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TIME TRAVELERS FOR SUSTAINABILITY: A DIACHRONIC BIBLIOMETRIC ANALYSIS OF DIGITAL INNOVATION AND ENTREPRENEURSHIP's IMPACT ON SDGs

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Abstract

This study investigates the intersection of digital innovation, entrepreneurship, and sustainable development goals (SDGs) through a comprehensive bibliometric analysis of scholarly publications from 2008 to 2023. Utilizing the Scopus database, 195 articles were identified and analyzed, focusing on parameters such as author productivity, citation analysis, thematic mapping, and keyword co-occurrence. R-studio is employed to conduct preliminary data analysis, perform citation and co-citation analysis, and perform bibliographic coupling in conjunction with co-authoring. The findings underscore the transformative potential of digital technologies, such as AI, IoT, and blockchain, in advancing SDGs across various domains, including climate action, sustainable cities, quality education, and health. Entrepreneurs are pivotal in leveraging these technologies to create sustainable business models, facilitate social inclusion, and drive innovation. The study highlights the significant growth in research output, with an annual increase of 14.31%, and identifies critical contributors, influential publications, and prevalent keywords within the field. This study adds to the current understanding of the factors that impact entrepreneurship and digital innovation on sustainable development goals (SDGs). Despite the promising impact of digital innovation on sustainability, challenges such as the digital divide and ethical considerations remain. This analysis offers a comprehensive understanding of the current research landscape and identifies future research directions to enhance digital innovation and entrepreneurship integration in achieving the SDGs.

Keywords: Entrepreneurship, sustainability, innovation, bibliometric analysis, sustainable development goals.

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Introduction

The Sustainable Development Goals, which the United Nations established in 2015, are a global call to action that aims to eradicate poverty, safeguard the environment, and guarantee prosperity and peace for all people by 2030. These goals are designed to be holistic and inclusive, addressing the root causes of poverty and inequality and fostering a sustainable future for all. The SDGs emphasize the importance of collaboration among governments, businesses, civil society, and individuals to achieve these ambitious targets by 2030. The analysis determines that the political and legal commitments arising from the universal policy agenda of the SDGs (to be executed by the rights and duties of nations under international law) have the potential to facilitate global (social) justice (Cimadamore, 2016). The concept of sustainable development was initially introduced in a study by the International Union for the Conservation of Nature and Natural Resources ("IUCN"), which directly connected the ideas of conservation and development. Nevertheless, the term was popularized by the 1987 Report of the World Commission on. The "Brundtland Commission" defined the relationship between the environment and development. Sustainable development can be defined as the notion that humanity can create and ensure sustainable growth that fulfils existing demands without compromising future generations and undermining the capacity of future generations to fulfil their requirements (Spring, 2015). The SDGs will have a crucial role in guiding the global system towards a fair and sustainable path, in response to the growing challenges of climate change and global inequality. The SDGs aim to integrate sustainable development objectives with their human development aims effectively (Knudson, 2014). The implementation of the SDGs presents unparalleled prospects to promote equitable opportunity and enhance economic empowerment, enabling countries to progress sustainable development within their borders and ultimately benefit their populations (Leal Filho et al., 2019).

Realizing these lofty objectives would necessitate revolutionary shifts in every sphere of life, and the convergence of entrepreneurship and digital innovation is becoming acknowledged as a potent engine of advancement. This study explores the expanding field of research that looks into how entrepreneurial endeavours, through digital innovation, aid in the advancement of the Sustainable Development Goals (SDGs) (Pigola et al., 2024) Talk about how sustainable development is affected by Digital Entrepreneurial Ecosystems (DEEs), especially in Latin America. They investigate how digital technology in entrepreneurial endeavours might tackle sustainability in the economy, society, and environment. The study emphasizes the importance of networking and digital tech transfer in promoting positive results and contends that even partial digitalization can result in considerable advantages in sustainable development. (Bresciani et al., 2021; Kumar et al., 2024; Pankaj et al., 2023), examine how digital transformation catalyzes product, process, and business model innovation, highlighting its crucial role in sustainable development. The study underscores the importance of digital ecosystems in driving inclusive economic growth and sustainable innovation.

