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A scientometric analysis of entrepreneurial and the digital economy scholarship: state of the art and an agenda for future research

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Abstract

Recently, there has been a greater focus on the relationship between entrepreneurship and the digital economy in academia and practice. However, no known work systematically reviews and analyses such a connection, which highlights the need to address this gap by conducting a thorough systematic literature review employing bibliometric and scientometric analyses concerning entrepreneurship and digital economy research. In doing so, analysis of key trends as well as knowledge structure (i.e., intellectual and conceptual) has been employed to analyze, visualize, and map 275 documents gathered from Web of Science (WoS) and Scopus data sets. The number of publications in the current research field has expanded dramatically due to the substantial efforts by major contributors (e.g., researchers, institutions, nations, and academic journals) worldwide. Key research themes, trends, approaches, and outlines were also emphasized by mapping the intellectual, social, and conceptual structures of entrepreneurship and digital economy-related research. The implications, limitations, and agenda for future research were all outlined.

Keywords: Bibliometrics, Digital economy, Entrepreneurship, Research agenda, Scientometric

Introduction

Entrepreneurship has been a point of discussion for decades. Its importance and contribution to economic growth and development have been highlighted in numerous studies (Meyer & Meyer, 2016, 2017; Parker, 2009; Wennekers & Thurik, 1999), while various economic policies have been formulated around its value creation (Dionisio et al., 2021; Storey, 2003). Entrepreneurs can be viewed as flexible creators who generate new opportunities and possibilities through creative destruction and innovation (Naudé, 2013; Wennekers & Thurik, 1999). In addition, the advancement of new technology and innovation has been emphasized in recent years, which has been fast-tracked by the fourth industrial revolution (Baumol et al., 2008). More recently, the impact of lockdowns and restrictions of movement due to the COVID-19 pandemic has also accelerated the use of technology and, thus, the advancement of the digital economy (Vargo et al., 2021). The use and advancement of technology

have altered the way many traditional actions were performed in the past, leading to a whole new concept of entrepreneurial activity. With the inception of the Internet during the 1980s, the birth of what we refer to as the "digital economy" today was witnessed (Bukht & Heeks, 2018). Currently, the digital economy is one of the most important drivers of not only innovation but also growth and job creation (United Nations, 2021). This has transformed the way in which business is done, thereby forcing many to review and amend their business models.

Over the last few years, an increasing trend in research on this topic has been noted. This highlights the rise in interest and knowledge regarding entrepreneurship and the digital economy. As a result, it has become significant to systematically analyze and map entrepreneurship and digital economy research over the past decades. In this respect, several studies have been conducted in different contexts, including digital entrepreneurship (Purnomo et al., 2020b), business digitization (Pan et al., 2020), and the sharing economy (Kraus et al., 2020). However, limited attention has been directed toward bibliometric overviews and scientometric analysis regarding entrepreneurship and the digital economy. Therefore, this study seeks to address the above-mentioned research gap by answering the following research questions: (1) what are the growth and trends of scientific research in entrepreneurship and the digital economy? (2) What are the top publication sources and reference networks? (3) What are the highly cited publications, and who are the most productive researchers? (4) What are the major topics of discussion within this area?

Consequently, the study's main objective is to conduct a comprehensive bibliometric overview and scientometric analysis of entrepreneurship and digital economy research. More specifically, the current paper seeks to (1) outline the development and evolution of entrepreneurship and the digital economy research through conducting performance analysis of the key trends, (2) systematically review, analyze, and map the intellectual and conceptual structures of entrepreneurship and digital economy research, and (3) design and develop a research agenda of entrepreneurship and the digital economy. To achieve these objectives, the present study used a sound framework and approach for analyzing the obtained documents. This includes a performance analysis that was conducted to identify the key trends, evolution, and contributors to the current research theme. Moreover, the network visualization was outlined by mapping the sciences in relation to the intellectual and conceptual structures of entrepreneurship and digital economy research. Accordingly, this study aims to contribute to the literature through the evolutionary mapping of entrepreneurship and the digital economy using a bibliometric analysis. Our study included 275 academic research papers that coalesce the concepts of entrepreneurship and the digital economy.

This article's remaining sections will be organized as follows. The conceptualization and theoretical basis are represented in the second section, while the research methods are expounded upon in the third section. The fourth section presents the research findings and discussions, while the fifth section includes the conclusion, followed by the implications in Sect. "Implications". The final section contains the limitations and future research agenda.

Conceptualization and theoretical background

Entrepreneurship

Entrepreneurship is one of the cornerstones of economic growth and development (Meyer & Meyer, 2016). This was already posited by Cantillon (1755), who stated that the creation of entrepreneurs leads to economic development through exchange, fluctuations in price, transfer of money, and increased competition. Schumpeter classified an entrepreneur as an innovator who acts as a change agent (Toma et al., 2014). These innovators or change agents, directly and indirectly, contribute to the growth and development of economies (Herrington & Kew, 2013; Wennekers & Thurik, 1999). Subsequently, entrepreneurship has been identified as a promoter of economic growth due to several reasons: (1) improved competition due to a rise in business numbers; (2) knowledge "spill-overs", which is an essential instrument for endogenous growth; (3) the diversity of innovation creating uniqueness leading to economic growth; (4) the reallocation and distribution of less productive resources into more usable outputs; and (5) directly contributing to employment (Acs & Szerb, 2010; Kressel & Lento, 2012; Toma et al., 2014). However, despite these numerous benefits, entrepreneurship has not been utilized to its full potential, especially in developing countries. The transition from traditional entrepreneurial activities, processes, and business models to more digitalized and technology-driven solutions has opened the door to many new opportunities (Fernandes et al., 2022) that allow entrepreneurs to draw on the benefits of the digital economy. As more demand is created as a result of a rising middle class in many countries, businesses can deliver higher outputs if intelligent digital networks are available for the collection of real-time data. Hence, this can modify how entrepreneurial ventures are managed, optimized, shared, and deployed (Heath & Micallef, 2022).

Digital economy

The world, as we know it, is continuously changing, prompting the rapid growth of technological innovations. The technology currently being utilized in business takes on many shapes and sizes; thus, it is necessary to differentiate between the different concepts (Aladhadh, 2021; Dehdarian & Tucci, 2021; Matt & Rauch, 2020). Digitization and digitalization are often confused as being one and the same. The former includes changing from an analog to a digital format (Cheek, 2021). In contrast, the latter is more complex and, simply put, includes transforming the way in which communication and collaboration in the workplace improve performance by implementing digital technologies and data (Kraus et al., 2022). Digital transformation involves the incorporation of digital technology, thereby prompting changes in the operations and delivery of goods and services. These changes often lead to fundamental modifications in business operations, delivery of products, and processes, which may potentially even lead to the development of new business models (Bouncken et al., 2021; Kraus et al., 2021). These concepts form part of a company's internal operations, whereas the digital economy is considered the external environment in which businesses function.

