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Navigating the Digital Age: A Bibliometric Analysis of Digital Entrepreneurship Adoption Trends and Patterns

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ABSTRACT

In the rapidly evolving digital landscape, understanding the adoption trends and patterns in digital entrepreneurship is essential. Despite the growing significance of digital entrepreneurship, there remains a gap in systematically analysing how this phenomenon has been adopted and evolved in scholarly research. This gap hinders the development pertaining to a cohesive comprehension with regard to the field's trends, challenges, and future directions. Employing a bibliometric analysis, this study examines scholarly publications on digital entrepreneurship from 2014 to 2023, sourced from Scopus analytics. We use tools like VOSviewer for visualizing trends in author productivity, co-authorship networks, and keyword co-occurrences. The analysis focuses on the volume of publications, author contributions, interdisciplinary nature, and global collaboration patterns in the field. The study anticipates uncovering a significant growth in digital entrepreneurship research, characterized by diverse and interdisciplinary contributions. We expect to identify critical scholars and their influence on the field, trends in research topics, and the evolution of digital entrepreneurship themes over time. This bibliometric analysis aims to provide a comprehensive overview of digital entrepreneurship as a field of academic inquiry, highlighting its multidisciplinary nature and global impact. By charting the adoption trends and patterns, the study offers insightful details about the evolution of digital entrepreneurship and its role in shaping the digital economy, guiding future research and practice in this dynamic domain.

Keywords:
Entrepreneurship; digital entrepreneurship; digital technology; technology adoption

1. Introduction

In the era of technological progress, society has shifted to an economy that is highly dependent on knowledge, accompanied by the simultaneous growth of information technology [1]. The presence of digital entrepreneurship has become a fundamental aspect of the digital-based economy. Digital entrepreneurship, a field crucial for corporate innovation, has gained substantial pace with the expansion of digital technology and shifting global economic conditions [2-5]. This study gives a bibliometric analysis, evaluating the trends, difficulties, and opportunities within this thriving sector. The internet era has changed entrepreneurship, making it accessible across

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boundaries, upsetting conventional company models, and promoting a culture of creativity [6-9]. Entrepreneurs are business operators, innovators, and visionaries employing digital platforms to build previously unfathomable values [10]. This spans from e-commerce disruptors to firms leveraging blockchain for security, highlighting the range of digital entrepreneurship.

However, the rapidly evolving industry encounters several obstacles, such as cybersecurity, legal requirements, and the disparity in digital technology access [11-14]. The rapid advancement of this technology requires constant adjustment, which contributes to the dynamic nature of the industry. The dynamic evolution of technology, accelerated product development, and shorter product life cycles can increase the rate of innovation, thus resulting in a transformation in the nature and type of economic growth [15,16]. This article performs a comprehensive bibliometric study to track the progression of digital entrepreneurship by examining scholarly articles, industry reports, and case studies. This investigation aids in comprehending the path it takes, providing valuable insights for future research and use. Understanding the evolving digital technologies is essential for creating policies and corporate strategies and encouraging new entrepreneurs [17-20]. Furthermore, it has significant implications for individuals, companies, and governments worldwide [21]. This paper serves as a valuable resource for academics, practitioners, and policymakers [22-25].

In the digital economy's evolving landscape, adopting digital entrepreneurship is pivotal, influencing economic growth and business innovation [26-30]. "Navigating the Digital Age: A Bibliometric Analysis of Digital Entrepreneurship Adoption Trends and Patterns" dissects this trend through bibliometric analysis, revealing the patterns and themes shaping this sector. By examining citations, co-citations, and key terminologies, the study maps the intellectual terrain of digital entrepreneurship, covering its evolution, key contributions, and future trends. It also highlights the geographical and institutional diversity in digital entrepreneurship research, underscoring its worldwide impact.

2. Literature Review

It is important to face the challenges of Industry 4.0 in a sustainable way [21], as entrepreneurs need to be digitally literate to accelerate economic growth. Therefore, digital entrepreneurship needs to be emphasized among entrepreneurs nowadays. One previous literature review that could be relevant to your topic is "Digital Entrepreneurship Research: A Literature Review and Research Agenda" by Kuckertz and Wagner [31]. This literature review provides an overview of what is known about digital entrepreneurship research at the moment and identifies gaps in the literature. It could be helpful for your article as it provides a foundation for understanding the current research landscape in digital entrepreneurship. The authors reviewed 116 articles published between 2000 and 2009. They identified four main themes:

i. the definition and conceptualization of digital entrepreneurship.
ii. the characteristics of digital entrepreneurs and their ventures.
iii. the antecedents and outcomes of digital entrepreneurship.
iv. the challenges and opportunities of digital entrepreneurship.