Digital Innovation as a Catalyst for Sustainable Development: Advances in artificial intelligence, big data analytics, blockchain, the Internet of Things, and other digital

technologies have the power to transform entire industries and tackle complex societal issues. Studies demonstrate how digital innovation can change several SDG-related fields, including:

Climate Action: The utilization of digital technologies facilitates the advancement of intelligent power distribution networks, sustainable energy alternatives, precise farming techniques, and climate surveillance systems, hence aiding in the mitigation and adaption to climate change, (Mosca et al., 2023). This systematic mapping review examines the capacity of digital technologies to promote behavioral change and encourage more sustainable activities, specifically regarding climate change mitigation. The authors examine the potential of these technologies to promote the adoption of environmentally beneficial behaviours, such as decreasing energy usage and choosing sustainable transportation options, among individuals and communities. The study offers an extensive examination of current research in this field, emphasizing important discoveries and possible directions for future research and advancement. (Divya Malhan, 2021; Malhan et al., 2021; Stapleton et al., 2022), Investigates the ways in which contextual behavioral science might help organizations (MDPI) encourage environmentally responsible behavior using social media, advertising, and strategic messaging (Huang, 2021), emphasizes how crucial it is to use sustainability concepts at every stage of the creation and application of technology. It highlights how important it is to evaluate technological advancements methodically in order to address social, environmental, and economic issues sustainably.

Sustainable Cities and Communities: Smart city efforts utilize digital innovation to optimize the management of resources, enhance transportation systems, increase public safety, and build more sustainable urban settings (Ismagiloiva et al., 2019) conduct a thorough examination of the impact of smart cities on the establishment of sustainable cities and communities, a key objective among the 17 sustainable goals set by the United Nations. Ongoing research is centred on various facets of a sustainable environment, including renewable and eco-friendly energy, energy efficiency, monitoring of the environment, air quality, and water quality. They offer a significant consolidation of the pertinent literature on smart cities through the analysis and discussion of the main discoveries from existing research on the role of smart cities in establishing sustainable cities and communities (Albino et al., 2015; Kumar Mohan, 2021), show off several aspects of smart cities, concentrating on the effectiveness and difficulties of implementing sustainable smart cities They provide findings from previous research on the role that digital technologies have in air quality, energy efficiency, and public transportation system monitoring (De Jong et al., 2015), Examine the discrepancy that exists between smart city theory and the real-world obstacles to attaining full sustainability. While intelligent technologies might contribute to environmental sustainability, they contend that an over-reliance on technology may cause citizens and the natural world to become estranged.

Quality Education: Online learning platforms, internet-based educational materials, and individualized learning tools are increasing the availability of high-quality education and reducing educational disparities, utilizing Digital Technologies to Attain UNESCO's Sustainable Development Goal for Quality Education by 2023. This report by UNESCO examines how digital technology can provide universal access to high-quality education. The document presents successful programs as examples and provides policy recommendations.

Good Health and Well-being: Digital health technologies, such as telemedicine, wearable health trackers, and AI-powered diagnostics, are enhancing the availability, excellence, and cost-effectiveness of healthcare.

Challenges and Opportunities: While the potential of digital innovation and entrepreneurship for advancing the SDGs is significant, several challenges and opportunities warrant attention:

Digital Divide: Inequitable access to digital technology and infrastructure can worsen pre-existing disparities and impede the inclusive advantages of digital innovation for sustainable development. The digital divide must be addressed by investing in infrastructure, implementing digital literacy initiatives, and adopting inclusive policies. The growing need for sustainable practices has emerged as a significant catalyst for innovation and entrepreneurship across multiple industries (Geels et al., 2008). Sustainable entrepreneurship is actively seeking out business possibilities that promote the advancement of a sustainable society, economy, and environment (Hossain, 2021) Within this particular framework, digital advancements have arisen as a potent instrument for addressing environmental and societal obstacles (George, Lakhani, et al., 2020; Kumar et al., 2023).

Ethical Considerations: The ethical considerations of data privacy, algorithmic bias, and the responsible use of AI necessitate meticulous attention to ensure that digital innovation is in alignment as digital technologies become more sophisticated. Nevertheless, sustainable entrepreneurship is not without its obstacles (Todeschini et al., 2017) Entrepreneurs may encounter challenges such as securing funding, navigating intricate regulatory environments, and surmounting social and cultural barriers to adoption. With the growing demand for more sustainable products and services from consumers and stakeholders, the opportunities for sustainable entrepreneurship are extensive despite these challenges (Haldar, 2019).
This research aims to rectify the deficiencies of prior studies and make a significant addition to the broader field of research on the impact of Entrepreneurship and digital innovation on Sustainable Development Goals (SDGs).

Review of literature

Entrepreneurship: Driving Digital Innovation for Sustainability

Entrepreneurs are essential in converting digital innovation possibilities into concrete solutions for sustainable development. Entrepreneurs are using digital technology and novel business models to tackle difficulties related to the Sustainable Development Goals (SDGs), driven by both the need for profit and the desire to make a positive social effect.

Sustainable Business Models: Entrepreneurs increasingly incorporate sustainable business structures that prioritize environmental and social considerations and economic viability. The following are examples of how entrepreneurs utilize digital innovations to establish sustainable business models that address climate change and contribute to sustainable development: circular economy models, sharing economy platforms, and impact-driven ventures. It provides an overview of successful ventures and explores the potential of digital technologies to drive positive environmental and social impact, (George & Schillebeeckx, 2022).

