

Mapping the Research on Artificial Intelligence and Entrepreneurship: A Bibliometric Review From Scopus Database

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ABSTRACT

Despite the increasing popularity and research focus on the application of artificial intelligence (AI) in entrepreneurship, no comprehensive bibliometric analysis of relevant papers has been conducted. Our review examines 127 Scopus-indexed publications from 2007 to October 2023. The inquiry explores thematic progression, geographical production trends, and seminal works shaping the discourse. Notably, while authors from Asia, mainly China, lead in publication volume, influential works from the USA, the UK, and Australia attract significant scholarly attention. The analysis reveals a prominent trend: highly cited papers often lack theoretical frameworks, with literature reviews and conceptual analyses prevailing over empirical investigations. When theoretical foundations are present, diverse theories are often amalgamated. In conclusion, our review highlights numerous avenues for future academic exploration in this domain. Pragmatically, our effort, the first of its kind, consolidates fragmented insights, providing a cohesive understanding of AI's pivotal role in entrepreneurship.

KEYWORDS

Artificial Intelligence, Bibliometric Review, Entrepreneurship, Future Research Directions, Methodology, Theories

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INTRODUCTION

Entrepreneurship is an endeavor to provide goods and services that incorporate innovative approaches aimed at meeting the evolving demands of society (Cueto et al., 2022). In recent times, however, digital technology has revolutionized the type and extent of this endeavor (Nambisan, 2017; Purbasari et al., 2023; Younis et al., 2020). A notable aspect of digitization is the application of artificial intelligence (AI) to automate tasks that require substantial human involvement and exertion (Jarrahi, 2018). In the context of entrepreneurship, AI has revolutionized entrepreneurial action, enabling sophisticated, adaptable algorithms to perform tasks that typically require the human intellect (Townsend & Hunt, 2019). For example, AI has assumed a central role in entrepreneurship, profoundly impacting various facets of business creation, operation, and growth (Weber et al., 2022).

Thus, AI's importance in this context cannot be overstated. It provides entrepreneurs with data-driven insights that are crucial for making informed decisions (Battisti et al., 2022). By analyzing extensive datasets, it uncovers trends, consumer preferences, and market opportunities. This gives entrepreneurs a competitive advantage in developing innovative products or services. Moreover, AI enables automation, alleviating the load of routine and time-consuming tasks (Chalmers et al., 2021). This not only streamlines operations but also permits entrepreneurs to dedicate time to more strategic, value-adding activities. For example, AI-powered chatbots improve customer service by offering consistent 24/7 support, a vital feature in today's global business environment (Cheng & Jiang, 2020). AI-driven personalization and recommendation systems enhance the user experience by tailoring it to individual preferences, which in turn amplifies customer retention, loyalty, and satisfaction (Cheng & Jiang, 2020). Additionally, AI is instrumental in risk assessment and fraud detection, ensuring that entrepreneurial ventures are shielded from potential threats and investment losses (Mirza et al., 2023).

Given the significance of AI in entrepreneurship, a noticeable growth in literature in this domain is evident, covering a variety of areas such as healthcare start-ups (Garbuio & Lin, 2019), big data (Obschonka & Audretsch, 2020), digital entrepreneurship (Upadhyay et al., 2022), and entrepreneurial education (Nuseir et al., 2020). The scattered and emergent nature of the extant literature in this important research domain necessitates a rigorous and bibliometric review to consolidate the current knowledge base and explore knowledge trajectories, key research clusters, and opportunities for future research.

While AI has long been studied within entrepreneurship (Obschonka & Audretsch, 2020), there is no study that quantitatively examines the intellectual structure of the area to elucidate how it has evolved. To the best of our knowledge, the only bibliometric review on the subject focused on presenting a drill-down of AI in entrepreneurial management with a concentration on start-ups (Li et al., 2022). In addition, the authors focused on the web of science (WoS) database, which has relatively fewer scholarly publications than Scopus. Li et al. (2022) admitted that the results of their review are limited by their choice of keywords and coverage of the WoS database. Moreover, beyond the quantitative representation of the trajectory of publications, citations, and knowledge structure in the existing work of Li et al. (2022), there is a missing link concerning the methodological and theoretical focus of studies that have been conducted on the subject. This is something we sought to shed light on in this study.

Our study bridged the gaps by providing a thorough review of the literature on the relationship between AI and entrepreneurship. We employed bibliometric analysis, which allowed for the automatic identification of research trajectory, clusters, and themes, facilitating the structured evaluation of extant studies. Our review was anchored by five main research questions:

1. What has been the publication trajectory of AI and entrepreneurship research?
2. What is the scientific landscape of publications' (countries, journals, articles, and authors) patterns for research on this topic?

3. What theoretical and methodological approaches have characterized the most influential studies?
4. How has entrepreneurship evolved through AI?
5. What are the avenues for future research at the nexus of AI and entrepreneurship?

The remainder of the article is structured as follows. Section two outlines the methodology and details the search procedures employed to identify literature pertinent to AI and entrepreneurship. Section three unveils the results, while section four highlights the implications of these findings and underscores potential thematic areas warranting future research. Finally, section five concludes and suggests prospective directions for future research on AI and entrepreneurship.

MATERIALS AND METHODS

In this study, we employed a bibliometrics approach to trace and analyze the evolution of research within AI and entrepreneurship. Bibliometric analysis uses quantitative methods to evaluate bibliographic content (Pritchard, 1969). Scholars have used this approach to distill key findings from a body of literature with bibliographic content (Donthu et al., 2021). Bibliometric techniques have been implemented in various disciplines including information technology (e.g., Blažun et al., 2017; Oliveira-Dias et al., 2021), economics (e.g., Bonilla et al., 2015; Castillo-Vergara et al., 2018), finance (e.g., Goodell et al., 2023), geography (e.g., Torres et al., 2020), supply chain management (e.g., Xu et al., 2020), electronic marketing (e.g., Gao et al., 2021), consumer marketing strategy (e.g., Rosário & Raimundo, 2021), and notably, in entrepreneurship (e.g., Dionisio, 2019; López-Fernández et al., 2016; Trabskaia, et al., 2023).

Database Selection and Retrieval of Papers

The bibliometric analysis was conducted using the preferred reporting items for systematic reviews and meta-analyses (PRISMA) guidelines. PRISMA outlines essential steps for systematically reviewing scientific literature, including the selection of indexed papers from bibliographical databases while excluding nonrelevant materials (Moher et al., 2009). Ho and Luong (2022), for example, used the PRISMA guidelines in a bibliometric study to analyze the research patterns and dissemination of publications across five major fields, encompassing time, prolific authors, notable sources, active institutions, and leading countries or regions.