Since the inception of the Internet in the 1980s, followed by the World Wide Web (www), a global network of knowledge sharing has emerged (Bukht & Heeks, 2018). The term "digital economy" was first coined by Tapscott (1995) in his best-selling book,

The Digital Economy: Promise and Peril in the Age of Networked Intelligence. Pratt (2017) defined the digital economy as a worldwide network of economic activities, which include professional interactions through commercial transactions supported by information and communications technologies (ICT). Heath and Micallef (2022) expounded even more on this and stated that the digital economy consists of several key components: policy and regulations; government; the Internet; the WorldWideWeb; telecommunication infrastructure; digital services; e-business and e-commerce; digital platforms; and information and knowledge management systems. Carlsson (2004) referred to this as the "new economy" and highlighted a clear change in the status quo during the 1990s. For example, the Census Bureau reported that US patents more than doubled between 1990 and 2001. In addition, spending on industry research and development (R&D) exceeded that of government R&D expenditures. This outcome was precipitated by a wave of innovation and an increase in IT production, which indirectly amplified competition among large and small industries. This so-called digital economy gives rise to billions of daily online connections, resulting in increased economic activity between businesses, people, devices, data, and processes. Moreover, the term digital economy is sometimes synonymously used with terms, such as automation and digitization. Although these terms are linked, the digital economy extends well beyond these parameters. The digital economy is built around numerous technologies and technology platforms, which are all integrated and interacting with each other. As such, the importance of the digital economy is immense, and institutions can significantly benefit from faster and more efficient production and service supply. This also enables institutions to participate in behaviors and actions that were previously not possible through the concept of digital transformation (Pratt, 2017).

Entrepreneurship and the digital economy

The digital economy has transformed entrepreneurship by providing opportunities for new innovations and reformed business models. This results in digital entrepreneurship, defined as entrepreneurial opportunities that evolve from the use of technological and digital platforms (Antonizzi & Smuts, 2020). In some instances, the digital economy has supplied opportunities for scaling up businesses that would not have been possible without these platforms and connectivity within the digital economy (Pratt, 2017). In addition, the digital economy not only allowed for new venture creation, but also assisted in the digital transformation of existing businesses. Moreover, the availability of data that was not previously accessible has led to businesses re-evaluating their current business models and adjusting them to be more aligned with the market and customer demands, leading to improved productivity. Subsequently, online sales platforms and digital marketing techniques, such as the use of marketing analytics, have increased consumer reach, leading to increased sales and competition (Gustavsen, 2021). Schumpeter (1911) opined that innovation in the form of new products, processes, and markets leads to economic growth, whereas adopting technology and involvement in the digital economy leads to opportunities for more innovation. In other words, the digital economy can be viewed as a space consisting of different elements and connections that provide entrepreneurs with a space to experiment with new technical possibilities (Pratt, 2017). In addition, the expansion of technology and digital transformation has significantly

impacted entrepreneurial processes. Therefore, a deeper understanding of the subtleties between entrepreneurship and the digital economy is necessary to conceptualize future research (Fernandes et al., 2022).

Previous bibliometric studies on entrepreneurship and the digital economy

Although several studies have identified aspects related to this topic in some way or another, none have focused on the joint analysis of entrepreneurship and the digital economy. For example, the study by Purnomo et al. (2020b) focused on visual trends in digital entrepreneurship, analyzing only publications in Scopus from 1993 to 2019. However, the study lacked the development of a future research agenda and did not sufficiently highlight the core research themes in this research area. Another study by Purnomo et al. (2020a) focused only on the digital economy and again only considered publications from the Scopus database (1984 to 2020). This study also neglected to provide an in-depth discussion on the theme development and failed to provide a future research agenda. Pan et al. (2020) conducted a bibliometric study focusing on the keywords digitalization, digital transformation, and business, which explored economics or finance based on Web of Science (WoS) publications. This study also lacked the development of a future research agenda. The study by Zhai et al. (2022) investigated the concept of digital entrepreneurship over a 20-year period based on WoS publications. This study addressed research themes and supplied a detailed future research agenda. However, our study differs in that it considers the connection between the concepts of entrepreneurship and the digital economy. Thus, we conclude that our study is different, because it considers publications from both Scopus and the WoS and has a unique keyword combination that has not been used previously. In addition, some of the studies touching briefly on this topic lack a detailed research agenda for future studies in this area.

Methodology

In this bibliometric analysis, we defined the search keywords by combining the terms "*entrepreneurship*" and "*digital economy*". First, we searched the two most used and renowned research databases: Web of Science (WoS) and Scopus (Chadegani Arezoo et al., 2013). Table 1 presents the search string used, which exported 261 articles from

Table 1 Document search query and the search string

Database	Query
Scopus	(TITLE-ABS-KEY(Entrepreneurship) AND TITLE-ABS-KEY(digital economy)) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE,"English"))
Web of Science	Entrepreneurship and digital economy (Title) or Entrepreneurship and digital economy (Author Keywords) or Entrepreneurship and digital economy (Abstract) and English (Languages) and Articles (Document Types)

the Scopus database in BibTeX format and 137 papers from the WoS database in a plain text format.

The PRISMA process allowed for the screening and final selection of 275 papers for the bibliometric analysis presented in Fig. 1.

The methodology employed for this bibliometric and scientometric analyses encompasses the utilization of two distinct tools, namely, Biblioshiny application of the bibliometrix 4.1.2 package in R (Aria & Cuccurullo, 2017) for performance analysis and VOSviewer 1.6.17 for network visualization (Van Eck & Waltman, 2010). Such techniques were widely applied in several prior review studies within diverse contexts (e.g., Au-Yong-Oliveira et al. (2021), de Bruyn et al. (2023), and Soliman et al. (2021).

Regarding performance analysis, Biblioshiny was harnessed to gauge and evaluate the performance metrics inherent in the scholarly landscape. This involved assessing various indicators, such as publication counts, citation frequencies, and collaborative patterns, to gain insights into the impact and influence of the examined documents. For example, a thematic map, often constructed using the Bibliometrix application, provides a visual representation of the thematic structure within a collection of scholarly documents. Furthermore, it showcases clusters of related topics, highlighting the central themes and their interconnections.

The network visualization aspect was facilitated by VOSviewer. This tool enabled the creation of visual representations that encapsulate the intricate relationships and collaborations between diverse entities within the scholarly domain. The network visualization approach allowed for the identification of clusters, trends, and key connections, thereby offering a comprehensive understanding of the scholarly landscape's structure and dynamics.

By synergistically integrating the capabilities of Biblioshiny for performance analysis and VOSviewer for network visualization, the methodology ensured a multifaceted exploration of scholarly endeavors. Within this research endeavor, the independent variables represent the aggregate publication count NP, the total citation count, the number of corresponding authors, and authors' productivity by country (Hendrix, 2008). The dependent variables are the calculated metrics, such as the h-index for sources and authors, as well as the centrality and density indexes calculated for the thematic map.

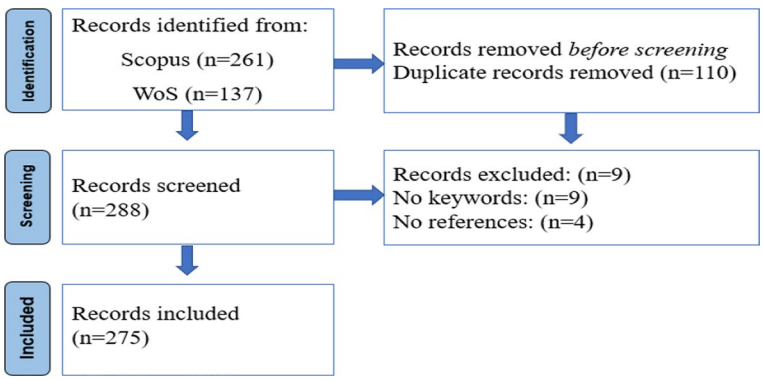

Fig. 1 PRISMA flowchart

Results and discussion

Performance analysis

The first analysis reveals a summary of the performance of the selected publications, as presented in Table 2.

Table 2 shows that the selected papers have been published between 2004 and 2022 and referenced in 198 sources. The average age of a paper is 2.83 years, with an average citation rate of almost 17 per paper. The number of references included in the 198 sources is approximately 14,364. A total of 776 authors contributed to these publications, which included 1090 keywords. The average number of authors per publication is almost equal to 3, with 49 publications compiled by a single author. The level of collaboration between the theme authors measured by the collaboration index is equal to 3.22 (Donthu et al., 2021).