The review also identified several gaps in the literature, including the need for more empirical research, the need to investigate how context plays a role in digital entrepreneurship, as well as the need to create a deeper comprehension of the relationship between innovation and digital entrepreneurship.

Another relevant literature review is "Female Digital Entrepreneurship: A Structured Literature Review" by Al Mamun *et al.,* [32]. This review provides a comprehensive overview of the literature on female digital entrepreneurship, identifying gaps and opportunities for future investigations. The authors reviewed 18 papers published between 2017 and 2022. They found that the literature on female digital entrepreneurship is fragmented, inadequate, as well as divergent when it comes to less practice-based concepts. The review identified several areas for future research, including the investigation of the effect pertaining to gender and cross-national comparative studies, diversity in epistemology and methodology, as well as theoretical relationships among the different research fields that affect female entrepreneurship.

The practice of digital entrepreneurship has numerous benefits, the most significant being its capacity to propel firms onto a worldwide platform, thereby expanding their market and customer reach [31,33]. This strategy also brings about cost-effectiveness, substantially diminishing administrative expenses and facilitating more economical consumer engagement through digital marketing strategies. Furthermore, it fosters a conducive atmosphere for creativity and adaptability, enabling companies to quickly adjust and enhance their offerings in accordance with dynamic market demands. Moreover, the data-focused aspect of digital entrepreneurship grants entrepreneurs the capacity to make well-informed, data-driven choices, allowing them to customize their products or services exactly to fulfil specific client requirements [34].

Engaging in digital entrepreneurship, albeit advantageous, presents an array of difficulties [10,35]. Entrepreneurs, particularly in developing nations, frequently encounter technological obstacles such as the restricted availability of digital infrastructure and a deficiency in technology expertise. In addition, they must successfully manage intricate and constantly evolving regulatory environments that involve several areas, including data protection and e-commerce legislation. Cybersecurity is a significant issue in the digital world [36-38]. Businesses are becoming more susceptible to dangers such as data breaches and cyber-attacks, which means they need to implement modern security measures and rely on expert knowledge. Moreover, the presence of a digital skills gap poses an additional obstacle, especially for conventional organizations that are shifting toward digital models. These businesses necessitate specific digital skills and expertise in order to succeed in this novel setting.

3. Research Question

In this context, the research questions addressed in this study are as follows:

i. What are the historical trends in research output in a particular field over the past decade?
ii. Who writes the most productive authors' topic articles?
iii. What are the documents by subject area?
iv. What is the number of citations?
v. What are the popular keywords related to the study?
vi. What are co-authorship countries' collaboration?
vii. What is co-citation by the cited author?

4. Methodology

Combining, organizing, and analysing bibliographic data from scientific publications is known as bibliometrics [39-42]. Bibliometrics and scientometrics use network visualization techniques that are rooted in knowledge and scientific mapping [43]. In addition to broad descriptive data like publication

year, publishing journals, as well as primary author classifications [44], it also includes intricate methods like document co-citation analysis. A successful literature review necessitates an iterative process involving the identification of appropriate keywords, literature search, and thorough analysis to build a comprehensive bibliography and yield dependable results [45]. In light of this, the study sought to focus on top-tier publications, as they offer valuable insights into the theoretical perspectives shaping the evolution of the research domain. To ensure data reliability, the study relied on the Scopus database for data collection. Moreover, books and lecture notes were purposefully excluded to guarantee the inclusion of high-calibre publications. Only articles that were published in rigorously peer-reviewed academic journals were taken into consideration [46]. Notably, Elsevier's Scopus, known for its extensive coverage, facilitated the collection of publications spanning from 2014 to December 2023 for subsequent analysis.

4.1 Data Search Strategy

To identify the search terms for article retrieval, this particular research utilized a screening sequence. The investigation began with a query made using the Scopus database with online TITLE-ABS-KEY (digital AND entrepreneurship), assembling 3,242 articles. Afterward, the search terms (Table 1) refinements were added to the query string, resulting in 1,462 articles that were utilized for bibliometric analysis. By December 2023, every article from the Scopus database that pertains to digital entrepreneurship was incorporated into the study.