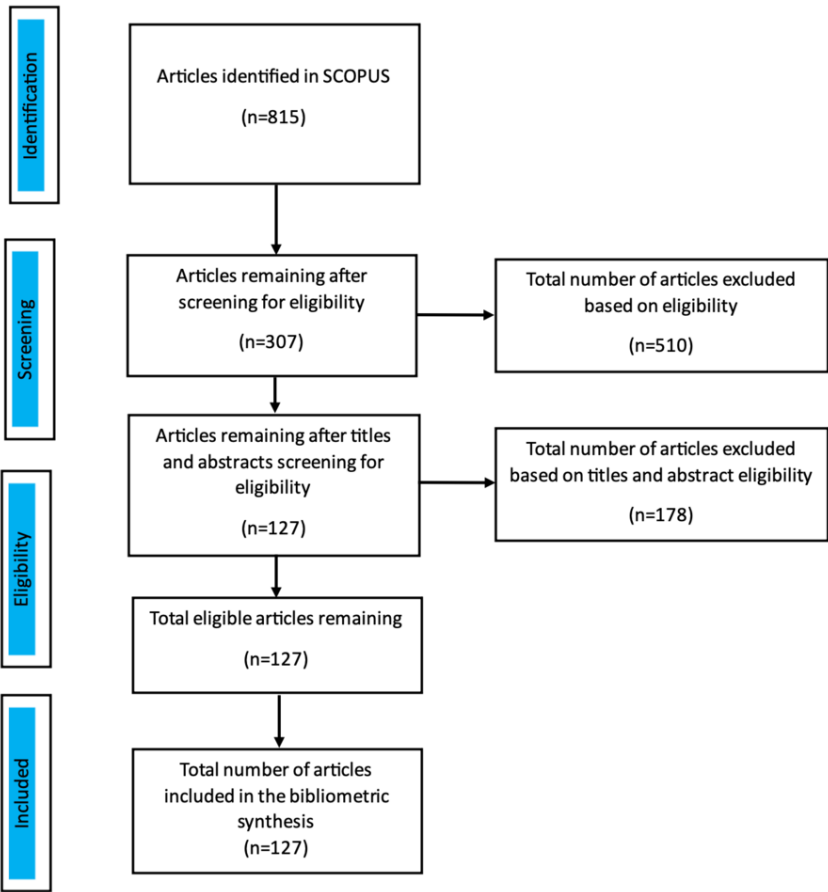
Search for Articles

We began by identifying articles within the Scopus bibliographical database to create our dataset. As of March 2023, Scopus, a database introduced in 2004 by Elsevier, had over 27,950 active titles, 292,000 stand-alone books, 90.6 million records, and 49.2 million patent records from five patent offices (Bilokon et al., 2023; Scopus, 2023). Among them, 26,591 active peer-reviewed journals (including 6,128 gold open access journals in prominent subject areas such as biological sciences, social sciences, physical sciences, and health sciences) were included (Scopus, 2023). To determine the relevant articles, we used “entrepreneurship” and “artificial intelligence” as the primary terms of our study. The query’s keywords were defined as: artificial intelligence and entrepreneurship or entrepreneurs; or entrepreneurship management. Keywords were searched in the title, abstract, and keyword fields of the Scopus database. The search timeframe was open and limited to journal articles published in English. Table 1 shows the inclusion and exclusion criteria used in this study. In total, 815 articles were identified based on the criteria. The articles were then screened to exclude irrelevant materials from our dataset, resulting in the removal of 688 papers. Ultimately, 127 articles were selected for analysis. Figure 1 shows the PRISMA flow diagram for the identification and screening of data.

Table 1. Inclusion and Exclusion Criteria

Search Target	Inclusion	Exclusion	Comment
Time period	From inception	Not applicable	The objective was to identify the trajectory of the discipline from the onset of scholarly discourse till date (October 2023).
Language	English only	Non-English languages (Chinese, German, Spanish, French, Portuguese)	English is the language that the authors understand.
Document stage and type	Only published (final) journal articles	Editorials, doctoral dissertations, master's theses, textbooks, letters, erratum, reports, letters (to the editor), commentaries, feature articles and studies, and articles- in press	Journal articles contain the most rigorous and high-quality research. They are often subjected to more rigorous peer review than conference proceedings, books, book chapters, reviews, editorials, and doctoral theses.
Keywords	Artificial intelligence and entrepreneurship or entrepreneurs; or entrepreneurship management	Journals focusing on artificial intelligence and entrepreneurship or entrepreneurs; or entrepreneurship management	Our study aims to analyze publications on artificial intelligence and entrepreneurship OR entrepreneurs OR entrepreneurship management.

Figure 1. PRISMA Flow Diagram on the Identification and Screening of Data (Note. Source: Adapted from Moher et al. (2009))



Analysis of the Data

After extracting and screening the papers, we proceeded with the actual bibliometric analysis. The 127 eligible bibliographic records from Scopus were stored as a CSV file. We used Biblioshiny, an open-source bibliometric software available in RStudio (Ab Rashid et al., 2023; Yadav & Banerji, 2023) for the analysis. Biblioshiny stands out among other bibliometric tools due to its comprehensive range of statistical techniques and visualization capabilities. This extensive toolkit enables effective performance analysis and supports the conceptual mapping of bibliographic information (Gutiérrez-Salcedo et al., 2018).

RESULTS

This section presents the results of the analysis of the 127 papers identified. It begins with an overview of the characteristics of the bibliographic datasets used in the final analysis. Thereafter, it highlights the publication trajectory around AI and entrepreneurship research, the scientific landscape of publications' (countries, journals, articles, and authors) patterns for research on the topic, the theoretical and methodological approaches that have characterized the most influential studies, and how entrepreneurship has evolved through AI.

Overview of the Analyzed Bibliographic Dataset

The dataset revealed that as of October 2023, 127 documents had been developed by 349 authors on the subject of AI and entrepreneurship. These publications covered 94 journal articles published between 2009 and October 2023. The authors of these publications used 435 keywords to communicate and argue on the subject matter. Figure 2 shows an overview of the bibliographic dataset.

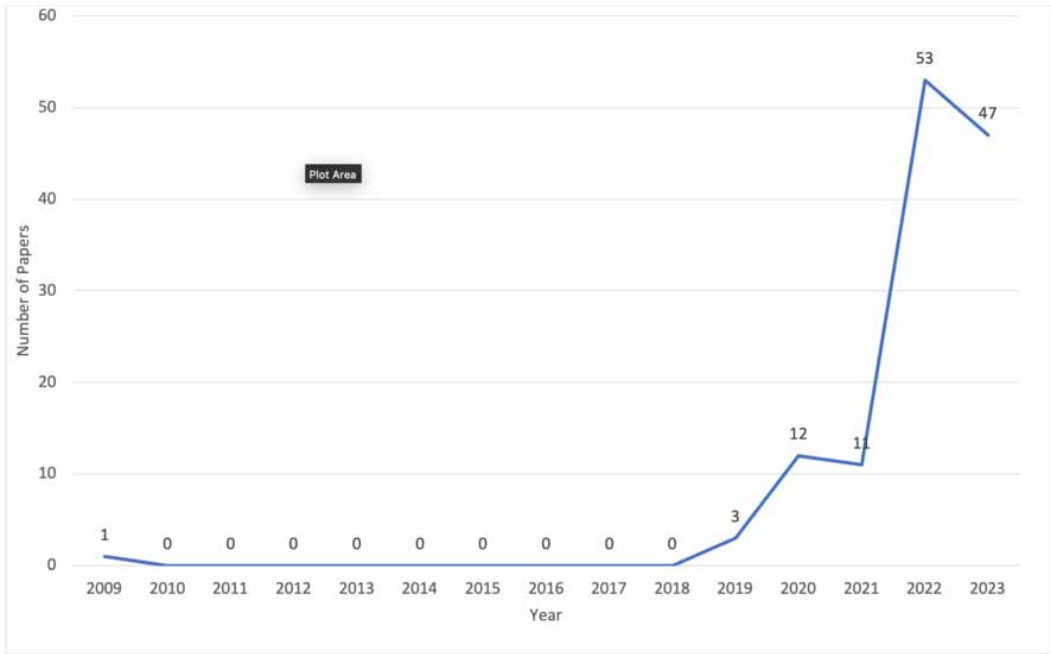
Trajectory of Publications

The yearly publication trend on AI and entrepreneurship is shown in Figure 3. From 2009 to 2019, the annual number of publications on the subject was low. Within that period, there were three publications in 2019 and one paper 10 years earlier in 2009. Over that time, scholars clearly showed little interest in the subject matter. After 2019, there was an increase in the annual number of publications: 12 in 2020, 11 in 2021, and 53 in 2022. And as of October 2023, when this review was conducted, the number