Figure 2 represents the annual scientific production on entrepreneurship and the digital economy from 2004 to 2022.

The temporal evolution analysis concerning publications on entrepreneurship and the digital economy theme (Fig. 2) reflects a significant increase in 2016 from 4 to 8 papers per year. This was also the year the OECD held the discussion meeting on "Skills for a

Table 2 Data overview

Description	Results
Main information concerning data	
Timespan	2004 to 2022 (19 years)
Sources (Journals, Books, etc.)	198
Documents	275
Average years from publication	2.83
Average citations per document	16.95
Average citations per year per doc	3.468
References	14,364
Document types	
Articles	259
Articles; early access	12
Article; proceedings papers	4
Document contents	
Keywords plus (ID)	561
Author's keywords (DE)	1090
Authors	
Authors	776
Author appearances	815
Authors of single-authored documents	49
Authors of multi-authored documents	727
Authors collaboration	
Single-authored documents	49
Documents per author	0.354
Authors per document	2.82
Co-authors per documents	2.96
Collaboration Index	3.22

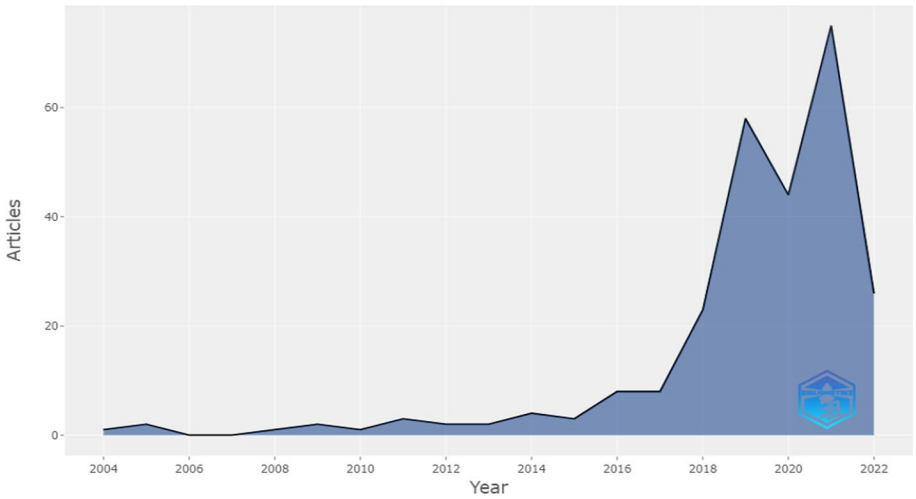

Fig. 2 Annual publications on entrepreneurship and the digital economy (2004–2022)

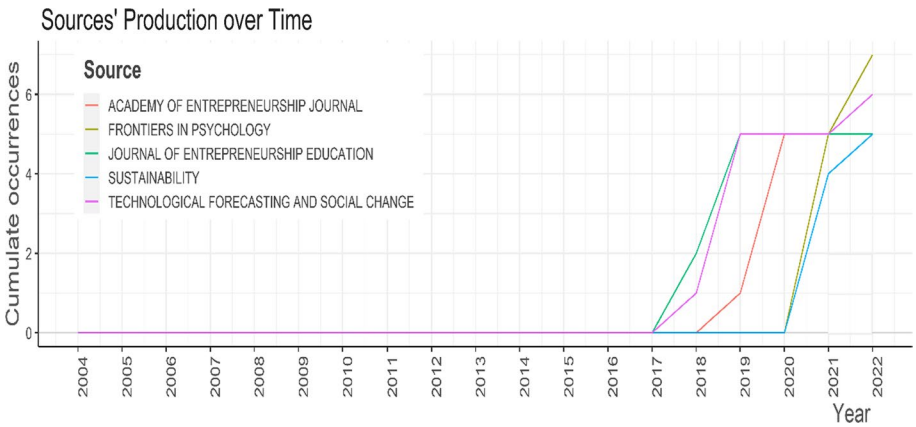

Fig. 3 Production evolution of the 5 most productive sources (minimum 4 papers)

Digital World", which provided new evidence on the effects of digital technologies on demand for future skills and presented key policies to foster skills development for the digital economy (Skills for a Digital World, 2016). In addition, the year 2018 recorded an escalation in the number of publications from 8 to 23, reaching a peak of 75 publications in 2021. This huge spike in publications highlights the importance and interest in this topic. This evolutionary analysis was conducted using the annual percentage growth rate of 19.84216 papers.

Figure 3 depicts the production evolution of the 5 most productive sources involving the theme of entrepreneurship and the digital economy.

Figure 3 illustrates the production evolution of journals, including a minimum of 4 publications dealing with the entrepreneurship and digital economy theme. *Frontiers in Psychology* published 7 papers (5 in 2021 and 2 in 2022). Interestingly, this journal focuses on psychological sciences. This provides evidence that entrepreneurship and the digital economy have a strong human-based psychological context and that studies on this topic strongly focus on our ability as humans to develop new intervention

Table 3 Top 10 most cited sources on entrepreneurship and the digital economy

	Sources	Articles
1	Small Business Economics	159
2	Entrepreneurship Theory Practice	136
3	Journal of Business Venturing	112
4	Technology Forecasting and Social Change	92
5	Research Policy	79
6	Strategic Management Journal	73
7	MIS Quarterly	72
8	Academy of Management Review	71
9	Journal of Business Research	71
10	Academy of Management Journal	69

Table 4 Top 10 most impactful sources on entrepreneurship and the digital economy

	Sources	h-index	g-index	m-index	TC	PY_start
1	Technological Forecasting and Social Change	5	6	1	421	2018
2	Journal of Business Research	3	3	1	73	2020
3	Journal of Entrepreneurship Education	3	5	0.6	30	2018
4	Journal of Innovation and Entrepreneurship	3	3	0.6	51	2018
5	Small Business Economics	3	3	1	60	2020
6	Sustainability	3	3	1.5	12	2021
7	American Behavioral Scientist	2	2	0.4	29	2018
8	Foresight and STI Governance	2	2	0.5	33	2019
9	Geoforum	2	3	0.4	37	2018
10	Information Communication and Society	2	3	0.33	61	2017

TC: Total Citation. PY: Publication Year

methods. The second most productive journal is *Technological Forecasting and Social Change,* with 6 papers published between 2018 and 2022. This journal focuses on technological forecasting and future studies serving as a planning mechanism to connect environmental, social, and technological aspects. The 5 sources, mentioned in Fig. 3, began publishing papers on the current research theme in 2018.

However, it should be stressed that the first paper on the theme by Lewis et al. (2004) appeared in the journal of *Management Decision,* which focuses on advancing the field of management with original, informative content and clear implications for business scholars, leaders, and professional managers on a global scale.

Table 3 depicts the top 10 most cited sources that focus on the theme of entrepreneurship and the digital economy.

Table 3 shows that the *Small Business Economics*, *Entrepreneurship Theory and Practice,* and the *Journal of Business Venturing* were cited most, each exceeding 100 citations.

Table 4 presents the rankings of the top 10 journals by performance measures.

The h-index assesses output and citations combined, indicating that a given author or source has published h articles, each of which has received h or more citations (Choudhri et al., 2015; Hirsch, 2005). The m-index is an index derived from the

h-index and is defined as the quotient of the h-index of an author or source divided by the number of years from the first publication (Hirsch, 2005). This index represents an average of the h-index during the entire production period of the author (career) or source. This allows for distinguishing between two units with different production durations (Choudhri et al., 2015). A g-index that equals k means that the first k articles published by an author or source are cited on an average of k times.