Digital Platforms for Social Good: Digital platforms are facilitating the development of a global ecosystem for sustainable innovation by connecting entrepreneurs with investors, mentors, and collaborators. Crowdfunding platforms, impact investing networks, and online communities facilitate the mobilization of resources and expertise toward SDG-aligned ventures. By concentrating on collaborative entrepreneurship's function in attaining the Sustainable Development Goals. It emphasizes the potential of digital platforms to enable the development and scaling of sustainable solutions by fostering collaboration among entrepreneurs, investors, and other stakeholders (Schaltegger et al., 2018).

Grassroots Innovation and Inclusivity: Digital technologies enable grassroots entrepreneurs and marginalized communities to participate in the digital economy and contribute to sustainable development. Economic inclusion is being promoted, and individuals are being empowered to establish sustainable livelihoods through mobile banking, e-commerce platforms, and digital skills training programs. While investigating the role of grassroots entrepreneurs in developing sustainable development solutions through parsimonious innovation. It emphasizes the potential of digital technologies to enable grassroots entrepreneurs, particularly those in developing countries, to develop solutions that are both affordable and accessible to local communities (Pansera & Sarkar, 2016). In 2016, Rudram, B., Faith, B., Prieto Martín, P., and Ramalingam reviewed the evidence regarding digital technologies' impact on environmental sustainability, including their role in climate change mitigation and adaptation. It emphasized the potential hazards and opportunities that are linked to these technologies. The potential of digitalization, digital transformation, and digital technologies is crucial for businesses' economic, social, and environmental sustainability and can be implemented in various sectors. The objective is to investigate the green digital transformation in a theoretical generalization, followed by an examination of the European Union's context and the application of digital technologies in the realm of sustainable development in a limited number of global companies (Bednarčíková & Repiská, 2021).

(Satalkina & Steiner, 2020) investigate the transformative potential of digital entrepreneurship in innovation systems. New opportunities and challenges are emerging as a result of the fundamental transformation of business operations by digital technologies. Additionally, it underscores the multifaceted influence of digital entrepreneurs on the innovation system. They modify the entire business landscape, including its structure, objectives, and networking mechanisms. This digital transformation has the potential to be disruptive, introducing new opportunities and vulnerabilities and facilitating a comprehensive understanding of the transformative power of digital entrepreneurship in a world that is constantly changing. In (Rosário & Dias, 2023), examine the relationship between sustainability and the digital economy. The increased development and adoption of technologies, as well as the growing awareness of climate change, have contributed to the popularity of these concepts.

The numerous applications of digital technologies to resolve sustainability concerns are currently being investigated by researchers, business leaders, and policymakers. To investigate the correlation between sustainability innovation and sustainable entrepreneurship. It examines how entrepreneurs can drive innovation to create more sustainable business models and discusses various categories of sustainable entrepreneurship (Schaltegger & Wagner, 2011).By conducting a comprehensive analysis of the role of digital entrepreneurship in promoting innovation for sustainable transitions.

An examination of sustainable entrepreneurship in the context of Sub-Saharan Africa is discussed. The discussion centres on the role of digital technologies in promoting inclusivity and enabling entrepreneurs from marginalized communities to participate in the digital economy and contribute to sustainable development (Juma et al., 2017).

It is imperative to identify and capitalize on sustainable business opportunities to engage in sustainable entrepreneurship (Eller et al., 2020). Entrepreneurs can convert environmental and social challenges into viable business models that generate economic value and contribute to societal well-being (Hossain, 2021)For instance, the fashion sector has experienced the development of sustainable and innovative business models that capitalize on digital technologies to address sustainability concerns (Todeschini et al., 2017).

Apostolopoulos et al., (2018) investigates the relationship between entrepreneurship and the United Nations Sustainable Development Goals (SDGs). Our current understanding of the potential of entrepreneurship to contribute to the SDGs and the potential for their

implementation to transform enterprises is restricted. This results from various factors, such as the recent launch of the SDGs and the swiftly evolving and expanding global economic, social, and environmental challenges. To investigate the connections between sustainable development and collaborative entrepreneurship. Sustainability challenges increase the importance for entrepreneurial collaboration in three ways: first, for cross-actor participation within entrepreneurial processes; second, for coordinating across sustainability issues and between entrepreneurial solutions; and third, for cross-sector cooperation between different forms of entrepreneurship, such as social entrepreneurship, sustainable entrepreneurship, and policy entrepreneurship (Schaltegger et al., 2018).