Figure 2. Overview of Bibliographic Dataset



Figure 3. Trajectory of Yearly Publications on AI and Entrepreneurship



of publications had reached 47. The first article, written by Fish and Ruby (2009), was published in the *International Journal of Entrepreneurship*. In their study, the authors sought to introduce a self-organizing map, which is an artificial intelligence technique, as a means of screening overseas markets. This approach aided small firms in identifying the specific foreign markets that they should explore. The article had received 19 citations as of October 2023.

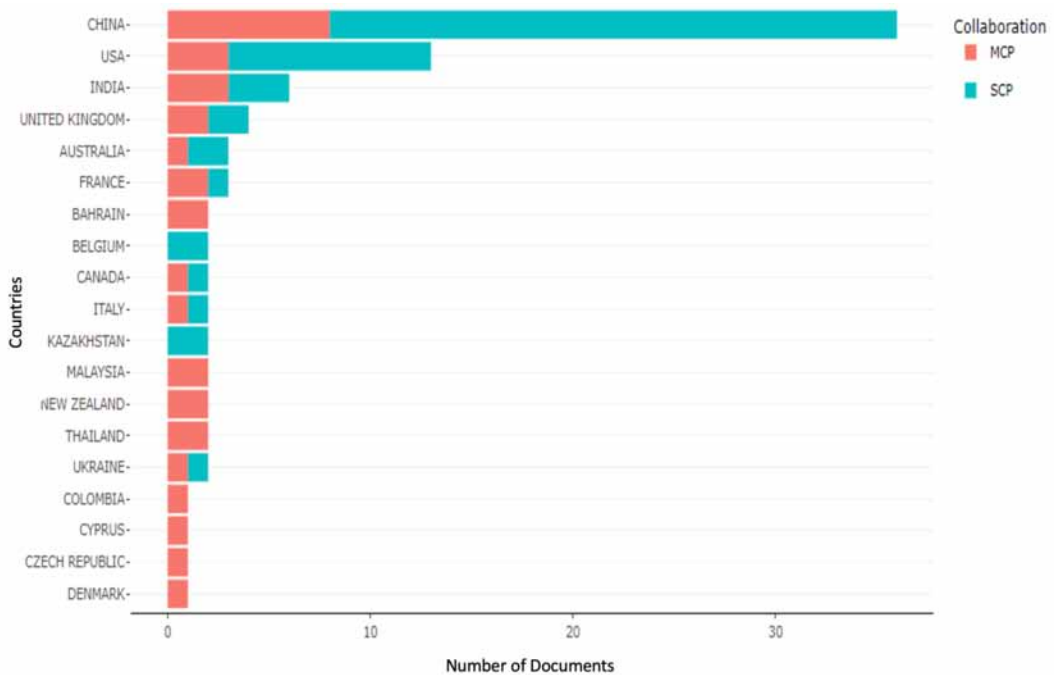
The Scientific Landscape of Publications

Countries

The results showed that 41 countries were affiliated with the studies that were conducted on AI and entrepreneurship. These included countries from both developed and developing regions of the globe. Nevertheless, developed nations constituted the majority among the top five. China was found to lead the chart with the highest number of publications, contributing 36 of the 127 publications, followed by the United States with 13 publications.

It is evident from Figure 4 that most of the countries producing publications are developed nations. Among the top 20 contributors, however, are the developing nations of India, Bahrain, Kazakhstan, Thailand, Columbia, Cyprus, and the Czech Republic, showing their promise concerning AI and entrepreneurship. The country-level analysis shows two types of collaborations among countries: multiple country publications (MCP) and single country publications (SCP). MCP refers to collaborations among authors from different countries, whereas SCP refers to those among authors from the same country. Thus, as evidenced in Figure 4, China had the most MCPs and SCPs, with approximately 20% of its publications being MCPs and 80% being SCPs, followed by the US and India. Notably, authors from Malaysia, New Zealand, Thailand, Colombia, Cyprus, the Czech Republic, and Denmark collaborated with authors from other countries on all their publications, while India, the United Kingdom, Canada, and Italy collaborated on half of their publications. Arguably, there is a broad global interest in AI and entrepreneurship research, with developed nations currently leading

Figure 4. Top 20 Countries Making Publications on AI and Entrepreneurship



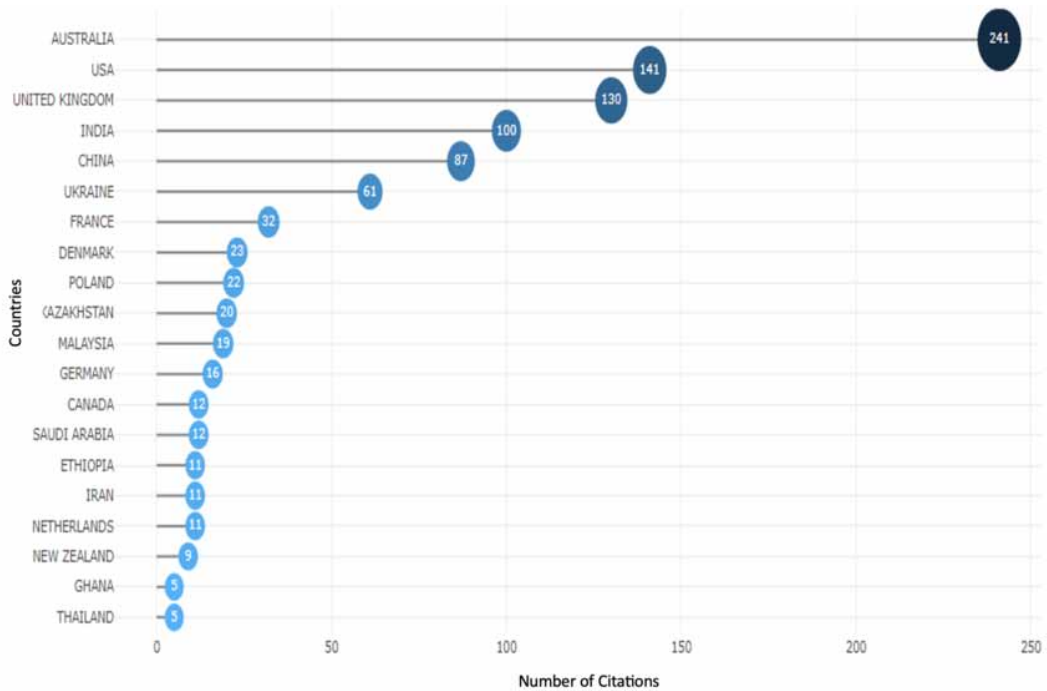
and developing nations showing promising involvement. The dynamics of research collaboration also highlight the interconnectedness of the global research community in this domain.