As can be ascertained from Table 4, the journal of *Technological Forecasting and Social Change* is ranked first in terms of the h-index and g-index, given the relatively high number of publications and excessive citations. The *Journal of Business Research* is rated second in terms of the h-index and g-index, reflecting its importance in the field of entrepreneurship and the digital economy.

Table 5 depicts the top 10 most cited documents on the subject of entrepreneurship and the digital economy.

Table 5 Top 10 most cited documents on entrepreneurship and the digital economy

Document	Citations		LC/GC (%)
	Local	Global	
Nambisan et al. (2019) *Research Policy* The digital transformation of innovation and entrepreneurship: progress, challenges and key themes	6	258	2.33
Burtch et al. (2018) *Management Science* Can You Gig It? An Empirical Examination of the Gig Economy and Entrepreneurial Activity	5	119	4.20
Sahut et al. (2021) *Small Business Economics* The age of digital entrepreneurship	5	35	14.29
Bellesia et al. (2019) *Journal of Managerial Psychology* Platforms as entrepreneurial incubators? How online labor markets shape work identity	3	8	37.50
Geissinger et al. (2019) *Technological Forecasting and Social Change* Digital entrepreneurship and field conditions for institutional change– Investigating the enabling role of cities	2	31	6.45
Browder et al. (2019) *Journal of Business Venturing* The Emergence of the Maker Movement: implications for Entrepreneurship Research	2	51	3.92
Yin et al. (2019) *Economic Modelling* What Drives Entrepreneurship in Digital Economy? Evidence from China	2	29	6.90
McAdam et al. (2020) *Small Business Economics* Digital girl: cyberfeminism and the emancipatory potential of digital entrepreneurship in emerging economies	2	16	12.50
Kitchin (2014) Geojournal The real-time city? Big data and smart urbanism	1	1327	0.08
Li et al. (2017) *Frontiers of Business Research in China* Digital entrepreneurship ecosystem as a new form of organizing: the case of Zhongguancun	1	13	7.69

The most cited article is the paper submitted by Nambisan et al. (2019), which has been published in the journal of *Research Policy* and elaborated on the key themes of digitalization and innovation. The authors identified three main themes related to digitization: openness, affordance, and generativity. Next, the study by Burtch et al. (2018), which has been published in the journal of *Management Science,* discussed the importance of the gig economy for entrepreneurs. It examined how the entry of gig-economy platforms affects entrepreneurial activity at a local level. The authors used the Uber X ridesharing platform as the case study. They found a negative but significant relationship between platform entry and two entrepreneurial activities (i.e., the Kickstarter crowdfunding campaign launched and the levels of self-employment from the Current Population Survey). Importantly, the impact was most pronounced among failed Kickstarter campaigns and unincorporated business endeavors, implying that gig-economy platforms mainly decrease lower-quality entrepreneurial activity, ostensibly by providing viable job opportunities for the unemployed and underemployed. Another survey of gig-economy service providers also supported these connections.

The paper with the highest LC/GC ratio (37.5%) was by Bellesia et al. (2019) and discussed how work identity construction unfolds for gig workers undergoing unstable working interactions in online labor markets. The authors interviewed 46 freelance gig workers active in popular online labor markets. The results indicated that the online environment limits the actions of workers forced to use the platform's technological tools to succeed. This interaction then prompts workers to explore new work qualities and develop an entrepreneurial orientation.

The distribution of countries, according to the corresponding authorship and citations, is presented in Table 6. As depicted in Table 6, the most corresponding authors are from the USA, China, and the UK, respectively, with 23, 21, and 20 publications. Regarding publications, the USA occupies first place with 54 papers, followed by Russia with 43, and the UK with 32. The countries with more than 1000 citations are Ireland with 1349 and the USA with 1134.

Figure 4 reflects the authors' keywords and trend evolution. The authors, publications, and citations are well spread across America, Europe, Asia, and Australasia, except for Africa.

Table 6 Countries classification by corresponding authors, publications, and citations

Corresponding authors		Publications		Citations	
Country	**Articles**	**Region**	**Frequency**	**Country**	**Total Citations**
USA	23	USA	54	Ireland	1349
China	21	Russia	43	USA	1134
UK	20	UK	32	UK	316
Russia	12	China	31	China	144
India	11	Ukraine	28	Germany	109
Ukraine	11	India	19	France	87
Australia	10	France	16	Norway	74
France	9	Australia	15	Sweden	68
Spain	7	Italy	12	Mexico	66
Italy	5	Spain	12	Russia	63

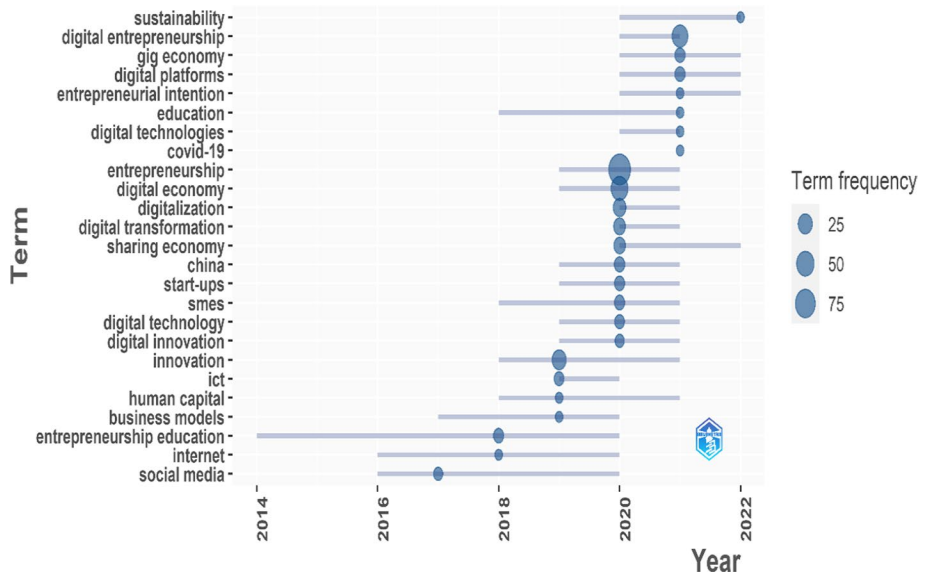

Fig. 4 Authors' keywords and trend evolution

The most impactful theme based on our search is entrepreneurship education. This theme emerged in 2014 and had high usage in 2017. Beyond creating the entrepreneurial ecosystem, incubation, and financing, the power of entrepreneurship has taken on new parameters. It also includes cultivating an entrepreneurial mindset in the youth and graduates through conventional schooling and higher education systems (Ho et al., 2018). Recommending entrepreneurship education among the youth can lead to competent individuals with relevant entrepreneurial skills and knowledge (Farhangmehr et al., 2016). As a result, most countries recognize entrepreneurial education as a prominent economic policy instrument (Rae et al., 2014). The year 2016 saw the appearance of themes associated *with social media and the Internet.* More specifically, the advent of social media has revolutionized almost every aspect of modern life.

Notably, social media users have a high potential for expediting and enabling the engagement of economic agents within the digital economy (Khalid et al., 2021). In 2020, the themes of entrepreneurship and the digital economy became dominant in the literature. These themes revolve around other themes, such as sharing economy, startups, SMEs, and digital innovation. The research in 2021 was dominated by the theme of digital entrepreneurship, the gig economy, and digital platforms. Figure 5 reflects the source (CR), authors (AU), and author's keywords (DE).