Entrepreneurship has been acknowledged as a significant conduit for sustainable products and processes, and new ventures are being held up as a solution to numerous social and environmental issues (Hall et al., 2010).The entrepreneurial landscape is undergoing a transformation as a result of grassroots innovators who reside and operate in impoverished environments, possess minimal formal education and technological expertise. This research is part of a new third generation of literature on Bottom of the Pyramid innovation, which involves providing products to and by the underserved.

The study investigates the phenomenon of resource-scarce entrepreneurs who create environmentally sustainable solutions with low overall ownership costs and utilize locally available materials, utilizing primary and secondary data from four cases of grassroots entrepreneurs in the Indian Subcontinent (Pansera & Sarkar, 2016). The framework is founded on a typology of sustainable entrepreneurship and the application of an entrepreneurial approach to address societal objectives and evolving market contexts, which are associated with sustainability innovation. Additionally, managers are advised to implement sustainability innovations and pursue sustainable business practices (Štverková et al., 2021).

Entrepreneurs: Driving Innovation for Sustainability

Within entrepreneurial ventures, the various motivations and categories of sustainability-focused innovation are investigated, and a framework is established to assist in comprehending the manner in which entrepreneurs approach sustainability (Schaltegger & Wagner, 2011).To underscore the critical role of supportive ecosystems in promoting sustainable entrepreneurship. It emphasizes the potential of collaborative environments to foster and expedite sustainability-focused initiatives (Simatupang et al., 2015). Eller et al., (2020), explores the motivations and processes that drive entrepreneurs to identify and capitalize on business opportunities that align with sustainable development goals. Climate change, economic inequality, and unethical business practices are prevalent challenges that employee-owned businesses, benefit corporations, and other sustainability entrepreneurship initiatives are addressing. Nevertheless, universities frequently fail to provide students with the necessary skills in sustainability entrepreneurship adequately. Outline the competencies of sustainability entrepreneurship under the entrepreneurial process model. The outcome is a framework of sustainability entrepreneurship competencies that is both literature-based and process-oriented. It is intended to serve as a comprehensive framework for the development of curricula, courses, and assessments, as well as for the guidance of students, faculty, and entrepreneurs (Foucrier & Wiek, 2019). Shahid et al., (2023), investigate the potential of parsimonious innovation, defined by its affordability and resource efficiency, to serve as a potent instrument for sustainable entrepreneurship, particularly in addressing environmental and social issues. Concentrates on the creation of a comprehensive model for sustainable entrepreneurship that takes into account the economic, social, and environmental aspects. By offering a framework for the assessment and comprehension of the sustainability performance of entrepreneurial enterprises (Kazemi et al., 2020). This study involved a comprehensive

review of the pertinent literature to gather information, followed by meticulous analysis of the collected data.

The research questions (RQ) of this study cover several aspects of document publication.

RQ1. What is the annual scientific output of articles about Digital Innovation, Entrepreneurship, and Sustainability?
RQ2. Which authors have produced the greatest number of publications in the field of Digital Innovation, Entrepreneurship, and Sustainability?
RQ3. Which documents in the integrated domain have the highest number of citations?
RQ4. Which journals have the highest publication rates for Digital Innovation, Entrepreneurship, and Sustainability research publications?
RQ5. Which authors' keywords are most commonly used in the domains of Digital Innovation, Entrepreneurship, and Sustainability?
RQ6. How does the thematic map of key terms from the bibliography highlight the interconnections between "sustainable development," "entrepreneurship," and "digital innovation?
RQ7. What are the primary factors that influence the relationship between "sustainable development," "entrepreneurship," and "innovation"?
RQ8. What are the potential topics identified in recent bibliometric analyses?

To address these questions, the present study used bibliometric analysis.

An empirical investigation was undertaken to assess the advancement of scholarly inquiry in a specific domain spanning the years 2008 to 2023. The assessment was conducted utilizing a multitude of pertinent criteria, including author productivity, country-specific productivity, collaboration among authors and countries, citation analysis, thematic mapping, keyword co-occurrence, and factors influencing the study. Hence, it became feasible to elucidate advancements in the matter that surpass what is encompassed in literature assessments (Capobianco-Uriarte et al., 2019; Castillo-Vergara et al., 2018; Terán-Yépez et al., 2020).

This study is more exhaustive than prior research and minimizes the probability of omitting any crucial components of the subject matter. Prior research has shown substantial variation in the duration under consideration, depending on the particular topic and objectives of the study. However, this analysis focused on publications that were published during a period of about 15 years, specifically from 2008 to 2023. This study uses scientific mapping and performance analysis to examine the influence of digital innovation and entrepreneurship on the progress of sustainable development goals from 2008 to 2023.