Regarding the number of citations, Australia's publications led with 241, followed by the US with 141 citations and the UK with 130, as illustrated in Figure 5. While China produced a high volume of publications, the data indicate that the fewer works that came out of Australia had a broader influence. This suggests that the impact of a country's publications is not solely determined by the quantity. This is further evidenced by the comparative citation counts among Australia, China, the US, and the UK.

Journal Sources

Table 2 presents the top 20 journals leading in publications on AI and entrepreneurship. As highlighted in Figure 1, the 127 papers reviewed were distributed across 94 different journals. The journal *Frontiers in Psychology* tops the list with seven papers. This is closely followed by both the *Journal of Intelligent and Fuzzy Systems* and the *International Journal of Entrepreneurial Behaviour and Research*, each hosting five papers. Regarding citations, *California Management Review* stands out as the most cited with 116. This is trailed by *Entrepreneurship: Theory and Practice* with 104 citations and *Journal of Business Venturing Insights* with 48. These statistics suggest that sheer publication volume does not necessarily equate to influence within the academic community. For instance, the 104 citations of *Entrepreneurship: Theory and Practice* underscore its significance in shaping discourse in entrepreneurial studies. Furthermore, it is notable that while many papers on AI and entrepreneurship are published in journals primarily focused on entrepreneurship, others are included in journals of different disciplines. Some are rooted in psychology (e.g., *Frontiers in Psychology*), intelligent systems (e.g., *Journal of Intelligent and Fuzzy Systems*), and communication systems (e.g., *Wireless Communications and Mobile Computing*). The findings suggest that the topic of AI and entrepreneurship attracts attention from journals across a wide range of fields, highlighting the interdisciplinary nature of AI's impact on business and other areas. The fact that journals dedicated

Figure 5. Countries with the Top 20 most cited publications on AI and entrepreneurship



to other areas publish such articles indicates that the idea of integration of AI into entrepreneurship is multifaceted and far-reaching, affecting multiple disciplines.

Authors

The data indicate that among the top 20 authors, the majority are affiliated with institutions in Asia. This observation aligns with the insight from Figure 2, which highlights China as the country with the highest number of productive authors. Outlined in Table 3, Gupta, B. B., associated with Asia University in Taiwan, leads the rest with four publications. Following that author are Chen, Y., from San Jose State University, USA; Liu, Y., from Dongguan Polytechnic, China; Panigrahi, P. K., from the Indian Institute of Management, India; and Li, Y. from Xinxiang University, China, each with three publications.

When considering citations as a metric of influence, however, Kwilinski, A., from The London Academy of Science and Business, stands out as the most cited author with 116 citations. The author is closely followed by Dwivedi, Y. K., from Swansea University, Upadhyay, N., from the Indian Institute of Management, and Upadhyay, S., from BITS Pilani–KK Birla Goa Campus, who has each produced two publications and accumulated 35 citations.

Theoretical and Methodological Approaches in the 20 Most Influential Studies

Methodological Approaches

Analyzing existing research methods can enhance our understanding of the methodologies currently used and highlight potential avenues for future studies. Such reviews play a pivotal role in the methodological evolution of a research domain (Ali et al., 2023). Upon examining the 20 most frequently cited articles (Table 4), we observed diverse research methodologies including six empirical (both qualitative and quantitative), five conceptual, seven literature review (either bibliometric or

Table 2. Productive and Influential Journal Sources

Journal	Number of Publications	Total Citations
<i>Frontiers In Psychology</i>	7	15
<i>Journal of Intelligent and Fuzzy Systems</i>	5	43
<i>International Journal and Entrepreneurial Behaviour and Research</i>	5	41
<i>Journal of Business Venturing Insights</i>	4	48
<i>Systems Research and Behavioral Science</i>	4	12
<i>Wireless Communications and Mobile Computing</i>	4	5
<i>Sustainability (Switzerland)</i>	4	11
<i>Technological Forecasting and Social Change</i>	3	46
<i>Academy of Entrepreneurship Journal</i>	2	25
<i>Entrepreneurship: Theory and Practice</i>	2	104
<i>Journal of Business Research</i>	2	12
<i>Journal of Risk and Financial Management</i>	2	9
<i>Security and Communication Networks</i>	2	1
<i>Applied Sciences (Switzerland)</i>	1	1
<i>British Food Journal</i>	1	18
<i>Business and Information Systems Engineering</i>	1	16
<i>Business: Theory and Practice</i>	1	4
<i>California Management Review</i>	1	116
<i>Cogent Business and Management</i>	1	19
<i>Communications of the Association for Information Systems</i>	1	3

systematic), and two experimental (typically involving data simulations) approaches. The most cited among these was an empirical paper by Garbuio and Lin (2019) that qualitatively delved into AI-powered healthcare start-ups to identify prevalent business model strategies adopted by global entrepreneurs.

Interestingly, quantitative empirical studies, primarily survey-based, were predominant. Outcomes from these studies enabled efficient and economical data collection from vast segments of the population. Remarkably, mixed-method studies were absent from the top 20. While conceptual papers and literature reviews lay the foundation for understanding key relationships and constructs within a topic, there is a pressing need for empirical validation of these frameworks (Ali et al., 2023). The preeminence of literature reviews among the top-cited papers was anticipated. This aligns with the widely recognized impact of research reviews in molding the knowledge landscape in a specific research domain, as underscored by scholars such as Hallinger (2014) and Ali et al. (2023).

Theoretical Approaches

From our analysis, it is evident that a significant majority (approximately 90%) of the top 20 influential papers are atheoretical, meaning the authors did not rely on any established research theory, framework, or model. In contrast, only six of these top-cited research papers were on specific theories or combined multiple theories. For instance, Chatterjee et al. (2022) merged the technology acceptance model (TAM) with the quo bias (SQB) theory to probe the factors influencing corporate digital entrepreneurship among small and medium enterprises (SMEs) in India. Upadhyay et al.

Table 3. Productive and Influential Authors

Author	Region	Country	Institution	Number of Publications	Total Citations
Gupta, B. B.	Asia	Taiwan	Asia University, Taiwan	4	14
Chen, Y.	North America	USA	San Jose State University	3	7
Liu Y	Asia	China	Dongguan Polytechnic	3	10
Panigrahi, P. K.	Asia	India	Indian Institute of Management	3	14
Li, Y.	Asia	China	Xinxiang University	3	1
Battisti, M.	Europe	France	Grenoble Ecole de Management	2	9
Dwivedi, Y. K.	Europe	UK	Swansea University	2	35
Ganapathy, A.	North America	USA	Adobe Systems, San Jose, California	2	25
Ge, B.	Asia	China	Jilin University	2	5
Kwilinski, A.	Europe	UK	The London Academy of Science and Business	2	116
Upadhyay, N.	Asia	India	Indian Institute of Management	2	35
Upadhyay, S.	Asia	India	Humanities and Social Sciences, BITS Pilani–KK Birla Goa Campus, Zuarinagar	2	35
Williamson, A. J.	Oceania	New Zealand	University of Waikato	2	9
Yao, M.	Asia	China	Jilin University	2	4
Bai, L.	Asia	Philippines	Manila University	2	2
D’Amico, E.	Europe	Italy	Politecnico di Torino	2	24
Deng, Y.	Asia	China	Wuhan University	2	12
Gaurav, A.	North America	USA	Ronin Institute	2	11
Han, H.	Asia	South Korea	Sejong University	2	5
Huang, Y.	Asia	China	Yiwu Industrial and Commercial College	2	4

(2022) integrated TAM, the unified theory of acceptance and use of technology (UTAUT), theory of planned behavior (TPB), and theory of reasoned action (TRA) in their study, aiming to discern the willingness of entrepreneurs to embrace AI and foster progress in the realm of digital entrepreneurship.

