the digital age.

The network highlights the convergence of entrepreneurship with commerce, marketing, and product development, illustrating the commercialization of new concepts. The associations with terminology such as "product development," "commerce," and "marketing" underscore the pragmatic aspect of entrepreneurship, wherein new business endeavors must traverse marketplaces and establish viable business models. The incorporation of terminology such as "competition" and "economics" illustrates the competitive landscape that entrepreneurs encounter while endeavoring to create their enterprises. This intricate network of interrelated concepts underscores the multifaceted essence of entrepreneurship, integrating economic, technological, educational, and social dimensions to promote sustainable and inclusive growth.

Overlay Visualization

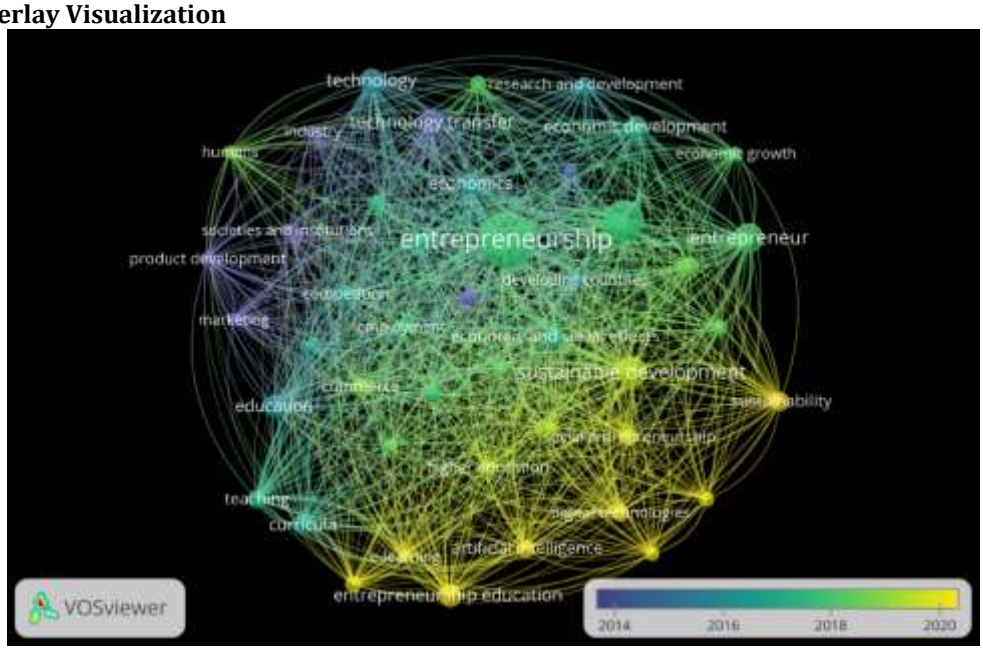

Figure 2. Overlay Visualization
Source: Data Analysis Result, 2025

The graphic depicts a bibliometric network map created with VOSviewer, illustrating the developing connections among principal concepts in entrepreneurship and technology from 2014 to 2020. The color-coded timeline, ranging from blue (2014) to yellow (2020), illustrates the chronological progression of significant subjects in the area. Entrepreneurship is positioned at the core, flanked

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by concepts such as economic development, technology transfer, and sustainable development, signifying its strong association with technical advancement and global sustainability initiatives. The relationships among these variables indicate an increasing focus on the impact of entrepreneurial endeavors on economic development and their contribution to social and environmental objectives.

The map illustrates the swift proliferation of digital technology, artificial intelligence, and "entrepreneurship education" in recent years, evidenced by the concentration of yellow nodes in the lower section of the network, denoting 2019-2020. This underscores the growing significance of digital transformation in entrepreneurship, especially regarding education and skill development. Terms such as "e-learning," "curricula," and "teaching" are grouped together, indicating the increasing significance of digital learning tools and entrepreneurial education programs in preparing new generations of entrepreneurs to thrive in the digital era.

The occurrence of phrases such as "sustainable development," "social entrepreneurship," and "sustainability" in the upper-left segment of the network signifies a growing emphasis on socially and ecologically responsible entrepreneurship. The evolution of these phrases indicates a transformation in entrepreneurial ambitions, transitioning from exclusive economic objectives to a more comprehensive strategy that harmonizes financial success with contributions to sustainable development goals (SDGs). The relationship between "entrepreneurship" and "sustainability" illustrates that contemporary entrepreneurial initiatives are increasingly aimed at addressing global issues like climate change and inequality, utilizing technology and innovation to provide enduring societal value.