Table 1
The search string

Scopus	TITLE-ABS-KEY (digital AND entrepreneurship) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (SRCTYPE , "j")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBYEAR , 2014) OR LIMIT-TO (PUBYEAR , 2015) OR LIMIT-TO (PUBYEAR , 2016) OR LIMIT-TO (PUBYEAR , 2017) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2022) OR LIMIT-TO (PUBYEAR , 2023))

Table 2
The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Timeline	2014 – 2023	< 2014
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press

4.2 Data Analysis

The Scopus database provided data sets including the publication year of the study, title, author, journal, citation, as well as keyword. The data covers the 2014 to December 2023 timeframe and was examined using VOSviewer software version 1.6.20. This software was used to analyse and create maps using the VOS clustering and mapping techniques. A practical substitute for the Multidimensional Scaling (MDS) method put forth by Van Eck and Waltman [43] is VOSviewer. Wu and Wu [47] explained that it shares a similar objective with MDS: to position items in a low-dimensional space in a way that accurately reflects their relatedness and similarity through the distance between them [48]. As opposed to MDS, which primarily focuses on computing similarity measures, for instance, Jaccard indices and cosine, VOS utilizes a more appropriate technique for

normalizing co-occurrence frequencies [46], known as AssociationS (ASij) Eq. (1). This measure is calculated as follows:

$$\mathrm{AS}_{ij} = \frac{C_{ij}}{w_i w_j} \tag{1}$$

The measure is defined as the ratio between the observed number of co-occurrences of i and j as well as the predicted number of co-occurrences of i and j, assuming that co-occurrences of i and j are statistically independent [49]. Therefore, utilizing this index, VOSviewer arranges objects on a map by minimizing the total weighted sum of squared distances between all pairs of items. The study conducted by Appio *et al.,* [48] implemented the LinLog/modularity normalization technique. In addition, the data set was analysed using VOSviewer, a tool for visualizing data. This analysis revealed patterns based on mathematical correlations, and various types of analyses, including citation analysis, keyword co-occurrence, as well as co-citation analysis, were conducted. Keyword co-occurrence analysis, as demonstrated by Zhao [50] can be used to examine how a research field has changed over time. Li *et al.,* [51] have shown that this method has been effective in detecting prevalent subjects across many domains. Citation analysis is a valuable tool for finding important research topics, trends, as well as methods, which also includes investigating the historical significance of a discipline's primary subject of study [52]. Document co-citation analysis is a commonly used bibliometric method that depends on network theory to discover the significant structure of data. The map influences its outcome and is dependent on the works [53].

5. Result and Finding

5.1 What are the Historical Trends in Research Output in a Particular Field over the Past Decade?

The graph in Figure 1 indicates both a strong academic interest and a correlation with the real-world growth and incorporation of digital technologies in the entrepreneurial field. This indicates that the subject is undergoing rapid changes, with research areas expected to expand to include new digital business practices, regulatory hurdles, the social and technical consequences of digitalization, and the widespread impact of digital innovation on startup ecosystems. The data contained in this linear progression offers ample opportunities for additional bibliometric investigation, such as citation analysis, to assess the influence and interdisciplinary reach of the research. Additionally, a co-authorship examination could unveil the collaborative networks and intellectual communities propelling the field forward. Overall, the statistic represents the rapid and ever-growing scholarly study on digital entrepreneurship, highlighting its crucial significance and pivotal influence on current conversations about the future merging of business and technology.

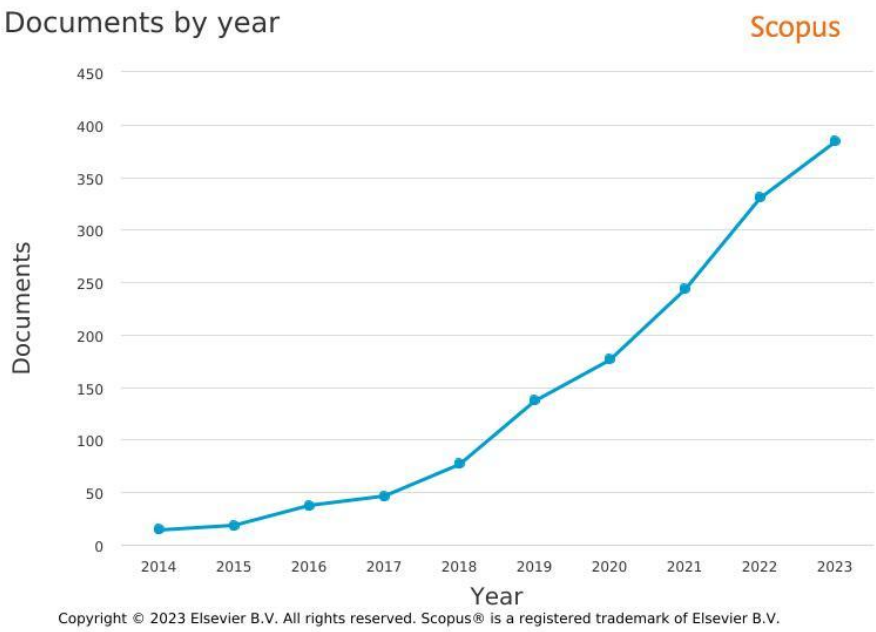

Fig. 1. The growth number of papers published on the subject of digital entrepreneurship between 2014 and 2023