In a different vein, Nuseir et al. (2020) synthesized the entrepreneurial ideas and plans employment model, the entrepreneurial happening model, and the TPB. Their focus was on the determinants of entrepreneurial intentions in Neom, Saudi Arabia’s smart city, particularly the influence of AI education on the nexus between entrepreneurial self-efficacy, competency, and intention.

Conversely, Battisti et al. (2022) examined how meta-organizations involve users and bolster tech entrepreneurs in crafting shared value via social innovations, drawing from a distinct conceptual

model. Ahmed and Ganapathy (2021) and Korzynski et al. (2021) similarly leaned on conceptual models, albeit with divergent objectives: the former assessed AI's potential to enhance learning management, while the latter delved into how impression management tactics can aid crowdfunding creators in attracting backers and achieving financial objectives using AI. Cetindamar et al. (2020) employed the knowledge-spillover-based strategic entrepreneurship theory to conduct a bibliometric review, tracking knowledge dissemination in tech-focused entrepreneurial ecosystems.

Although the 20 most cited papers revealed a leaning toward atheoretical approaches, instances where theories were employed often involved a combination of established frameworks to provide a more comprehensive lens for analysis. This suggests that while foundational theories and models offer a structured approach to studying complex phenomena such as AI and entrepreneurship, there is also an evident trend of scholars navigating beyond singular theoretical boundaries to capture the nuances and intricacies of evolving entrepreneurial landscapes. The use of combined theoretical frameworks also underscores the multifaceted nature of entrepreneurship in the digital and AI domains.

How Entrepreneurship has Evolved Through AI

From the 127 articles analyzed, we identified 435 unique keywords which served as indicators of prevalent research themes and trajectories within the field (Yang & Sulaiman, 2022). As illustrated by the tree map in Figure 6, distinct blocks represent various keywords associated with AI and entrepreneurship studies. The size of each block is directly proportional to its frequency or significance.

It is evident that “artificial intelligence” dominates as the principal keyword, accounting for 27% of the entire keyword usage in the realm of AI and entrepreneurship research. Following closely, “entrepreneurship” emerges as the second most frequent term at 12%. The prominence of “machine learning” underscores the academic community's keen interest in specific AI techniques. This inclination toward AI techniques is further echoed by the inclusion of “college students” on the tree map, suggesting that the next generation of scholars and practitioners are pivotal in this discourse.

In effect, while AI remains at the forefront, the significant mention of machine learning and college students suggests a burgeoning interest in specific AI methodologies and the educational aspects surrounding them. It is evident that as AI continues to evolve, the academic community seeks to understand its various facets, applications, and implications, especially among the emerging generation of scholars and entrepreneurs.

The Main Research Domains (Keyword Co-Occurrence)

Figure 7 depicts the co-occurrence of author keywords, illustrating how research themes have been discussed alongside one another. The size of a node represents its weight or frequency of occurrence, whereas the similarity in color reflects the clustering of keywords. The lines connecting the tags symbolize the strength of the connections between the keywords, where thicker lines indicate strong connections between nodes. Figure 7 shows two major clusters, one minor cluster, and two independent nodes. Based on the size of the nodes, the dominant terms are “artificial intelligence” and “entrepreneurship.”

In addition, the two terms are connected by thicker lines in the network, indicating that they have been used side-by-side by scholars on the research topic. Where Figure 6 communicates only the most dominant themes that authors have used, Figure 7 communicates the most dominant themes and how they have been discussed alongside other themes in the literature regarding AI and entrepreneurship.

Cluster 1 (Blue Nodes). Cluster 1 is primarily represented by the term “artificial intelligence.” AI's significance in entrepreneurship has garnered considerable attention, leading experts to explore areas including entrepreneurial opportunities, marketing, augmented reality, crowdfunding, entrepreneurship education, industry 4.0, and digital transformation, and tools such as ChatGPT. For instance, Short and Short (2023) investigated the potential of generative language models, such as ChatGPT, as tools for content creation. They aimed to deepen our understanding of AI's

Table 4. Top 20 Most Cited Articles

Authors	Title and Source of the Study	Area/Focus	Total Citations	Methodology	Theory
Garbuio and Lin (2019)	Artificial intelligence as a growth engine for health care startups: Emerging business models. <i>California Management Review</i> .	Healthcare	116	Empirical paper (Qualitative)	Atheoretical
Obschonka and Audretsch (2020)	Artificial intelligence and big data in entrepreneurship: A new era has begun. <i>Small Business Economics</i> .	Entrepreneurship research	110	Literature review (Systematic review)	Atheoretical
Chalmers et al. (2021)	Artificial intelligence and entrepreneurship: Implications for venture creation in the fourth industrial revolution. <i>Entrepreneurship Theory and Practice</i> .	Entrepreneurship research	98	Conceptual Paper	Atheoretical
Chatterjee et al. (2022)	Digital transformation and entrepreneurship process in SMEs of India: A moderating role of adoption of AI-CRM capability and strategic planning. <i>Journal of Strategy and Management</i> .	SMEs	66	Empirical paper (Quantitative)	TAM + quo bias (SQB) theory
Tkachenko et al. (2019)	Introduction of artificial intelligence tools into the training methods of entrepreneurship activities. <i>Journal of Entrepreneurship Education</i> .	Entrepreneurship education	59	Experimental/ Simulation	Atheoretical
Bogachov et al. (2020)	Artificial intelligence components and fuzzy regulators in entrepreneurship development. <i>Entrepreneurship and Sustainability Issues</i> .	Decision-making in entrepreneurship	57	Experimental/ Simulation	Conceptual model
Wilson et al. (2022)	The circular economy meets artificial intelligence (AI): Understanding the opportunities of AI for reverse logistics. <i>Management of Environmental Quality: An International Journal</i> .	Impact of AI on entrepreneurship	46	Conceptual paper	Atheoretical
Townsend et al. (2019)	Entrepreneurial action, creativity, & judgment in the age of artificial intelligence. <i>Journal of Business Venturing Insights</i> .	Decision-making in entrepreneurship	36	Conceptual paper	Atheoretical
Upadhyay et al. (2022)	Theorizing artificial intelligence acceptance and digital entrepreneurship model. <i>International Journal of Entrepreneurial Behavior & Research</i> .	Entrepreneurship in general	24	Empirical (Quantitative)	TAM, UTAUT, TPB, TRA
Battisti et al. (2022)	Creating new tech entrepreneurs with digital platforms: Meta-organizations for shared value in data-driven retail ecosystems. <i>Technological Forecasting and Social Change</i> .	Creating new entrepreneurs	23	Empirical (Qualitative)	Conceptual model
Ahmed and Ganapathy (2021)	Creation of automated content with embedded artificial intelligence: A study on learning management system for educational entrepreneurship. <i>Academy of Entrepreneurship Journal</i> .	Entrepreneurship education	23	Conceptual paper	Conceptual model
Filieri et al. (2021)	Artificial intelligence (AI) for tourism: A European-based study on successful AI tourism start-ups. <i>International Journal of Contemporary Hospitality Management</i> .	Start-ups	23	Literature review (Bibliometric)	Atheoretical
Korzynski et al. (2021)	Impression management techniques in crowdfunding: An analysis of Kickstarter videos using artificial intelligence. <i>European Management Journal</i> .	Crowdfunding creators	22	Empirical (Quantitative)	Conceptual model
Fish and Ruby (2009)	An artificial intelligence foreign market screening method for small businesses. <i>International Journal of Entrepreneurship</i> .	Foreign market screening by SMEs	19	Conceptual paper	Atheoretical