Research Methodology

The investigation began by extracting and consolidating document publishing data from the Scopus database on July 2, 2023. A search was conducted on the Scopus database to find scholarly papers related to the study topic "The Impact of Digital Innovation and Entrepreneurship on Advancing Sustainable Development Goals." Since Scopus contains roughly 84% of the articles identified in WoS and has a larger number of indexed journals, this study chooses to use the Scopus database as a sample to minimize the possibility of missing any relevant documents throughout the search process ((Mongeon & Paul-Hus, 2016)

The following parameters were used to retrieve the search: “TITLE-ABSTRACT-KEYWORD (“sustainable* AND “entrepreneur*” AND “digital Innovation”). Data was downloaded in csv formats and processed with Excel. Digital Innovation and entrepreneurs impact the sustainability in various ways. Therefore, we do not consider any related term as we consider that they are not within the core focus of this research according to the arguments given in the above sections.

The search was carried out in July 2024, with the chosen study period spanning from 2008 to 2023. The earliest paper included in Scopus that matches the search parameter dates back to 2008. Only papers published until 2023 were included to ensure a comprehensive comparison of full calendar years. After conducting a thorough examination of the titles and abstracts of research papers, a total of 1700 articles were excluded. The search was restricted to articles, eliminating reviews to prevent the duplication of documents. The ultimate sample had a total of 195 articles.

The data was later exported as comma-separated values (.CSV) files and research information systems (.RIS) files. In addition, the descriptive and visualization data were evaluated separately using software programs such as Microsoft Excel, R-Studio, and VOSviewer. The researchers employed VOSviewer software to conduct mapping analysis (Van Eck & Waltman, 2020), Microsoft Excel for descriptive analysis, and R-Studio for metric citation analysis, bibliometric coupling, thematic mapping, and other data examination purposes in this study. The identification and selection of papers were conducted according to the instructions specified in the study protocol, as illustrated in Figure 1.