Citation Analysis

To investigate the convergence of innovation, entrepreneurship, and organizational performance, it is crucial to analyze significant academic contributions that have influenced the examination of technology-driven enterprises, entrepreneurial ecosystems, and innovation policy. The subsequent table delineates the 10 most often cited articles that substantially progressed research in these domains, encompassing theoretical frameworks on dynamic capacities and empirical investigations on university start-ups and intrapreneurship. These studies elucidate the key factors of entrepreneurial success, encompassing internal competencies, external networks, and the transformative influence of digital technologies on entrepreneurial processes. These studies offer a thorough grasp of how innovation, networks, and organizational structures facilitate the success of entrepreneurial enterprises in a worldwide market.

Tabel 1. Citation Analysis

Citations	Authors and Year	Document title
1392	Lee, C., Lee, K., Pennings, J.M.	Internal capabilities, external networks, and performance: A study on technology-based ventures
1216	Schot, J., Steinmueller, W.E.	Three frames for innovation policy: R&D, systems of innovation and transformative change
1118	Hjalager, A.-M.	A review of innovation research in tourism
1019	Etzkowitz, H.	Research groups as 'quasi-firms': The invention of the entrepreneurial university

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958	Teece, D.J.	A dynamic capabilities-based entrepreneurial theory of the multinational enterprise
920	Di Gregorio, D., Shane, S.	Why do some universities generate more start-ups than others?
830	Li, L.	China's manufacturing locus in 2025: With a comparison of "Made-in-China 2025" and "Industry 4.0"
802	Antoncic, B., Hisrich, R.D.	Intrapreneurship: Construct refinement and cross-cultural validation
731	Elia, G., Margherita, A., Passiante, G.	Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process
638	Lechner, C., Dowling, M.	Firm networks: External relationships as sources for the growth and competitiveness of entrepreneurial firms

Source: Scopus 2025

The bibliometric data presented underscores the most significant research in entrepreneurship, innovation policy, and organizational performance, illuminating the dynamic characteristics of entrepreneurial ecosystems and the determinants of company success. (Lee et al., 2001), with 1,392 citations, is the most referenced study, providing an extensive examination of the interplay between internal capabilities and external networks in technology-driven enterprises, highlighting how firms utilize their resources and relationships to enhance performance and foster innovation. Schot and Steinmueller (2018), cited 1216 times, delineate three essential frameworks for comprehending innovation policy: R&D, systems of innovation, and transformative change, thereby offering a comprehensive structure for policymakers and scholars to address the intricacies of promoting innovation in dynamic industries. (Hjalager, 2010), with 1118 citations, provides a comprehensive assessment of innovation research in tourism, emphasizing the sector's distinctive attributes and the significance of innovation in establishing competitive advantage. (Etzkowitz, 2003), with 1019 citations, emphasizes the entrepreneurial university, positing that research groups within universities operate as quasi-firms and are essential catalysts for knowledge transfer and innovation. (Teece, 2016), cited 958 times, expands the notion of dynamic capacities in multinational corporations, providing a framework for comprehending how organizations adjust to swiftly evolving surroundings and maintain competitive advantage over time. (Di Gregorio & Shane, 2003), cited 920 times, examine the start-up development process at various universities, elucidating the elements that facilitate the effective commercialization of academic research. (Li, 2018), with 830 citations, elucidates China's manufacturing sector by contrasting national strategies like "Made-in-China 2025" with "Industry 4.0," thereby contextualizing technological innovation in emerging nations.

Subsequent empirical research, including Antoncic and Hisrich (2001) with 802 citations, elucidates the concept of intrapreneurship, investigating how internal entrepreneurial conduct within organizations fosters innovation and competitiveness. In contrast, (Elia et al., 2020) with 731 citations, analyze the impact of digital technologies on the entrepreneurial process, emphasizing the significance of collective intelligence in the digital era. (Lechner & Dowling, 2003), with 638 citations, underscore the importance of company networks in the growth and

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competitiveness of entrepreneurial enterprises, illustrating how external ties are essential for scaling businesses in competitive and interconnected marketplaces. Collectively, these studies illustrate the extensive and interdisciplinary scope of study in innovation and entrepreneurship, connecting theoretical frameworks to practical discoveries and offering a thorough comprehension of the factors propelling entrepreneurial success in the contemporary global economy.