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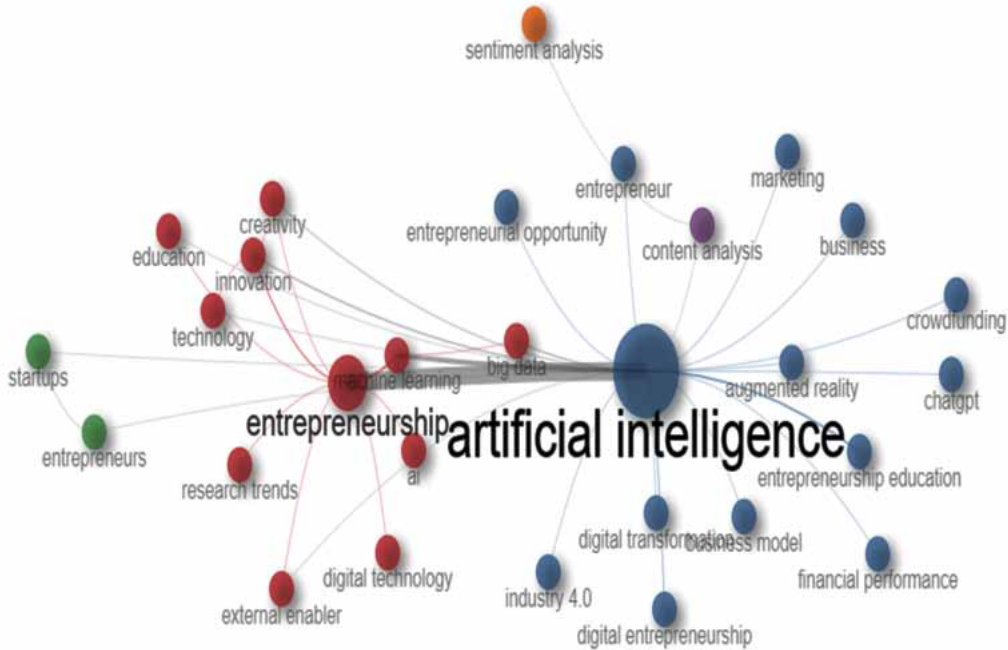
Table 4. Continued

Authors	Title and Source of the Study	Area/Focus	Total Citations	Methodology	Theory
Nuseir et al. (2020)	Antecedents of entrepreneurial intentions in smart city of Neom Saudi Arabia: Does the entrepreneurial education on artificial intelligence matter? <i>Cogent Business & Management</i> .	Entrepreneurship education/Smart cities	19	Empirical (Quantitative)	Entrepreneurial ideas and plans employment model, the entrepreneurial happening model and the TPB
Secinaro et al. (2021)	Exploring agricultural entrepreneurship and new technologies: Academic and practitioners' views. <i>British Food Journal</i> .	Agricultural entrepreneurship (AE)	18	Literature review (Bibliometric)	Atheoretical
Weber et al. (2022)	AI Startup Business Models: Key characteristics and directions for entrepreneurship research. <i>Business & Information Systems Engineering</i>	Startups	16	Literature review (Systematic review)	Atheoretical
Robledo et al. (2023)	"Hasta la vista, baby"—Will machine learning terminate human literature reviews in entrepreneurship? <i>Journal of Small Business Management</i> .	Entrepreneurship education	15	Literature review (Bibliometric)	Atheoretical
Hannigan et al. (2022)	A new tool for policymakers: Mapping cultural possibilities in an emerging AI entrepreneurial ecosystem. <i>Research Policy</i> .	Entrepreneurship education	15	Literature review (Bibliometric)	Atheoretical
Cetindamar et al. (2020)	Exploring the knowledge spillovers of a technology in an entrepreneurial ecosystem—The case of artificial intelligence in Sydney. <i>Thunderbird International Business Review</i> .	Entrepreneurship education	15	Literature review (Bibliometric)	Knowledge-spillover-based strategic entrepreneurship theory

Figure 6. Tree Map Showing the Most Used Keywords on AI and Entrepreneurship



Figure 7. Keyword Co-Occurrence on AI and Entrepreneurship



role in shaping entrepreneurial narratives. Their findings underscore ChatGPT’s capability to produce diverse and adaptive narrative content for entrepreneurs, emphasizing its potential to catalyze further research bridging entrepreneurship and AI. On another note, within the context of AI in entrepreneurship education, Jia (2023) evaluated current curricula for computer science students in higher education. The goal was to understand the aspirations and hurdles faced by these students in innovation and entrepreneurship. The survey results indicated that 51.63% of respondents had a favorable attitude toward entrepreneurship, and 23.48% had either embarked on or gained entrepreneurial experience.

Cluster 2 (Red Nodes). The central theme of Cluster 2 is entrepreneurship. With the rise of AI techniques and concepts like big data, machine learning, and education, there has been a surge of interest in fostering innovation and creativity within entrepreneurial landscapes using digital technology such as AI. For example, Secinaro et al. (2021) investigated the intersection of machine learning, AI, and new technology. Their paper, titled *Exploring agricultural entrepreneurship and new technologies: Academic and practitioners’ views*, assessed how cutting-edge technologies such as AI, machine learning, and augmented reality could bolster agribusiness. They explored the synergy between agricultural entrepreneurship and these technologies, seeking insights from both academia and industry. Their research highlighted the mutual exchange of knowledge between scholars and professionals. Moreover, they identified four primary themes: businesses using AI for weather forecasting, innovative strategies for crop monitoring, and ventures leveraging cloud technology to regulate plant humidity.

Minor Nodes (Green, Yellow, and Purple nodes). See below:

Green Nodes. Centered on start-up entrepreneurship, discussions within this cluster highlight dynamics in the digital entrepreneurial domain. Truong (2023) offered a novel insight into the relatively uncharted territory of membership categorization in relation to funding decisions in the burgeoning AI sector. The research demonstrated that core members in this nascent AI arena were more successful in attracting investor funding than their peripheral counterparts.

Key determinants positively impacting financing included founding team size, number of lead investors, patent counts, and CEO endorsement.

Yellow Nodes. This cluster is primarily devoted to sentiment analysis. Williamson et al. (2022) employed AI to gauge entrepreneurial passion by analyzing longitudinal qualitative data, specifically scrutinizing the evolution of zeal toward founding a social venture throughout a six-month social accelerator program. Their analysis revealed a decline in the emotional intensity of passion for launching such ventures over the said duration.