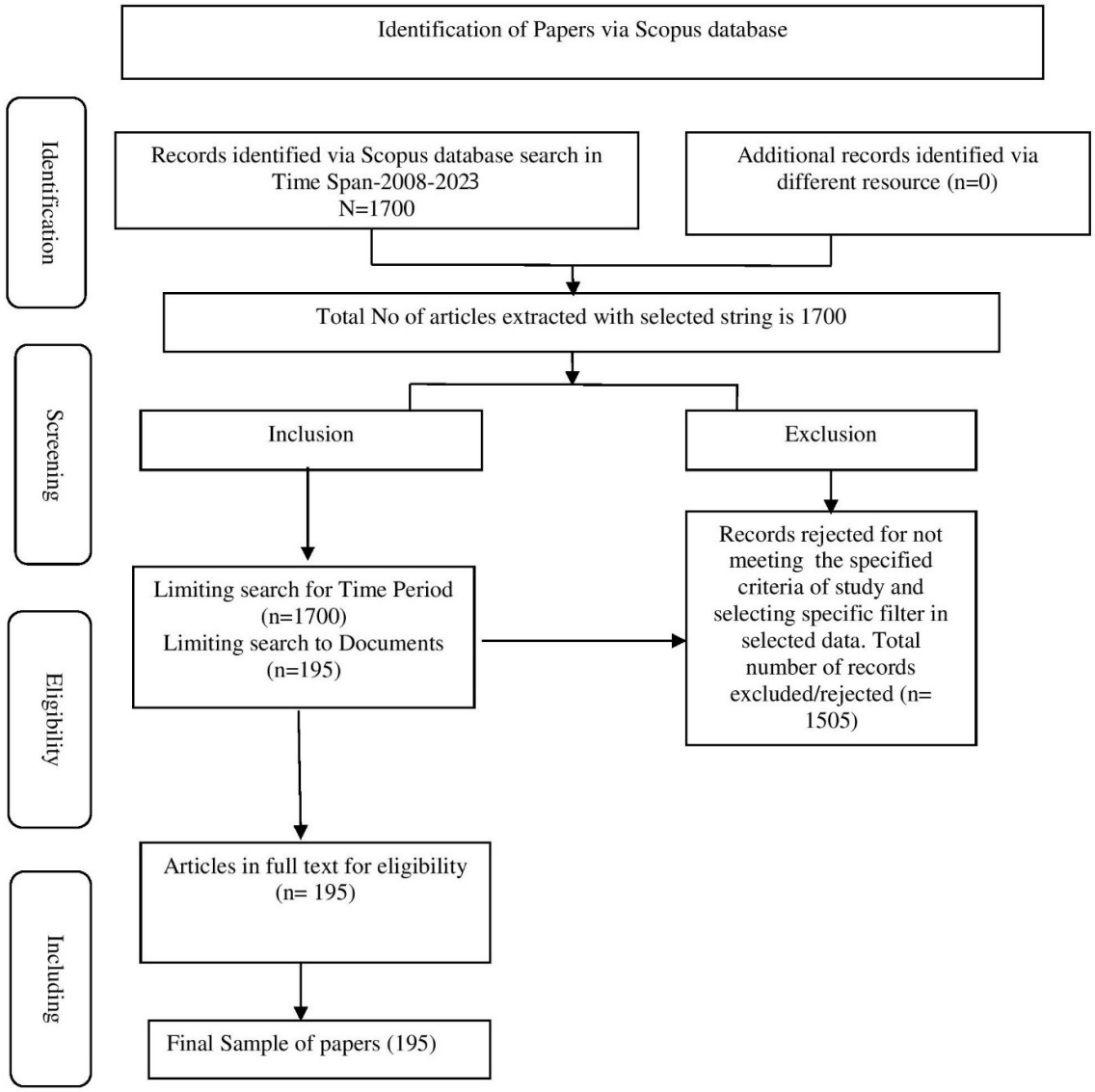
Data Analysis

The quantification of scientific article development was performed by utilizing a variety of parameters. The parameters included the overall number of publications, the average number of citations per document, the average annual number of citations per document, the author's keywords, the frequency of author appearances, the percentage of documents authored by a single author versus multiple authors, the number of documents attributed to each author, and the collaboration index. A total of 195 articles were obtained from the Scopus database from 2008 to 2023. 18 relevant review papers were also added manually other than the Scopus database.

The publications achieved an average of 36.83 citations per document. The first table, labelled "Main Information About Data," presents a dataset with 99 sources. These sources consist of journals, books, and possibly other academic publications. The sources contain a total of 195 distinct documents, demonstrating the extensive scope of the dataset. Moreover, the dataset has exhibited a consistent yearly growth rate of 14.31%, signifying a continuous rise in the quantity of documents throughout the years. The study's results indicate a comprehensive compilation of 429 keywords and an additional 654 authors' keywords, covering a broad spectrum of language employed to investigate the factors associated with work stress, gender diversity, and job satisfaction in higher educational institutions.

This growth rate reflects the expanding research and publications in the field covered by the dataset

Figure 1: Flowchart for the identification of research articles



Source: Authors' Development

Table 1: Scientific production of articles from 2008 to 2023

Description	Results
Main Information about Data	
Timespan	2008:2023
Sources (Journals, Books, etc.)	99
Documents	195
Annual Growth Rate %	14.31
Document Average Age	4.04
Average citations per doc	36.83

References	12673
Document Contents	
Keywords Plus (ID)	429
Author's Keywords (DE)	654
Authors	
Authors	585
Authors of single-authored docs	17
Authors Collaboration	
Single-authored docs	17
Co-Authors per Doc	3.19
International co-authorships %	28.72
Document Types	
Article	195

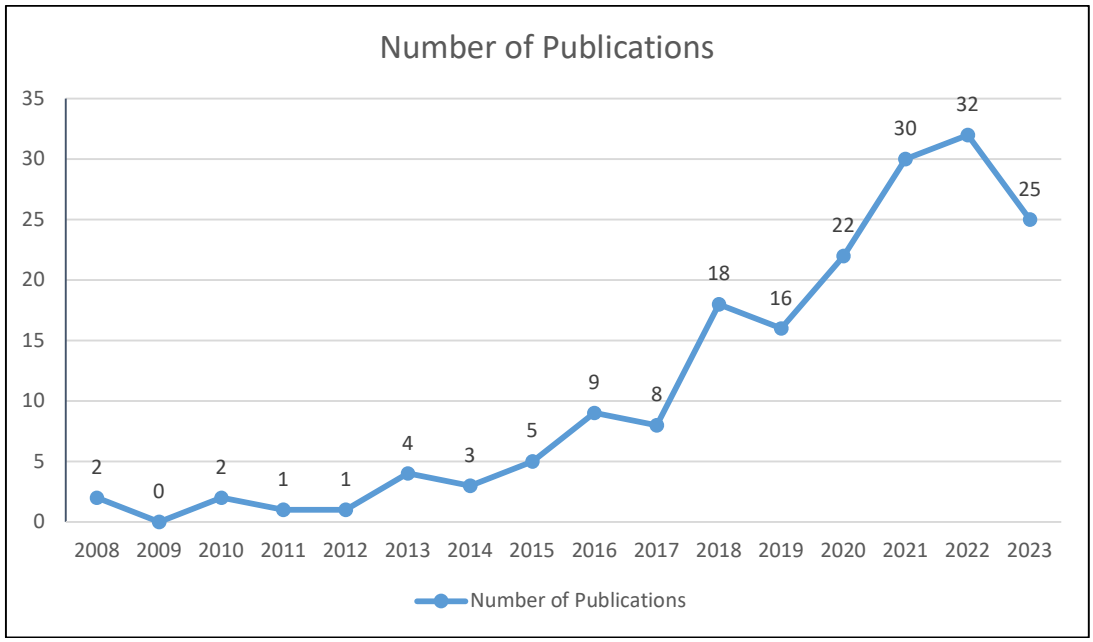
Source: Authors development using R-Studio (Biblioshiny).