The data obtained from Scopus analytics displays a notable increase in the number of papers published on the topic of digital entrepreneurship between 2014 and 2023 (Table 3). This can be seen as a clear indication of the growing interest and scholarly engagement in this sector. Commencing with less than 50 documents in 2014, there is a conspicuous and steady yearly growth in production, reaching a peak of around 450 documents by 2023. This significant expansion may be attributed to various fundamental trends: the surge of digital platforms and their revolutionary influence on conventional business models, augmented funding and institutional backing for technological entrepreneurship research, and an intensified worldwide focus on innovation and the digital economy as catalysts for economic growth.

Table 3
The percentage of papers published on the subject of digital entrepreneurship between 2014 and 2023

Year	Number of Publication	Percentage %
2023	384	26.3
2022	330	22.6
2021	243	16.6
2020	176	12.0
2019	137	9.4
2018	77	5.3
2017	46	3.1
2016	37	2.5
2015	18	1.2
2014	14	1.0

5.2 Who Writes the Most Productive Authors' Topic Articles?

Figure 2 and Table 4, obtained from Scopus analytics, present a bibliometric analysis of author productivity in the specific domain of digital entrepreneurship. It showcases the magnitude of each author's scholarly contributions to this topic. Leading the way is "Kraus, S." as the most productive

author, having authored over 13 documents. This suggests a strong involvement in the field and potentially a significant influence on the conversation surrounding digital entrepreneurship. This person is closely monitored by "Ratten, V.," "Franco, M.," and "Ghezzi, A.," all of whom have extensive research indicating their significant contributions to the fundamental and progressive features of this field. The document counts arranged in descending order indicate a distribution of authorial output that suggests different levels of involvement and impact. A bibliometric profile provides insights into both the commitment of individual scholars and the whole landscape of digital entrepreneurship, which is known for its fast-paced changes and the convergence of technology, business, and innovation. This figure highlights the intellectual contributions advancing the theoretical and empirical understanding of digital entrepreneurship.