Purple Nodes. Discussion emphasizes content analysis. In a bid to shed light on the metaverse's nuances, Tunca et al. (2023) embarked on a two-pronged exploration. They identified the metaverse's positive and negative emotional facets and then mapped the interrelations between the metaverse and related constructs. Utilizing natural language processing (NLP) in tandem with computational qualitative analysis, primarily powered by AI, the research unveiled that proponents of the metaverse extol the transformative potential of virtual experiences underpinned by blockchain, algorithms, and nonfungible tokens (NFTs), for both consumers and businesses, with a pronounced emphasis on the gaming realm. Conversely, the research also uncovered negative sentiments pointing toward challenges arising from misinformation, deleterious content, algorithmic pitfalls, data issues, and technological snags predominantly observed on platforms such as Facebook and other social media. The discourse also touched upon users who had faced adversities within the metaverse or concerns about new problems emerging within this virtual realm.

Evolution of Keywords

Figure 8 illustrates a thematic map with the y-axis representing density and the x-axis signifying centrality. Centrality measures the importance of a theme, while density gauges its progression or expansion in the literature. The map is divided into four distinct quadrants.

The top right quadrant contains the “motor themes” such as content analysis, metaverse, and digital entrepreneurship. These themes are central and have significantly evolved in AI and entrepreneurship

Figure 8. Keyword Thematic Map for Articles

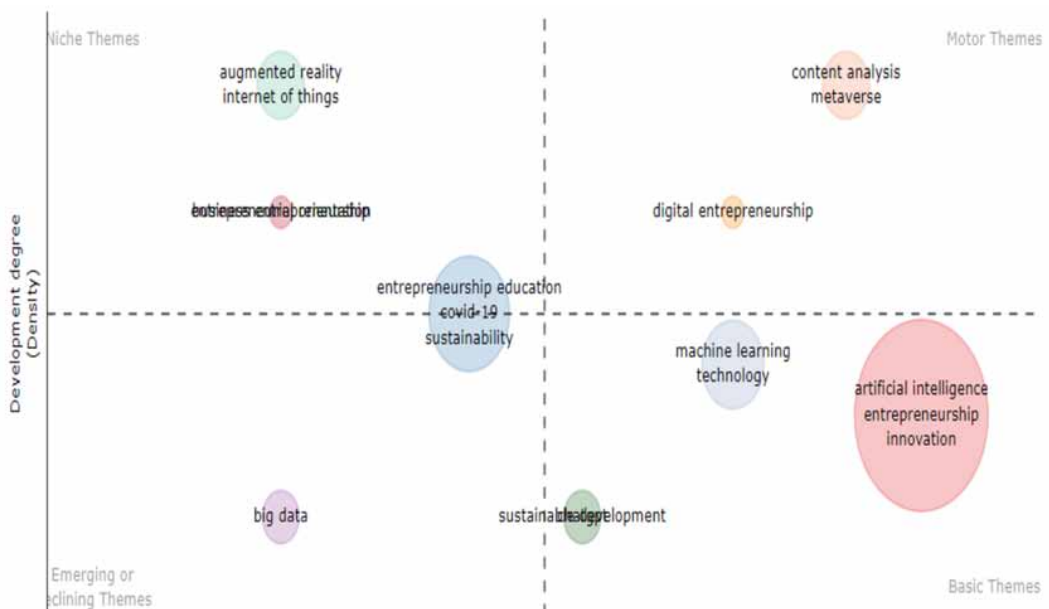
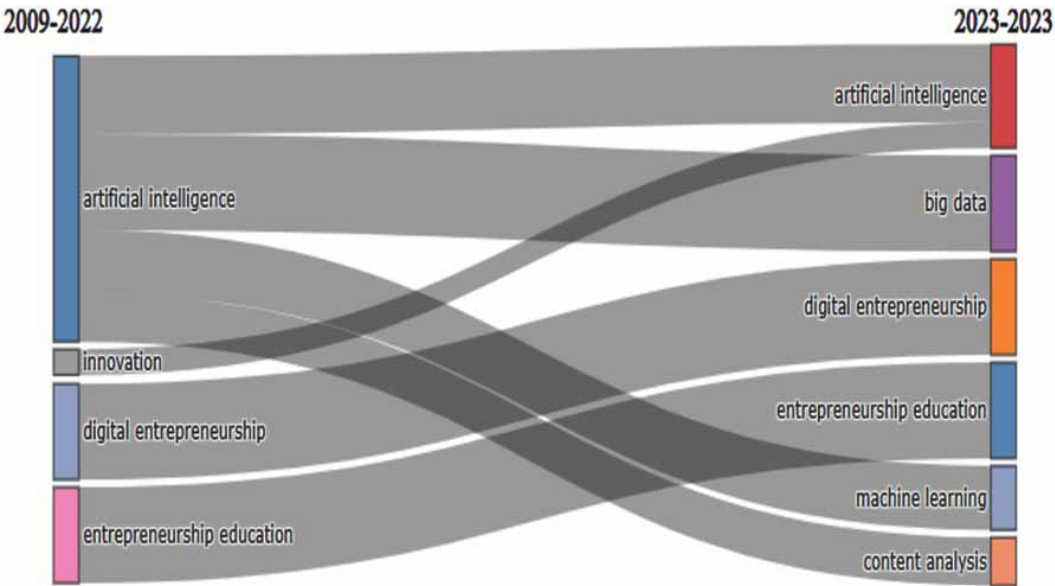


Figure 9. Sankey Diagram Based on Keyword Thematic Evolution



literature, symbolizing core and mature areas of study. The top left quadrant encompasses the “niche themes,” which include augmented reality, Internet of things, and business entrepreneurship. These are well-developed but specialized topics within the broader scope of AI and entrepreneurship research.

The bottom left quadrant is reserved for “emerging or declining themes.” Here, big data is positioned centrally, while entrepreneurship education, covid-19, and sustainability straddle the boundary between the niche and emerging sections. Themes in this quadrant can be rising in prominence or receding in significance. Those straddling themes suggest a dual status. They are either well-established yet evolving areas of focus or topics that might be losing their traction in AI and entrepreneurship literature. The bottom right quadrant features the “basic themes.” Even though artificial intelligence, entrepreneurship, innovation, machine learning, technology, and sustainable development have a low density, indicating limited progression, they are fundamental to the field. These themes set the groundwork for future research and require further investigation to bolster their significance against the backdrop of primary themes in the domain.

Figure 9 offers a graphical representation of thematic trends across time, bifurcated into two predominant subject domains, each delineated by specific durations and keyword clusters symbolized by color-coded blocks. Spanning from 2009 to 2022, scholarly endeavors in the realm of AI and entrepreneurship predominantly revolved around core themes of artificial intelligence, succeeded by digital entrepreneurship, entrepreneurship education, and innovation. As we transition to the latest period, commencing in 2023, it’s imperative to highlight the sustained relevance of the previous themes. Additionally, the emergence and continuity of subjects such as big data, machine learning, and content analysis from 2009 through to 2023 are clearly showcased in Figure 9.

IMPLICATIONS AND FUTURE RESEARCH DIRECTIONS

In this study, we sought to examine the body of research regarding the convergence of AI and entrepreneurship. We used the bibliometric review technique, which is commonly used by scholars to condense the most significant findings from a collection of papers with bibliographic content (Donthu et al., 2021). In this section, we discuss the implications and future research directions of our findings.