Annual scientific production of articles:

In order to research question 1, we analyse the progression of scholarly articles that explore the influence of Digital Innovation and Entrepreneurship on Sustainability. The graph titled "Annual Scientific Production" displays the yearly count of published papers from 2008 to 2023. The data indicates a period of limited and consistent publication activity from 2008 to about 2012, with the annual number of articles published remaining below ten. Starting in 2013, there has been a clear and consistent increase in scientific output, characterized by substantial growth in published publications. This growth reached its highest point between 2018 and 2020.

This peak signifies an upsurge in research activities during this period. Nevertheless, beyond the year 2020, there has been a noticeable fall in the annual publication of publications, indicating a decline in research productivity. The graph demonstrates fluctuations in scientific publication activity over a 16-year period, indicating periods of substantial increase as well as decline. These variations reveal trends and changes in research productivity.

Figure 1: Trend of publications



Source: Authors' development Using Biblioshiny (R-Studio).

Most prolific authors for publications related to digital innovation, entrepreneurship, and sustainability.

To fully comprehend this study area and investigate Research Question 2, we also analyzed the authors who have generated the most substantial scholarly research on this subject. Table No. 2 displays data regarding the compilation of authors who have made substantial contributions to the domains of digital innovation, entrepreneurship, and sustainable development goals (SDGs)The information provided consists of their present associations, the quantity of published works (NP), the overall number of citations (TC), the Scopus h-index, andtheScopusID. Noor Hazlina Ahmad, a researcher from Universiti Sains Malaysia, has authored 51 publications and has an h-index of 30. David B. Audretsch, a researcher affiliated at Alpen-Adria-Universität Klagenfurt in Austria, has authored six scholarly articles and has achieved an h-index of 99. Klaus Fichter, a researcher from Universitat Oldenburg in Germany, has authored 103 articles and has an h-index of 15.

Notable authors in this field include Frank J. Van Rijnsoever from Utrecht University in the Netherlands, Junaid Aftab from Tongji University in China, Aikaterini Argyrou from Utrecht University School of Law, Silvia Baiocco from Università degli Studi di Roma "Tor Vergata" in Italy, Malte Brettel from WHU - Otto Beisheim School of Management in Germany, and Andrea Caputo who is associated with the University of Lincoln.

Table 2: Most prolific authors of the incorporated domain.

Authors	Authors current affiliation	NP	TC	Scopus h_index	Scopus ID
Noor Hazlina, Ahmad	Universiti Sains Malaysia	3	51.00	30	35777347300
David B. Audretsch	Alpen-Adria-Universität Klagenfurt, Klagenfurt, Austria	3	6.00	99	7006423146

Klaus Fichter	Universitat oldenburg, Germany	3	103.00	15	6602873863
Frank J. Van Rijnsoever	Copernicus Institute of Sustainable Development, Utrecht, Netherlands	3	28.00	27	24336611400
Junaid Aftab	Tongji University, Shanghai, China	2	6.00	12	57221920478
Aikaterini Argyrou	Utrecht University School of Law	2	5.00	6	57094903600
Silvia,Baiocco	Università degli Studi di Roma "Tor Vergata" Rome, Italy	2	5.00	6	56451154000
Malte ,Brettel	WHU - Otto Beisheim School of Management, Vallendar, Germany	2	3.00	45	24402546200
Andrea, Caputo	University of Lincoln, Lincoln, United Kingdom	2	30.00	33	55513877500
Castaño-Martínez, María Soledad	Universidad de Castilla-La Mancha, Ciudad Real, Spain	2	51	13	55351730100

Source: Authors' development using Biblioshiny (R-Studio).

In order to understand this study area and investigate Research Question 2, we also analyzed the Most cited Documents of the incorporated domain. The most prolific writers in a certain field of study are shown in the table together with information on their current affiliations, total citations (TC), number of publications (NP), Scopus h-index, and Scopus ID. Universiti Sains Malaysia's Noor Hazlina Ahmad is a noteworthy contributor with 3 publications, 51 citations, and an h-index of 30. Although David B. Audretsch of Alpen-Adria-Universität Klagenfurt only has three publications and six citations, his remarkable h-index of 99 shows that he has had a significant impact in other fields. With three publications, the maximum citation count (103), and an h-index of 15, Klaus Fichter is affiliated with the Universitat Oldenburg. With 28 citations and an h-index of 27, Frank J. Van Rijnsoever from the Copernicus Institute of Sustainable Development has consistently made contributions. Aikaterini Argyrou, Silvia Baiocco, and Junaid Aftab are authors with slightly lower h-indices and fewer publications (2 each). In contrast, Andrea Caputo of the University of Lincoln stands out with an h-index of 33 and 30 citations, despite having only two publications in this subject. This table showcases a variety of up-and-coming and seasoned researchers who are making contributions to the discipline.