The link between references, authors, and keywords (Fig. 5) reflects the importance of the paper by Nambisan et al. (2019) in the work of Crowley C (Maastricht School of Management, Netherlands), who conducts research that primarily focuses on the digital economy. This author, who has published two papers exploring the theme of entrepreneurship and the digital economy, has linked the following references: Giones and Brem (2017) and Welter (2011). Feldman M (University of North Carolina at Chapel Hill, USA) and his co-authors have linked the digital economy theme to other areas, such as digital entrepreneurship, digitalization, and China. Bouncken

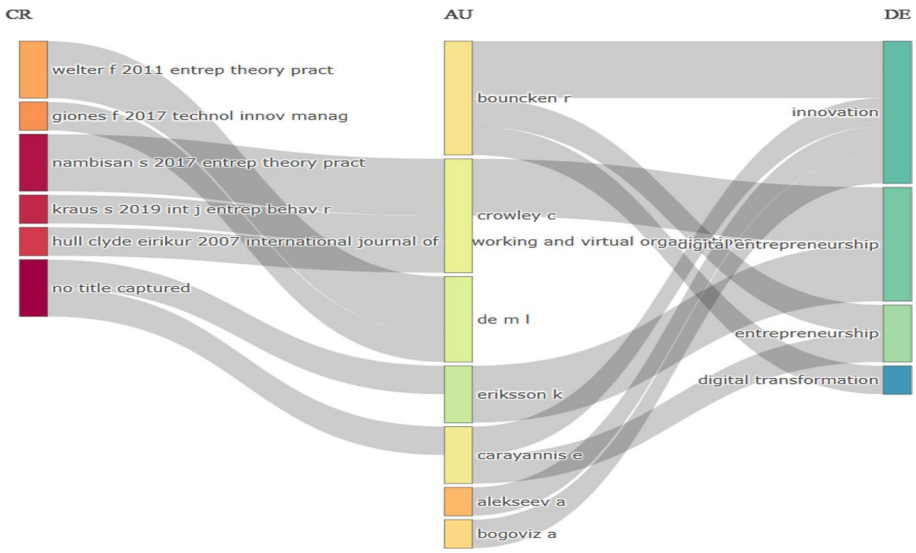

Fig. 5 Source (CR), authors (AU), and author's keywords (DE)

Table 7 Comparison of bibliometric indicators between Scopus and WoS databases

Description	Scopus	WoS
Main information about data		
Timespan	1995:2022	2003:2022
Annual Growth Rate %	13,28%	16,43%
Document Average Age	4,08	3,3
International co-authorships %	25,67	33,58%
Most cited journal	Journal of Business Venturing with 137 citations	Small Business Economics with 195 citations
Most impactful journal	Technological Forecasting and Social Change with h-index 4	Technological Forecasting and Social Change h-index 4
Most impactful author	Sascha Kraus with h-index 3	Elias G Carayannis with h-index 2
Most cited document	Richter et al. (2017) with 6 local citations and 114 global citations	Nambisan et al. (2019) with 6 local citations and 258 global citations
Corresponding countries	China with 19 documents	China with 18 documents
Most productive country	USA with 60 documents	Russia with 45 documents
Most cited country	Ireland with 1349 citations	USA with 1068 citations
Most cited keyword	Entrepreneur with 24 occurrences	Innovation with 23 occurrences

R (Strategic Management and Organization, University of Bayreuth, Universitaetsstr, Germany) integrated *innovation* themes into the digital economy and entrepreneurship analysis.

Table 7 showcases a comparison of performance indicators between Scopus and WoS databases, as outlined in the document by Suárez et al. (2022).

By comparison, Scopus and WoS data sets reveal intriguing distinctions. While Scopus covers a broader timespan from 1995 to 2022, WoS examines a more recent range from 2003 to 2022. The annual growth rates of 13.28% for Scopus and 16.43% for WoS suggest a consistent increase in scholarly output. The average document age is slightly higher in Scopus at 4.08 years, compared to WoS's 3.3 years. Notably, WoS exhibits a higher

percentage of international co-authorships at 33.58%, compared to Scopus's 25.67%, emphasizing its global collaborative nature. The most cited journal differs with "Journal of Business Venturing" topping Scopus, while "Small Business Economics" leads in WoS. "Technological Forecasting and Social Change" emerges as the most impactful journal in both databases, boasting an h-index of 4. Divergent influential authors include Sascha Kraus (Scopus) and Elias G Carayannis (WoS), each with distinct h-index values. While the most cited documents depict similar local citations, "Nambisan et al., 2019" garners more global citations in WoS (258) compared to Scopus's "Richter et al., 2017" (114). The corresponding country counts and productivity levels differ, with China (Scopus) and Russia (WoS) leading the latter category. Finally, Ireland dominates citations in Scopus with 1349, while the USA takes the lead in WoS with 1068, underlining differing citation patterns. The varying emphasis on keywords such as "Entrepreneur" (Scopus) and "Innovation" (WoS) further showcases the distinctive scholarly foci of the two databases.

Intellectual structure

The analysis of the intellectual structure involves the construction of a reference co-citation network and a sources co-citation network. First, the co-citation reference network (Fig. 6) consists of 4 clusters.

Cluster 1 (Blue): entrepreneurial ecosystems

The first cluster in blue is influenced by the research of Autio et al. (2018) on digital affordances and entrepreneurial ecosystems, while the paper by Malecki (2018) deals with the concept of entrepreneurial ecosystems, and the paper of Acs et al. (2017) focuses on the lineages of the entrepreneurial ecosystem approach. Hence, this cluster deals with themes relevant to ecosystems, digital entrepreneurship, complex relationships, and human capital theory. Some main findings arising from research conducted in this cluster include how entrepreneurial ecosystems differ from traditional clusters, such as industrial districts and agglomerations, clusters, and systems of innovation. These differences are precipitated by their emphasis on the following: exploitation of digital affordances; their focus on entrepreneurial opportunity discovery and pursuit; their

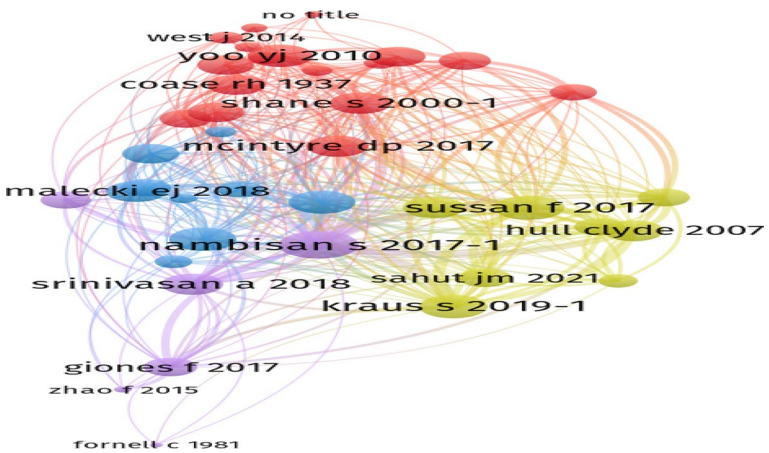

Fig. 6 Reference co-citation network

emphasis on business model innovation; voluntary horizontal knowledge spillovers; and cluster-external locus of entrepreneurial opportunities (Autio et al., 2018). Furthermore, according to bibliometric data, the phrase entrepreneurial ecosystem has surpassed previous notions, such as settings for entrepreneurship, which emphasize the mechanisms, institutions, networks, and cultures that assist entrepreneurs (Malecki, 2018). Acs et al. (2017) argued that economic systems have always been about explaining differences in production and results. However, the function of entrepreneurship in economic systems has typically been disregarded, just as entrepreneurship studies have mostly ignored the importance of systems in understanding entrepreneurship's prevalence and performance. The concepts of the entrepreneurial ecosystem approach are brought forward, expressing that there are two dominant facets within the entrepreneurial ecosystem, including regional development and strategic management, with both sharing common roots in ecological systems thinking.