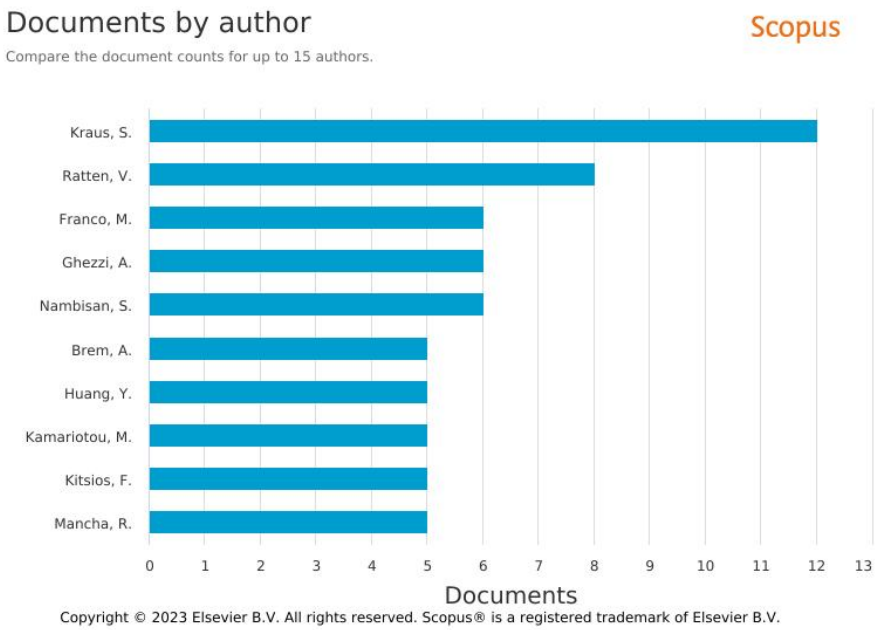

Fig. 2. Analysis of most productivity authors in the digital entrepreneurship

Additionally, it implies the existence of a possible network for academic contact and collaboration, which may be further investigated through the examination of co-authorship. The variation in the number of publications indicates a dynamic hierarchy of influence within the discipline, where specific writers play a crucial role in spreading information. An in-depth analysis of these papers may uncover patterns in research topics, methodologies, and theoretical frameworks, providing insight into the development of digital entrepreneurship as a discipline within academia. Furthermore, analysing the citation impact of these publications will enhance the quantitative data, providing valuable insights into the extent and influence of the research done by these writers throughout the academic community and beyond. Essentially, this image visually represents the intellectual landscape of digital entrepreneurship, delineating the areas explored by various authors through their research and publications.

Table 4
The most productive author percentage in digital entrepreneurship

Author Name	No. of Documents	Percentage %
Kraus, S.	12	19.0
Ratten, V.	8	12.7
Franco, M.	6	9.5
Ghezzi, A.	6	9.5
Nambisan, S.	6	9.5
Brem, A.	5	7.9
Huang, Y.	5	7.9
Kamariotou, M.	5	7.9
Kitsios, F.	5	7.9
Mancha, R.	5	7.9

5.3 What are the Documents by Subject Area?

The Scopus analyser generates a pie chart that displays the distribution of documents according to subject area (Figure 3 and Table 5). This graphic provides a bibliometric viewpoint on the multidisciplinary aspect of digital entrepreneurship. The table indicates that the 'Business, Management and Accounting' category is the most prevalent, accounting for 28.3% of the papers. This highlights the inherent link between digital entrepreneurship and commercial operations and organizational procedures. Furthermore, the category of 'Social Sciences' represents 22.7% of the research, demonstrating a notable focus on studying the societal consequences and behavioural elements of digital entrepreneurship.

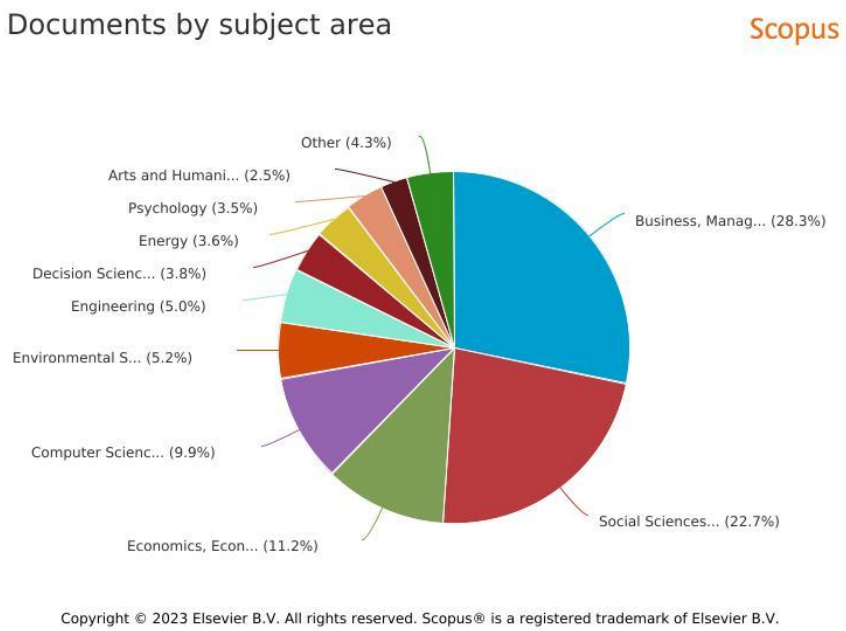

Fig. 3. The distribution of documents according to the subject area in digital entrepreneurship

The category of 'Economics, Econometrics, and Finance' accounts for 11.2% of the total, indicating its focus on economic theories and financial aspects that are essential to this area. The field of 'Computer Science' holds a significant position at 9.9%, emphasizing its crucial role in digital entrepreneurship. It covers several subjects, such as software development, digital platforms, and

information systems, which constitute the technological foundation. 'Environmental Science' (5.2%) and 'Engineering' (5.0%) make notable contributions, potentially in the areas of sustainable technology development and inventive product design within entrepreneurial endeavours.