Density Visualization

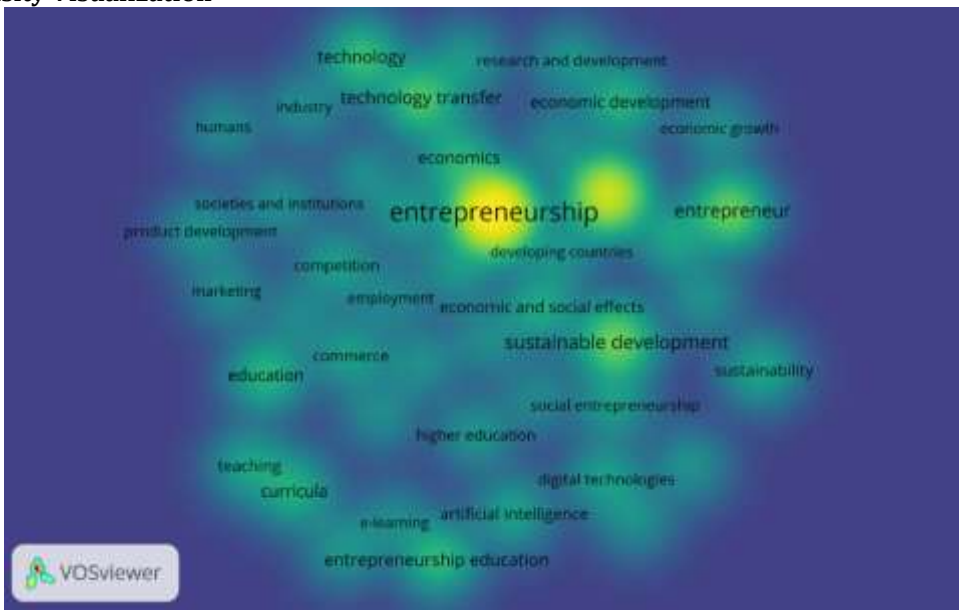

Figure 3. Density Visualization
Source: Data Analysis Result, 2025

The graphic depicts a density map of the bibliometric network, emphasizing the centrality and prevalence of terms associated with entrepreneurship and technology. The concept of "entrepreneurship" is central to the map, encircled by related terms including "economic development," "sustainable development," and "entrepreneurship education." The vibrant green regions signify robust correlations among these phrases, demonstrating their frequent co-occurrence in the literature. The significant concentration on "entrepreneurship" indicates its prominence in academic discussions, with research frequently highlighting its contribution to economic growth, innovation, and sustainability, especially in developing nations.

The map depicts the increasing significance of digital technology, artificial intelligence, and e-learning in entrepreneurship education, as evidenced by the more vibrant green areas in the lower section of the network. This transition signifies the growing incorporation of technology in entrepreneurial activities and education, highlighting a distinct tendency towards employing digital technologies to promote innovation and corporate expansion. Furthermore, concepts such as "social entrepreneurship" and "sustainability" are associated with "sustainable development," underscoring the increasing emphasis on entrepreneurial endeavors that seek to tackle social and environmental issues. The density map highlights the evolution of entrepreneurship to encompass not only economic success but also a wider dedication to societal and environmental welfare.