Cluster 2 (Purple): digital technologies and innovation

The second cluster in purple is dominated by studies Nambisan et al. (2019) submitted on digital entrepreneurship and the paper by Srinivasan and Venkatraman (2018) on entrepreneurship in digital platforms. This cluster deals with innovation, digital entrepreneurship, curvilinear relationships, and the human capital theory. Research by Nambisan et al. (2019) also revealed that the nature of the uncertainty inherent in entrepreneurial processes and outcomes, as well as the methods for coping with such uncertainty, has been revolutionized by new digital technologies. The authors provide two comprehensive implications: (1) a less defined locus of entrepreneurial action and fewer limited entrepreneurial processes and results, and (2) to establish a research agenda that demands clear thinking concerning ideas pertaining to digital technology. Srinivasan and Venkatraman (2018) introduced a network-centric perspective to comprehend how entrepreneurs in the position of third-party developers enhance digital platforms by linking with them. Furthermore, the authors create ideas that reflect a dynamic view of the two essential phases of competition in digital platforms, namely, the preliminary launch and scaleup. Their research reveals how digital entrepreneurs may coordinate strategic movements to negotiate the complicated environment of connecting and adapting to numerous platforms and how these connection decisions can lead to successful entrepreneurship.

Cluster 3 (Red): entrepreneurial knowledge and opportunities

The third cluster in red comprises the papers of McIntyre and Srinivasan (2017) dealing with the themes of networks and platforms. The authors incorporated perspectives, such as strategic management, industrial organization economics, and technology management. They proposed a future research agenda focusing on the influence of network effects and the quality of platforms to ensure competitive results, what drives indirect network effects, what type of complementary attributes are prevalent, and how these can be leveraged for maximum competitive advantage. Understanding these concepts can maximize strategic planning. The study by Shane (2000) deals with prior knowledge and entrepreneurial opportunities, which is a classic study that has formed the foundation for numerous future studies. It reveals several implications: (1) entrepreneurs

do not necessarily choose between different market opportunities for new innovation and technologies; (2) differences in information regarding opportunities are the source of entrepreneurship; (3) previous studies concerning entrepreneurial exploitation may be biased; and (4) disparities influence the discovered opportunities, how their entrepreneurial efforts are structured, and how the government influences this process.

Cluster 4 (Yellow): digital entrepreneurship

The fourth cluster is composed of the papers by Sussan and Acs (2017), which deal with the theme of digital entrepreneurial ecosystem, the paper by Hull et al. (2007), which explores the digital opportunities theme, and Kraus et al. (2018) producing an agenda to facilitate new business models. This cluster is concerned with digital entrepreneurship, complex relationships, human capital perspectives, and seemingly unrelated probit models applied to this theme. Sussan and Acs (2017) highlighted a significant gap in the conceptualization of entrepreneurship and the digital era. They focused on integrating digital and entrepreneurial ecosystems to better understand the connection between agents and users in the consumer and social realm. Hull et al. (2007) investigated the differences between digital and traditional startups and how these different characteristics shape each business' ability to succeed. One of the most recent papers in this cluster, by Kraus et al. (2018), focused on providing an up-to-date compilation of key topics and methods discussed in the relevant literature. Their findings revealed six new streams of research that are linked to digital entrepreneurship: (1) digital entrepreneurship process; (2) platform strategies; (3) digital business models; (4) digital ecosystems; (5) social, digital entrepreneurships; and (6) entrepreneurship education.

Figure 7 reflects the sources in the co-citation network. Five source clusters are visible, of which red, green, and blue are the most predominant. Table 8 reflects the main sources and topics. Cluster C1 (Blue) consists mainly of the journals *Small Business*

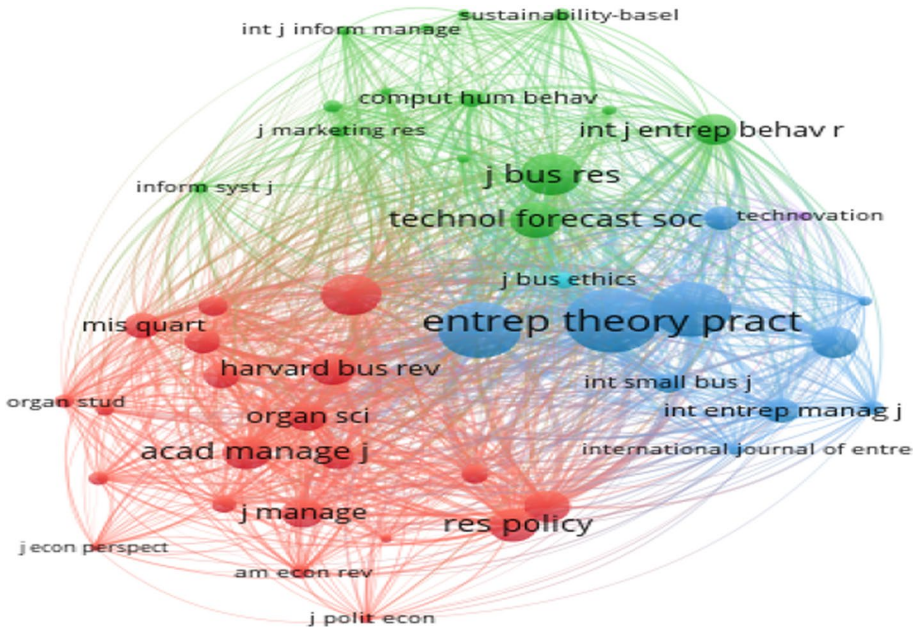

Fig. 7 Sources co-citation network

Table 8 Sources cluster topics

Cluster	Sources	Topics
C1 Blue	Small Business Economics	Startup age, knowledge conversion, digital conversion
	Entrepreneurship Theory and Practice	
	Journal of Business Venturing	
	Entrepreneurship and Regional Development	
C2 Red	Research Policy	The gig economy, entrepreneurial activity, digital credit
	Academy of Management Review	
	Strategic Entrepreneurship Journal	
	Administrative Science Quarterly	
C3 Green	International Journal of Entrepreneurial Behavior and Research	Digital subsistence entrepreneur, digital entrepreneurship
	Journal of Business Research	
	Technological Forecasting and Social Change	
	Computers in Human Behavior	
C4 Turquoise	Journal of Business Ethics	Business ethics
C5 Violet	Technovation	Digital innovation

Economics, *Entrepreneurship Theory and Practice*, *Journal of Business Venturing* and *Entrepreneurship and Regional Development*. The main topics in this cluster are startup age, knowledge conversion, and digital conversion. The red cluster (C2) is made up of the following journals: *Research Policy*; *Academy of Management Review*; *Strategic Entrepreneurship Journal;* and *Administrative Science Quarterly.* The main topics include the gig economy, entrepreneurial activity, and digital credit. Cluster C3 (Green) includes the *International Journal of Entrepreneurial Behavior and Research*, the *Journal of Business Research, Technological Forecasting and Social Change* and *Computers in Human Behavior.* These journals focus mainly on digital subsistence entrepreneurs and digital entrepreneurship. Cluster 4 (Turquoise) and Cluster 5 (Violet) consist of only one journal each.

Table 8 reveals the network features. Cluster C1 includes the journals focused on startup themes; these journals cover the theme of business and entrepreneurship. Cluster C2 contains journals that are mainly concerned with entrepreneurship and management. Cluster C3 groups together journals that deal primarily with the issue of the human and social dimensions of entrepreneurship.