Table 5
The distribution percentage of documents according to subject area in digital entrepreneurship

Subject Area	No. of Documents	Percentage %
Business, Management and Accounting	811	28.3
Social Sciences	651	22.7
Economics, Econometrics and Finance	322	11.2
Computer Science	283	9.9
Environmental Science	148	5.2
Engineering	143	5.0
Decision Sciences	110	3.8
Energy	102	3.6
Psychology	101	3.5
Arts and Humanities	71	2.5

The smaller segments, namely 'Decision Sciences' (3.8%), 'Energy' (3.6%), 'Psychology' (3.5%), and 'Arts and Humanities' (2.5%), demonstrate the wide scope of digital entrepreneurship. It encompasses more than just business and technology, exploring aspects such as decision-making processes, psychological factors of entrepreneurship, and even the cultural and ethical considerations of conducting business in the era of digitalization. The presence of the 'Other' category (4.3%) indicates that digital entrepreneurship study extends into other fields, perhaps encompassing disciplines such as law, health, and education. The distribution exemplifies the intricate and diversified nature of digital entrepreneurship, requiring the integration of various academic fields to comprehend and create comprehensively within the digital market. The chart provides an overview of the existing academic landscape and directs future scholars toward potential gaps or developing trends in the subject. It highlights the significance of cross-disciplinary collaboration in increasing our comprehension of digital entrepreneurship.

5.4 What is the Number of Citations?

Table 6 presents the top 10 writers identified using a Scopus analysis on digital entrepreneurship, emphasizing the most influential works based on citation counts. Kitchin R.'s research on intelligent urbanism ranks first with 1639 citations, highlighting the substantial impact of big data in contemporary cities. Nambisan's research on the digital technology aspect of entrepreneurship and its transformation is often referenced, indicating the importance of digital innovation in discussions on entrepreneurship. The list encompasses studies on algorithmic labour, analyses of manufacturing advancements, and investigations into the composition of digital entrepreneurial ecosystems, highlighting the diverse and complex character of studies related to digital entrepreneurship. This data is crucial for identifying significant research patterns and prominent researchers in the subject.

Table 6
The top ten authors of citation in digital entrepreneurship

Authors	Title	Year	Source Title	Cited By
Kitchen [54]	The real-time city? Big data and smart urbanism	2014	GeoJournal	1639
Nambisan [55]	Digital Entrepreneurship: Toward a Digital Technology Perspective of Entrepreneurship	2017	Entrepreneurship: Theory and Practice	1151

Nambisan *et al.,* [56]	The digital transformation of innovation and entrepreneurship: Progress, challenges, and key themes	2019	Research Policy	852
Rosenblat & Stark [57]	Algorithmic labour and information asymmetries: A case study of Uber's drivers	2016	International Journal of Communication	700
Li [58]	China's manufacturing locus in 2025: With a comparison of "Made-in-China 2025" and "Industry 4.0."	2018	Technological Forecasting and Social Change	606
Sussan & Acs [59]	The digital entrepreneurial ecosystem	2017	Small Business Economics	412
Elia *et al.,* [60]	Digital entrepreneurship ecosystem: How digital technologies and collective intelligence are reshaping the entrepreneurial process	2020	Technological Forecasting and Social Change	354
Cenamor *et al.,* [61]	How entrepreneurial SMEs compete through digital platforms: The roles of digital platform capability, network capability and ambidexterity	2019	Journal of Business Research	321
Ghezzi & Cavallo [62]	Agile Business Model Innovation in Digital Entrepreneurship: Lean Startup Approaches	2020	Journal of Business Research	314
Von Briel *et al.,* [63]	Digital technologies as external enablers of new venture creation in the its hardware sector	2018	Entrepreneurship: Theory and Practice	293

5.5 What are the Popular Keywords Related to the Study?

Figure 4 shows the visualization depicts a bibliometric analysis of author keywords related to digital entrepreneurship. It utilizes VOSviewer to emphasize the frequency and co-occurrence of phrases in academic works. The phrases "digital entrepreneurship," "entrepreneurship," and "digital economy" represent primary topics of inquiry, while terms like "digital innovation," "e-business," and "business models" indicate specific sub-themes of interest. The inclusion of "gender," "circular economy," and "social enterprise" signifies the progressive development of the discipline, embracing both social aspects and sustainability. This map highlights the wide range of issues included in the digital entrepreneurship domain, emphasizing its interconnectedness and that it is a complex and multidisciplinary area of study.