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Co-Authorship Network

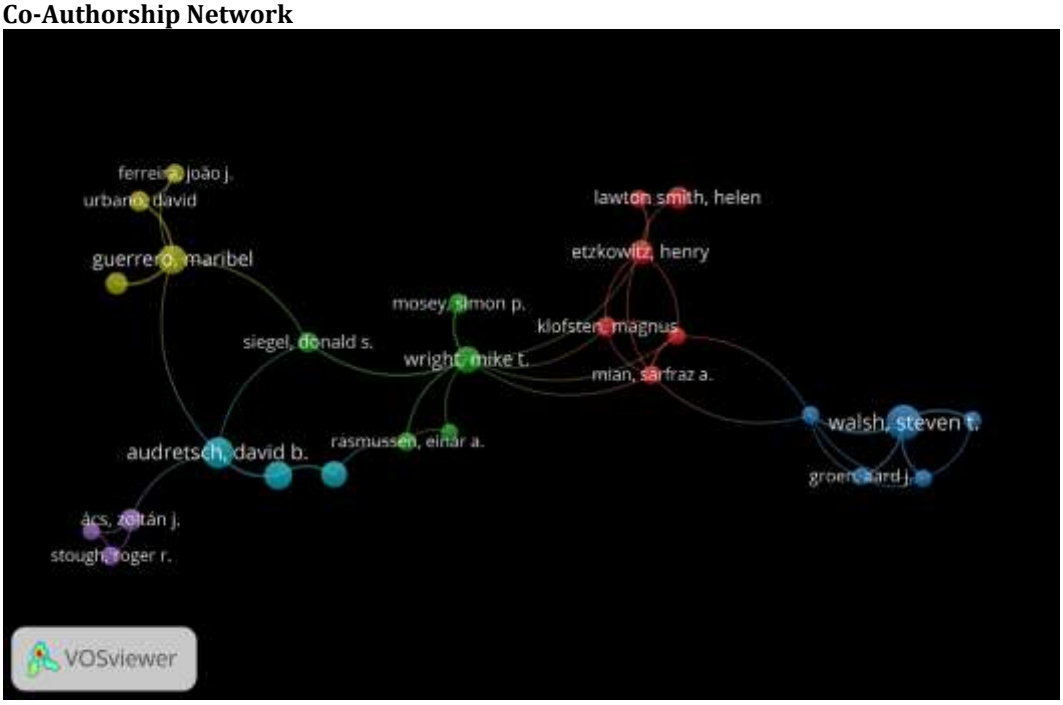

Figure 4. Author Visualization
Source: Data Analysis Result, 2025

The image displays a co-authorship network map of prominent scholars in the field of entrepreneurship and innovation, created using VOSviewer. The nodes represent authors, and the edges between them signify collaborative relationships. The map highlights clusters of researchers who frequently collaborate on similar topics. For instance, the green cluster includes scholars like Simon P. Mosey, Mike T. Wright, and Donald S. Siegel, indicating a strong network of collaboration in areas related to entrepreneurial dynamics and innovation. Similarly, the red cluster, featuring scholars like Henry Etzkowitz, Magnus Klofsten, and Safraz A. Mian, reflects a focus on entrepreneurial ecosystems, innovation systems, and the role of universities in entrepreneurship.

Notably, the map also shows connections between scholars from different areas of expertise. For example, the blue cluster with David B. Audretsch, Zoltán J. Ács, and Roger R. Stough demonstrates a focus on the relationship between entrepreneurship and economic development, with a significant emphasis on regional innovation systems. The visual representation of these clusters allows for an understanding of how research is interconnected and how different scholars contribute to the broader dialogue within the field of entrepreneurship, innovation, and economic development. This collaborative mapping provides valuable insights into the intellectual structure of entrepreneurship research.

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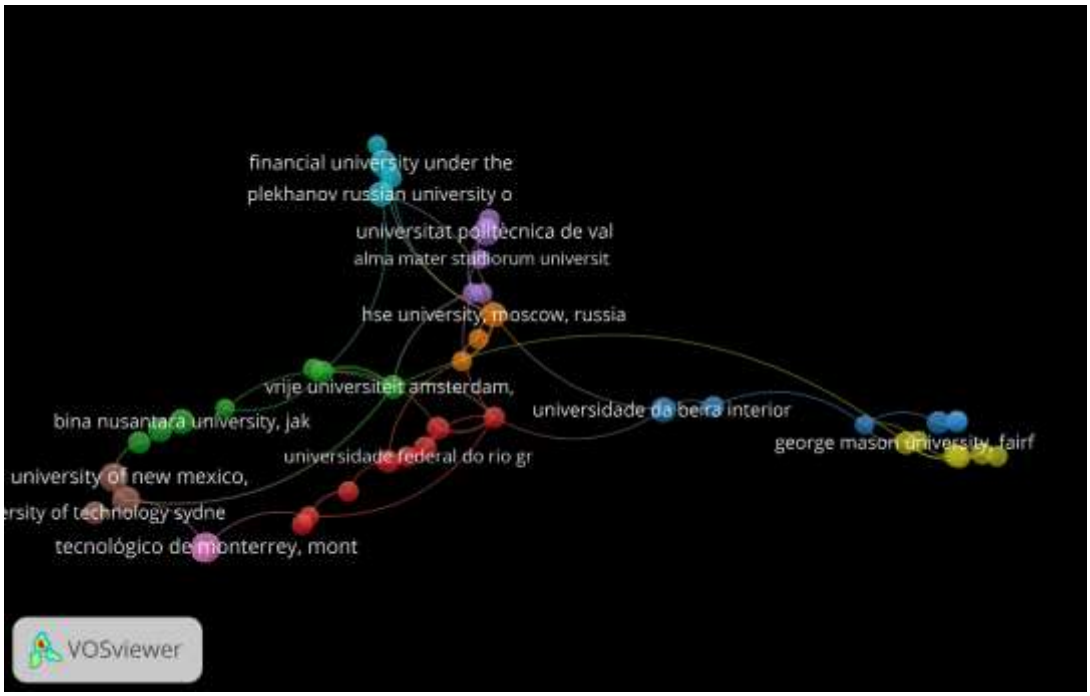