Conceptual structure

The conceptual structure includes the analysis of the keyword cloud (Fig. 8), the keyword co-occurrence network (Fig. 9), and the theme map (Fig. 10).

The authors' keyword cloud reveals that the theme of digital entrepreneurship constitutes the central theme addressed by the majority of the researchers, followed by the digital economy, which occupies the second place in terms of appearance in the papers. Moreover, innovation and the sharing economy are closely related to digitalization and digital transformation. Startups and the gig economy represent the areas that were the subject of the appearance of digitalization.

Figure 9 of the keyword co-occurrence network depicts the existence of 7 clusters. The yellow cluster is built around the central theme of innovation. This topic revolves

Fig. 8 Keywords cloud

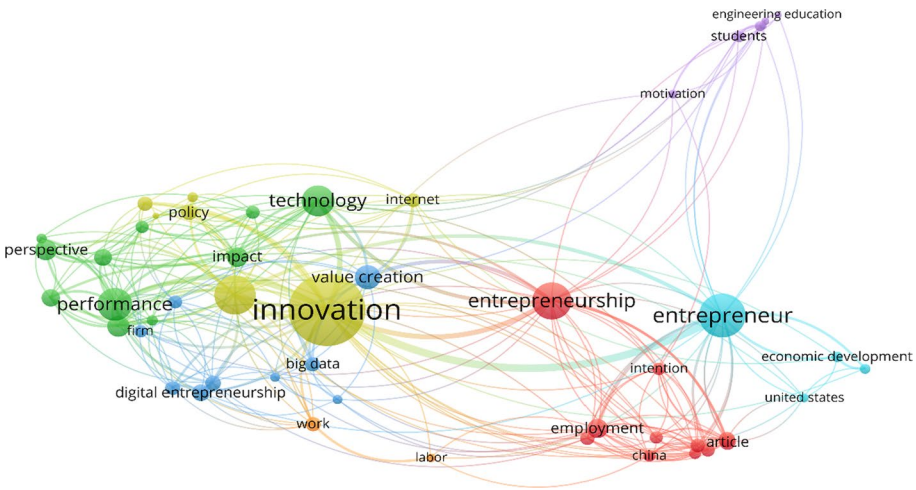

Fig. 9 Keyword co-occurrence network

around innovation in business relevant to platforms and the Internet. The cluster in red is dominated by the subject of entrepreneurship and supports the themes that deal with the intentions and behavior of entrepreneurs in China. This cluster links innovation to the third cluster in purple, which is associated with engineering education and motivation. The fourth cluster is dominated by the topic of technology, which conveys themes related to impact, performance, management information, and creation. The fifth cluster in turquoise is built around the topic of entrepreneurship and involves the economic development in the US within the context of digitalization and entrepreneurship. The sixth cluster in blue is dominated by its focus on business modeling and digital entrepreneurship models and their relationship to Big Data. The seventh cluster in orange links innovation to employment through the topic related to work and labor, the axis of the gig economy.

Figure 10 illustrates the map of themes projected on a plane composed of the axis of centrality on the abscissa and the axis of density on the ordinate. An analysis of this map will allow us to reveal the driving themes, the basic or transversal themes,

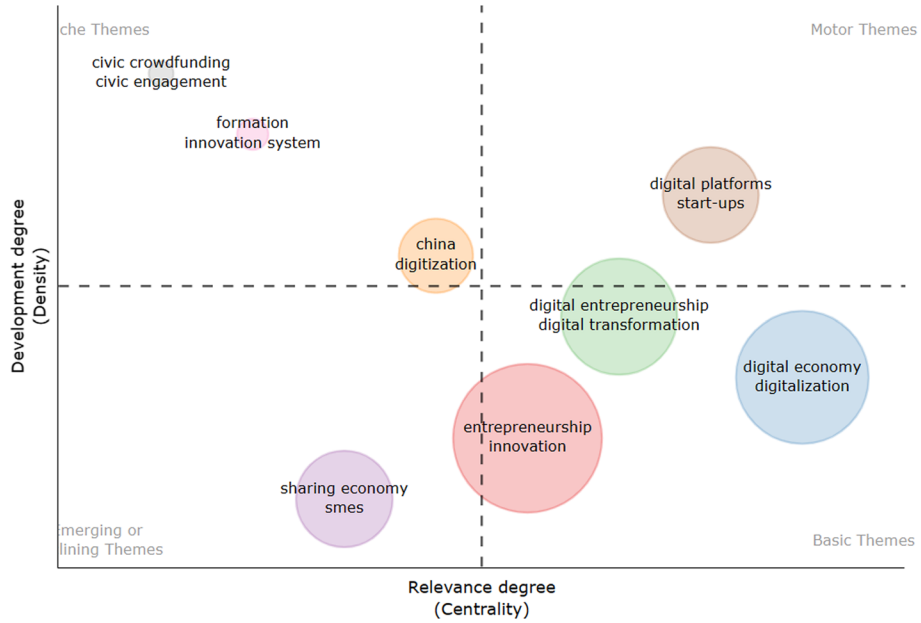

Fig. 10 Thematic map (150 most frequent keywords)

the emerging or declining themes, and niche themes according to the classification of Della Corte et al. (2019).

The motor themes are in the right-hand frame at the top, characterized by high density and centrality. One cluster is considered the driving topic, namely, the digital platforms, which co-occurs with the business model and entrepreneurial ecosystem topics. These topics are applied to startups and female entrepreneurs; such issues are investigated in India, Indonesia, and Lebanon. The core document in this cluster is that of Prasetyo (2021).

The basic or transversal themes are the elements in the right-hand bottom frame. They are topics that have a low density and a high centrality. This cluster constitutes the entrepreneurship cluster, which co-occurs with innovation, gig economy, and COVID-19 subjects. These topics are applied to ICT in emerging countries, and the central document for this cluster is by Bögenhold (2019). The second basic cluster is the digital economy topic that co-occurs with digitalization and entrepreneurship education. These topics are applied to startups and are analyzed mainly in Asian countries, while the central document for this cluster was generated by Gaziz et al. (2020). The third basic cluster focuses on digital entrepreneurship while combining digital transformation and innovation. These topics are applied to small and mid-size enterprises, primarily for agglomeration and the development of smart cities. The central document for this cluster was produced by Nambisan et al. (2019).

The left bottom frame reflects the emerging concepts, characterized by low centrality and low density. The emerging cluster deals with the sharing economy theme, which co-occurs with social entrepreneurship and fintech. These topics are applied to small and mid-size enterprises, which are analyzed primarily in African countries. These issues are mainly evaluated through artificial intelligence, and the central document for this cluster is by Gössling and Michael Hall (2019).

Niche themes are topics of China, which co-occur with digitalization and the digital platform ecosystem. The second cluster deals with the topic of the innovation system, which co-occurs with training and risk management. The third cluster deals with the theme of civic crowdfunding, which co-occurs with civic entrepreneurship and digital citizenship themes.

Conclusion

Through this review, we conducted a thorough systematic literature review employing bibliometric and scientometric analyses pertaining to entrepreneurship and digital economy research in which we identified the key trends and knowledge structure (i.e., intellectual and conceptual structure). This review work contributes to the existing body of knowledge by drawing attention to the increasing developments in scholarly research concerning the intersection of entrepreneurship and the digital economy. Thus, we were able to determine which institutions and individuals were the most prolific publishers in this field and the studies that received the most citations. This also allows us to provide a concise summary of the most important issues in this domain, which may serve as a guide for researchers interested in the intersection of entrepreneurship and the digital economy. Understanding the role that the digital economy plays in the development of novel business models for enterprises and entrepreneurs necessitates research that takes into account several cross-levels of study. Here, we discussed the emergence of digitization and entrepreneurship, small and medium-sized enterprises (SMEs), and digital platforms as three fundamental issues within the context of the digital economy. Accordingly, we offered several theoretical and practical implications, which include the limitations in this field of study. This enables us to identify promising directions for a future research agenda.