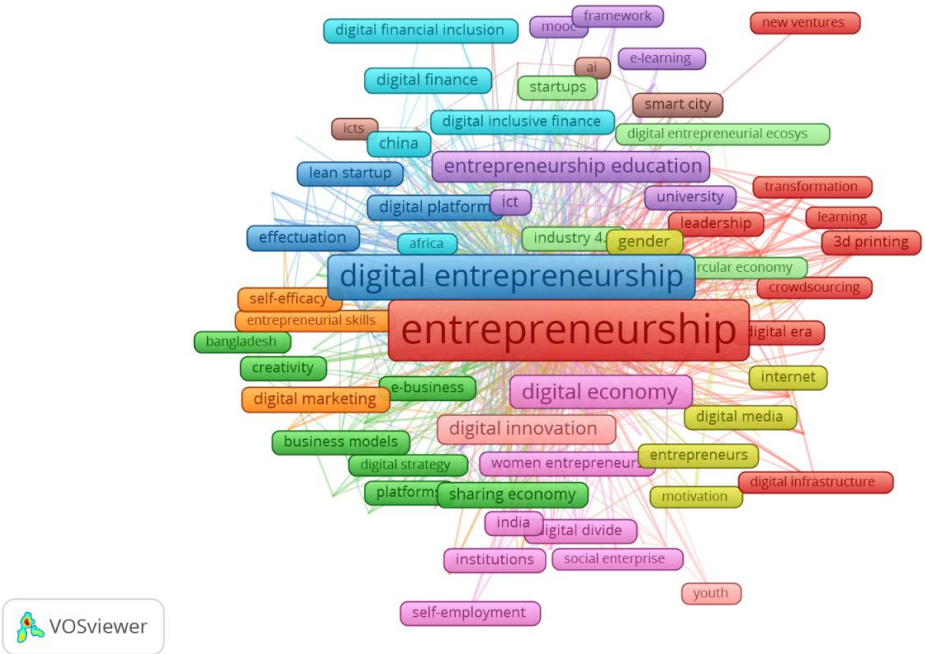

Fig. 4. The popular keywords related to digital entrepreneurship

5.6 What are Co-Authorship Countries' Collaboration?

Figure 5 shows the VOSviewer visualization depicting the interconnectedness of countries in the sphere of digital entrepreneurship through co-authorship ties. The United States occupies a prominent and influential position, demonstrating extensive research cooperation worldwide. India, Brazil, and Italy demonstrate notable connectedness, indicating their active engagement in global research networks. The global reach and scale of nodes demonstrate the extent of digital entrepreneurship research, underscoring the significance of collaborative endeavours that encompass both developed and developing countries. This emphasizes the value of international academic partnerships in stimulating innovation and generating knowledge in this dynamic domain.

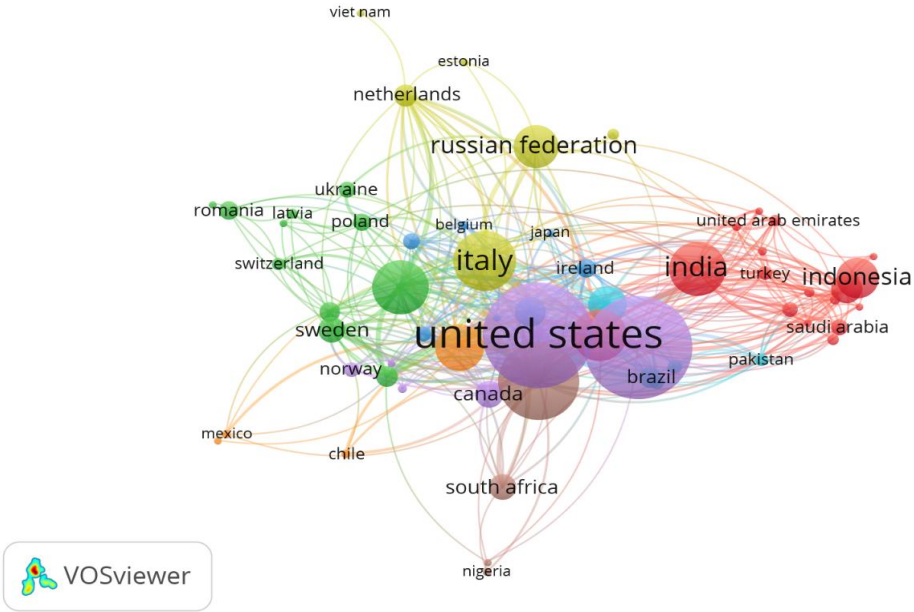

Fig. 5. The interconnectedness of countries in the sphere of digital entrepreneurship through co-authorship ties

5.7 What is Co-Citation by the Cited Author?

The VOSviewer map depicts the co-citation trends among writers in the domain of digital entrepreneurship (Figure 6). Authors with larger node sizes, such as "Nambisan S." and "Kraus S.," are cited together more frequently. This suggests that these authors are essential contributors whose work is often referenced together in scholarly publications. The map displays concentrations of scholarly impact and the connections among academics, emphasizing the collaborative and accumulative process of knowledge development related to digital entrepreneurship.