Figure 5. Affiliation Visualization
Source: Data Analysis Result, 2025

The graphic depicts a co-authorship network map of universities and academic institutions engaged in research pertaining to entrepreneurship and technology. The nodes of the network symbolize various universities, while the edges denote collaborations on research initiatives. The map use color coding to group institutions according to their collaborative relationships. The green cluster comprises institutions like the Financial University under the Government of the Russian Federation, Vrije Universiteit Amsterdam, and Bina Nusantara University, signifying a network of universities dedicated to diverse facets of entrepreneurship and economic development.

The map emphasizes international academic connections, featuring universities from several countries, including Russia, the United States, Europe, and Latin America, such as George Mason University (USA), HSE University (Russia), and Universidad de Beira Interior (Portugal). This international network illustrates the transnational character of entrepreneurship study, wherein academics from diverse regions cooperate on analogous topics, including economic development, innovation, and technology transfer. The variety of institutions engaged underscores the interdisciplinary character of entrepreneurship research, incorporating insights from economics, business administration, and technology management.

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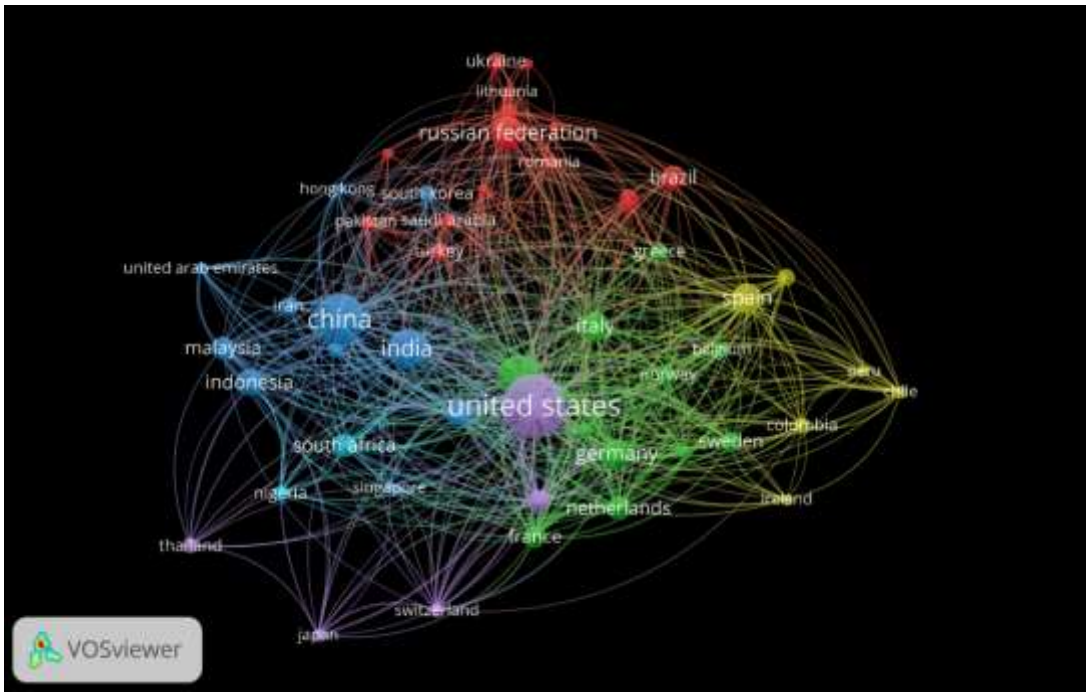

Figure 6. Country Visualization
Source: Data Analysis Result, 2025

The graphic depicts a co-authorship network map illustrating countries engaged in worldwide research on entrepreneurship and associated disciplines. The nodes symbolize nations, whereas the edges between them denote collaborative research endeavors. The map illustrates clusters of nations with robust academic partnerships. The core cluster, comprising the United States, Germany, and the United Kingdom, indicates a significant concentration of research collaboration, especially in entrepreneurship and innovation. These nations are pivotal in advancing intellectual discourse and fostering the growth of entrepreneurial ecosystems.