Implications

Our findings are supported by a well-designed methodology, which reduces the possibility of bias in our recommendations for policy and practices. In addition, to ensure objectivity, one member of the author team focused closely on coding the data, while others focused on linking the theoretical aspects of the findings with theory. In line with Aguinis and Cronin (2022), along with the help of the outcomes, we were able to combine theory and policies in the form of an integrated twofold theory and policy perspectives agenda. An overview of this combination is provided in Table 9. Due to the development of cutting-edge, efficient digital platforms, networks, and technological tools, research on the relationship between technological innovation and entrepreneurship has seen an upward trend over the past few years. This calls for the thorough mapping and evaluation of entrepreneurship and digital economy research. In this regard, different studies have been established, such as business digitization, sharing economy, and digital entrepreneurship (Kraus et al., 2020; Pan et al., 2020; Purnomo et al., 2020a).

However, bibliometric summaries and comprehensive literature evaluations on entrepreneurship and the digital economy have received little attention. Thus, through 275 academic research papers that combine the concepts of entrepreneurship and the digital economy, this paper contributes to the literature through the

Table 9 Synthesis of a future research agenda

Cluster	Avenues for further work
Entrepreneurial ecosystems	Future studies are recommended to: Explore how entrepreneurial ecosystem components (e.g., entrepreneurs, investors, and policymakers) respond to external shocks and crises Examine how interactions between entrepreneurial ecosystem components could affect entrepreneurial resilience and self-efficacy Empirically assess how networks, intermediaries, and other institutional structures facilitate ecosystem components' contacts and motivate entrepreneurial endeavors among different contexts Examine how stakeholders in the ecosystem negotiate cross-border disparities in institutional, cultural, and regulatory frameworks and how those differences affect the outcomes of their entrepreneurial activities Develop a framework for evaluating entrepreneurial ecosystems and determining the crucial indicators to gauge the efficiency of various ecosystem components Investigate how ecosystem stakeholders might improve the diversity and inclusivity of entrepreneurs' environments from various backgrounds and how this impacts the outcomes of entrepreneurial activities
Digital technologies and innovation	Future studies are recommended to: Investigate how disruptive technologies affect innovation and entrepreneurial activities Explore how businesses (entrepreneurs) could adapt to disruptive technologies to maintain a competitive advantage Understand the ethical and societal ramifications of digital technology, along with the ways in which businesses could establish responsible innovation strategies that consider such concerns Empirically examine the dynamics and structure of digital ecosystems and how these ecosystems would promote innovation and provide new value Test how digital technologies affect education and learning and how organizations could use them to drive innovation and skill development Assess how businesses develop and employ effective digital transformation strategies and demonstrate how such strategies can boost creativity and productivity Analyze platform economies dynamics and the ways in which they might foster innovation and open novel economic opportunities
Entrepreneurial knowledge and opportunities	Future studies are recommended to: Investigate the impact of regional and sectoral disparities on the likelihood of entrepreneurial success Examine the various knowledge domains that entrepreneurs must possess to succeed Analyze the dynamics and organizational structure of entrepreneurial networks and the ways in which entrepreneurs could use these networks to increase their chances of success Examine how entrepreneurial cognition influences behavior and how business owners can develop a mentality supporting innovation and expansion, especially in developing countries (e.g., Africa) Explore the cognitive and behavioral processes involved in identifying opportunities and how business owners can enhance their capacity to seize possibilities Empirically examine the effects of innovations and AIs on various types of entrepreneurial knowledge and opportunities Explore how businesspeople might benefit from the current trends to produce new value

Table 9 (continued)

Cluster	Avenues for further work
Digital entrepreneurship	Future studies are recommended to: Understand the impact of digital marketing and branding on digital entrepreneurship (or digital social entrepreneurship) Empirically examine the link between digital innovation and digital entrepreneurship in different regions Investigate the traits of effective digital business models and the development of new value by entrepreneurs using these models Analyze the ways in which digital ecosystems might promote the expansion of digital entrepreneurship Analyze how digital platforms affect entrepreneurship within different sectors Systematically review digital entrepreneurship research

evolutionary mapping of entrepreneurship and the digital economy using bibliometric analysis. In other words, this bibliometric review has added to the current body of knowledge by highlighting scientific research growth trends in entrepreneurship and the digital economy. In so doing, we identified the top publication sources and reference networks, the highly cited publications, and the most productive researchers in this field. This has enabled us to summarize the major discussion topics within this realm, which can be used as a roadmap for future studies on entrepreneurship and the digital economy. To comprehend the connection between entrepreneurship and the digital economy, research requires one to consider various cross-level analyses and consciously recognize the digital economy's contribution to creating new business ideas for companies and entrepreneurs. In this regard, we outlined three essential themes associated with entrepreneurship and the digital economy, namely, digitalization and entrepreneurship growth, SMEs, and digital platforms.

On the other hand, this bibliometric review of entrepreneurship and the digital economy literature offers several practical implications for decision-makers and startup companies. Entrepreneurial businesses should utilize the digital economy's benefits, including business interactions backed by ICT technologies. To increase their competitive advantage, studies demonstrated that these businesses could, for example, invest in telecommunications infrastructure, digital services, e-business and e-commerce, digital platforms, and information and knowledge management systems. In this regard, governments are urged to formulate strict policies and laws that facilitate the safe usage of digital economy techniques and promote the deployment of such services. Moreover, these laws should address issues, including patent rights, data protection and consumer protection laws, and employee rights.

Furthermore, studies showed that startup businesses should also take note of how the digital economy has changed entrepreneurship by opening doors for fresh innovation and new business models. For example, the digital economy can be leveraged to expand firms that would not have been able to do so without its facilities and interconnectivity (Pratt, 2017). In addition, companies are recommended to make use of data to review their current business models and modify them as necessary to better meet customer and market demands. In particular, companies should note that online shopping systems, digital marketing strategies, and advanced analytics can be leveraged to expand customer reach, which will improve sales and competitiveness (Gustavsen, 2021).

Limitations and an agenda for future research

This review research has some limitations, just as other research studies, despite its significant theoretical and practical contributions. Such limitations also pose considerable opportunities, guidance, and directions for upcoming and potential future research. First, the current paper depended on documents published in the WoS and Scopus databases. Therefore, it is proposed that future studies consider additional publications on entrepreneurship and the digital economy published in other data sets, such as PubMed, Google Scholar, IEEE Xplore, ScienceDirect, etc. This could aid in locating additional documents, providing deeper comprehension and priceless insights into the present research theme. In addition, the current study concentrated on documents that were written in English. Hence, future studies could also collect and analyze non-English written publications. This might offer thorough overviews and an in-depth understanding of the current research field. Moreover, subsequent work can extend the findings of the current paper by analyzing the research methods and data analysis techniques employed in the extant scientific production concerning the entrepreneurship and digital economy domain. Indeed, this could help highlight the existing research approaches and methodological techniques as well as open new directions and avenues for upcoming academic work. In addition, future studies should employ effective research methods and analysis procedures while conducting research in the area of entrepreneurship and digital economy among diverse disciplines and contexts.

Table 9 indicates directions for a future research agenda that relates to the four main clusters derived from the analysis of the intellectual structure.

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Availability of data and materials
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Declarations

Competing interests
The authors declare that they have no competing interests.

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