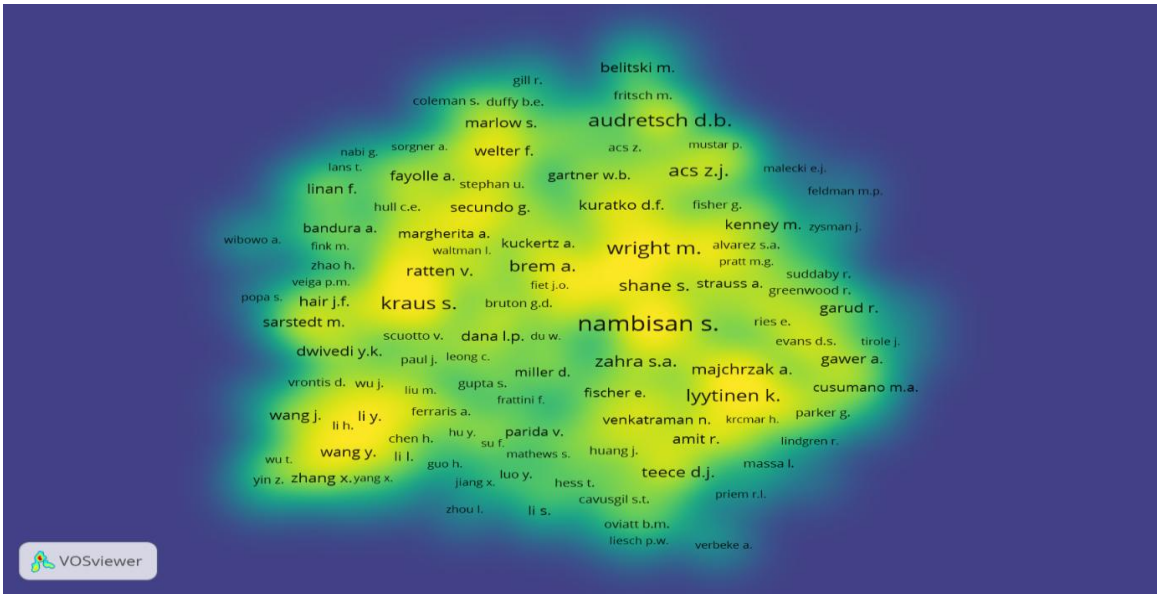

Fig. 6. The co-citation trends among writers in the domain of digital entrepreneurship

6. Discussion and Conclusions

The extensive Scopus analytics data on digital entrepreneurship from 2014 to 2023 highlights a significant academic interest, indicating the substantial expansion and development of the industry in the actual world. The surge in scholarly focus, characterized by substantial growth in publications, underscores the dynamic and diverse nature of the discipline. The presence of various authors, including prominent personalities such as Kraus and Ratten, indicates a diverse and multi-faceted discussion. Furthermore, the pie chart demonstrates the complex combination of knowledge domains necessary for comprehending digital entrepreneurship, spanning business, social sciences, and computer science disciplines. The VOSviewer visualizations provide additional insights into the worldwide collaboration and influence of this research, highlighting the numerous multinational collaborations involved. The subject of digital entrepreneurship research is constantly changing in reaction to technological improvements in business. This demonstrates the importance and influential role of this field in determining future entrepreneurial strategies and regulations.

The digital entrepreneurship domain is characterized by its dynamic and continuously changing nature. The increase in academic interest in this field is a direct result of the widespread effect of digital technologies on the entrepreneurial domain. The multidisciplinary nature of the area necessitates a wide array of scholarly inputs, as seen by the varied contributions from different domains. The bibliometric analysis provides insights into the present status of research and also paves the route for future scholarly pursuits. Prominent themes for future investigation may encompass examining digital business methodologies, regulatory hurdles, the socio-technical consequences of digitalization, and the influence of digital innovation on startup ecosystems. Moreover, a significant prospect exists to explore citation analysis and co-authorship networks, which may uncover more profound understandings of the intellectual framework and collaboration patterns inside this domain. To summarise, digital entrepreneurship is a dynamic and diverse domain that possesses a pivotal role in comprehending the convergence of technology and business in the contemporary day. The ongoing examination of this subject is not only intellectually rewarding but also essential for understanding and manoeuvring through the constantly changing terrain of the digital economy.

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