The map emphasizes other foreign links alongside the primary cluster. Countries like China, India, and Brazil constitute substantial clusters, indicating an increase in entrepreneurial research from emerging markets. The map illustrates global diversity in entrepreneurship research, highlighting robust links from countries including Europe, South America, and Asia. This underscores the expanding global character of the discipline, wherein academics from diverse regions engage and contribute to the advancement of information pertaining to entrepreneurship, technological innovation, and economic development. The network's diversity highlights the transnational character of entrepreneurial challenges and solutions, underscoring the importance of international collaboration in tackling global economic and social crises.

Practical Implications

The findings of this study offer significant insights for politicians, entrepreneurs, and educators aiming to promote innovation and entrepreneurship in various countries. By analyzing the worldwide networks and collaborations depicted in the co-authorship maps, policymakers may devise ways to strengthen international research partnerships, foster innovation ecosystems, and facilitate the flow of best practices across borders. Moreover, entrepreneurs can gain advantages by identifying

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essential collaborative networks, allowing them to utilize global expertise and resources for business advancement. This study emphasizes the significance of entrepreneurship education and the role of universities in fostering entrepreneurial skills, advocating for educators to incorporate global perspectives and technological advancements into their curricula to adequately equip students for the challenges and opportunities of the digital era.

Theoretical Contribution

This study significantly contributes to the literature on global entrepreneurship by delineating the academic connections and networks that propel the field's advancement. The co-authorship network study provides a fresh viewpoint on the geographical distribution and interrelation of entrepreneurship research, emphasizing the growing significance of international collaboration in tackling global issues. The findings enhance the theoretical comprehension of how various locations and nations shape and impact entrepreneurship studies, highlighting the significance of both developed and emerging economies in fostering innovation. This study use bibliometric and network analysis to elucidate the multidisciplinary characteristics of entrepreneurship research, connecting it to economics, technology, and sustainable development.

Practical Implications

This study offers significant insights into the global entrepreneurship research scene, however it possesses certain limitations. The data utilized in the co-authorship network analysis was confined to published academic works, perhaps failing to encompass the entire scope of entrepreneurial activity, particularly in informal sectors or nascent enterprises where research output may be diminished. The emphasis on collaborative networks may neglect the contributions of individual scholars or institutions that significantly impact the area without considerable collaboration. A further issue is the potential bias in source selection, as the study depends on indexed databases that may not encompass all pertinent papers, especially from non-English speaking areas. Ultimately, although the study provides a comprehensive overview, it fails to explore the intricacies of regional disparities in entrepreneurial behaviors, which can vary markedly across cultural, political, and economic frameworks. Subsequent study could mitigate these limitations by integrating a broader array of data sources and examining the geographical dynamics of entrepreneurship in greater depth.

CONCLUSIONS

This study offers a thorough bibliometric analysis of worldwide research on entrepreneurship, highlighting the complex networks of academic collaboration and the increasing significance of international partnerships in progressing the discipline. The study elucidates the contributions of various countries to the discourse on entrepreneurship, innovation, and economic development by mapping co-authorship networks. The results highlight the pivotal role of the United States, Germany, and the United Kingdom in advancing research, while also illustrating the growing impact of emerging economies like China, India, and Brazil. The analysis highlights the growing interdisciplinary character of entrepreneurship research, with significant links to economics, technology, and sustainable development. This illustrates the changing environment of entrepreneurship, wherein academics are progressively tackling intricate global issues through cooperative and interdisciplinary methods. The study

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emphasizes the significance of entrepreneurship education, especially in incorporating global viewpoints and technical innovations into academic curricula to adequately prepare future entrepreneurs for the difficulties of the digital era.

The study greatly enhances our comprehension of worldwide entrepreneurial research networks, however it recognizes several limits, such as its emphasis on published academic articles and the potential bias in source selection. Subsequent study may enhance these findings by integrating supplementary data sources and examining geographical disparities in entrepreneurial behaviors. This study offers significant insights for politicians, educators, and researchers aiming to promote global innovation and entrepreneurship, highlighting the necessity for ongoing international collaboration and knowledge sharing.

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