The Need for Increased Scholarly Output

Our investigation and analysis highlight the emergence of literature on AI and entrepreneurship in 2009. However, from 2009 to 2019, spanning over a decade, the rate of scientific progress remained notably low, culminating in only three publications in 2019. Subsequently, between 2020 and 2023, there was a substantial acceleration in research output. Significantly, the past three years have witnessed a remarkable surge in literature, indicating a heightened academic interest in the subject. Given this escalating trend in publications, we assert that there exists ample opportunity for additional scholarly contributions in this interdisciplinary field situated at the intersection of technology and entrepreneurship. This presents an inviting space for scholars specializing in both domains to delve deeper into this area.

The Need for Enhanced Diversity in Publications From Developing Countries

An examination of the geographical distribution of literature reveals an imbalance, with a predominant concentration of scholarly work originating from China, as well as the US and the UK. While there is a modest representation of academic publications from developing regions in Asia, Africa, and Oceania, the recorded numbers suggest a need for intensified efforts from scholars in these regions concerning AI and entrepreneurship. It is encouraging to note the presence of academic contributions from developing countries. However, fostering greater participation and output from these regions remains imperative for a more comprehensive understanding of the research area.

The Need for More Inter-Country Publications

Furthermore, our findings indicate that there has been scant research on collaborations between two or more countries. China is the primary collaborative contributor to substantial research, followed by the US and India. This raises the concern of geographical silos, which can hinder diversity and advancement in the literature on AI and entrepreneurship. We propose adopting an inter-country collaboration perspective on AI and entrepreneurship research by fostering robust collaboration between advanced and emerging economies. This will facilitate the comprehensive mapping of societal challenges and the formulation of universally dependable and globally relevant solutions.

The Need for Empirical Studies on AI and Entrepreneurship

There exists an imbalance in the research conducted on AI and entrepreneurship. The studies that have received attention from researchers (by way of citations) have been literature reviews and conceptual studies (e.g., Chalmers et al., 2021; Obschonka & Audretsch, 2020). Therefore, we recommend conducting more compelling empirical studies in this area to enhance the existing knowledge in the field, which is essential for tackling the increasing issues related to AI and entrepreneurship. Researchers must examine forms and types of entrepreneurs birthed through AI and the institutional, technical, and behavioral factors that shape AI-driven entrepreneurship. Likewise, we see an opportunity to research the inherent obstacles and hindrances associated with utilizing tools, technologies, and techniques in entrepreneurship, and whether these tools spur migration from other forms of tech entrepreneurship into AI entrepreneurship. Or are AI entrepreneurs entirely new tech entrepreneurs? (Battisti, 2022).

It will be helpful if future research can illuminate the sectors of the economy where AI entrepreneurship has gained ground, be it fintech, healthcare, education, retail, agriculture, or the sharing economy. Such knowledge can shape future AI business models and developmental priorities for firms, institutions, and governments. Further, the role of entrepreneurial education programs in driving the innovative capabilities of entrepreneurs cannot be overemphasized (Hernández-Sánchez, 2019). As pointed out in Figures 8 and 9 of this review, there appears to be a gradual shift and interest of scholars toward entrepreneurship education, competence, and skillset (e.g., Fiore, 2019; Joensuu-Salo, 2021; Kozlinska, 2020; Marques, 2020; Muñoz, 2019; Szymanska, 2020). Consequently, it

is of considerable interest to investigate further the relationship between AI and entrepreneurship education, examining its practical applications, research implications, and policy considerations. The apparent absence of studies on AI and entrepreneurship, as revealed by our research, draws out the need for researchers to look into studies in the area of ethical considerations and the social impact of AI in entrepreneurship, as that area remains a virgin territory under the current review.

The Need for Theoretical Advancements

Our examination revealed that a significant number of highly influential studies, as indicated by their citation rates, lacked robust theoretical foundations. However, studies rooted in theory contribute to a deeper comprehension of a phenomenon (Ridder, 2017). To improve the theoretical understanding of the research area, we suggest conducting additional investigations firmly grounded in both multi and interdisciplinary theoretical principles. Such forthcoming research holds the promise of generating novel insights and a comprehensive understanding of AI and entrepreneurship.

The Need for Methodological Advancements

In examining the methodological landscape of this field, we found notable that the predominant focus of influential papers, specifically those garnering the most citations, is on literature reviews and conceptual studies. Conversely, there exists a notable scarcity of research utilizing survey-based approaches, simulation and solution models, and mixed methodologies. The incorporation of survey-based approaches in studies holds the potential to enhance the applicability of findings. Additionally, the adoption of mixed-methods research provides a valuable avenue for triangulation in analysis, thereby ensuring the rigor and generalizability of results as emphasized by Onwuegbuzie and Collins (2007). Furthermore, the integration of simulation or mathematical modeling techniques can contribute significantly to the development of solutions rooted in statistical and quantitative foundations (Loague and Green, 1991). Considering these observations, we recommend that future studies in this field embrace survey-based approaches, mixed methodologies, and simulation and solution models. This shift in methodological orientation has the potential to advance the field by diversifying research approaches and contributing to the robustness of findings.

CONCLUSION

This bibliometric review was undertaken to evaluate the prevailing literature on AI and entrepreneurship, aimed to delineate avenues for subsequent research that might offer profound insights. Our assessment identified three pivotal themes dominating the current discourse on AI and entrepreneurship: The role of entrepreneurship education, the specific AI technologies adopted in entrepreneurial ventures (e.g., big data), and the AI analytics techniques and tools employed (e.g., content analysis and machine learning). Drawing from the extant literature, we ascertain that entrepreneurship education significantly mediates the interplay between AI and entrepreneurship. Thus, there is a pressing need to accentuate the significance of equipping entrepreneurs with the requisite training and skills for effective AI integration. While the domain has witnessed substantial contributions, most research remains anchored in literature reviews, conceptual explorations, and quantitative methodologies.

Additionally, our analysis underscores a predominant research concentration in regions like China, the US, and the UK, leaving substantial research gaps in developing or underdeveloped regions, notably Africa and parts of Asia. These regions, being particularly vulnerable to technological and societal disruptions, necessitate closer scrutiny. We advocate for a renewed entrepreneurial paradigm, one that extensively leverages AI's prowess to address business challenges both efficiently and economically. Regarding various methods, there is a need for more studies that use survey-based approaches, simulation and solution models, and mixed methodologies, as studies in those areas on the subject matter of AI and entrepreneurship have been low. There is also the need for researchers

to support their findings with established theories and frameworks to clarify research and provide a better comprehension of the subject matter of AI and entrepreneurship.

Limitations of This Review

Despite our confidence in the rigor of this review's methodology, it is essential to acknowledge the inherent limitations associated with bibliometric analyses, as encapsulated by our study. One significant limitation is our reliance on the Scopus database for data acquisition. The inherent constraints of Scopus inevitably impact our findings. Specifically, Scopus employs a complete counting methodology for bibliographic content, attributing each coauthor with a singular publication unit, regardless of the coauthor count. As a result, multiauthor papers often receive undue prominence in our study compared with those by only one author. Another constraint arises from our exclusive focus on Scopus-indexed articles exploring AI and entrepreneurship. While our selection rationale was strategic, it inadvertently excluded a range of sources such as books, conference papers, theses, and articles on AI and entrepreneurship from non-Scopus platforms. Consequently, our review may not provide a holistic representation of the AI and entrepreneurship literature spectrum. Moreover, our keyword spectrum was limited to terms such as artificial intelligence and entrepreneurship, leaving room for future researchers to expand this list with synonymous or related terms.

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The authors of this publication declare there are no competing interests.

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