Table 3: Most cited Documents of the incorporated domain.

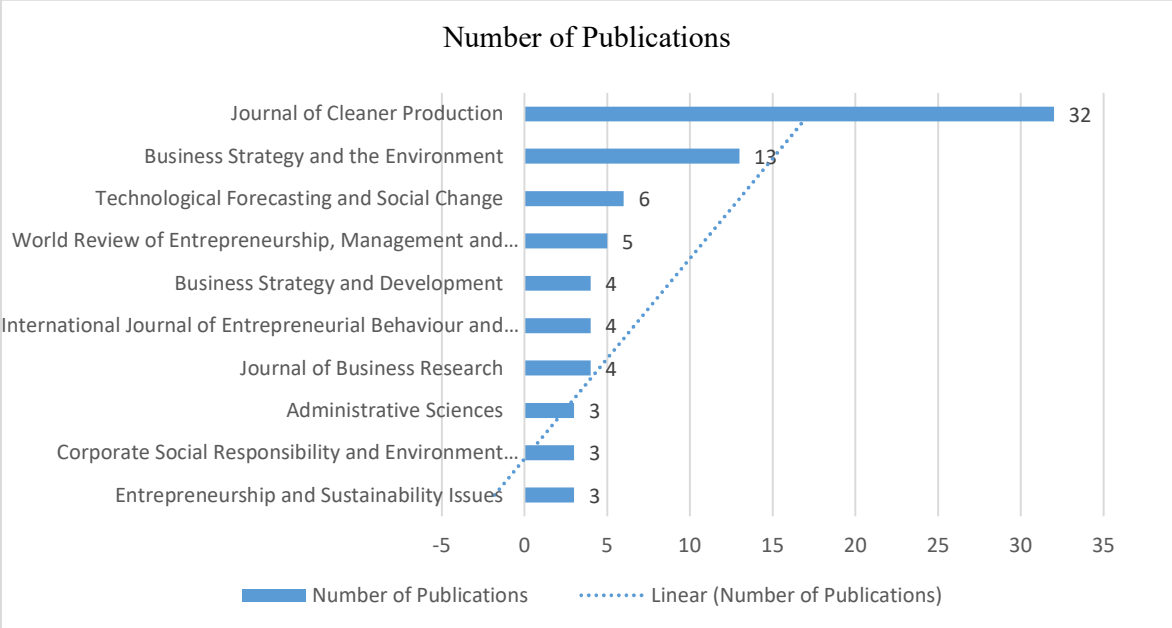
Authors	Source	Title	TC	TC/Y	Normalized TC
Hall et al., (2010)	Journal of Business Venturing	Sustainable development and entrepreneurship: Past contributions and future directions	774	51.6	1.21
Shepherd & Patzelt, (2011)	Entrepreneurship Theory and Practice (ETP)	The New Field of Sustainable Entrepreneurship: Studying Entrepreneurial Action Linking "What is to be Sustained" with "What is to be Developed"	706	50.43	1
Kuckertz & Wagner, (2010)	Journal of Business Venturing	The influence of sustainability orientation on entrepreneurial intentions — Investigating the role of business experience	501	33.4	0.79
George, Merrill, et al., (2020)	Entrepreneurship Theory and Practice (ETP)	Digital Sustainability and Entrepreneurship: How Digital Innovations Are Helping Tackle Climate Change and Sustainable Development	303	75.75	7.94
Terán-Yépez et al., (2020)	Journal of Cleaner Production	Sustainable entrepreneurship: Review of its evolution and new trends	180	36	4.04
Ploum et al., (2017)	Organization & Environment	Toward a Validated Competence Framework for Sustainable Entrepreneurship	175	25	3.26
Rahdari et al., (2016)	Journal of Cleaner Production	Achieving sustainability through Schumpeterian social entrepreneurship: The	175	19.44	4.74

		role of social enterprises			
Neumeyer & Santos, (2018)	Journal of Cleaner Production	Sustainable business models, venture typologies, and entrepreneurial ecosystems: A social network perspective	173	24.71	3.22
Johnson & Schaltegger, (2019)	Entrepreneurship Theory and Practice	Entrepreneurship for Sustainable Development: A Review and Multilevel Causal Mechanism Framework	149	29.8	3.35
Méndez-Picazo et al., (2021)	Journal of Innovation & Knowledge	Effects of sociocultural and economic factors on social entrepreneurship and sustainable development	143	35.75	3.75

Source: Authors' development.

Most prolific sources

Figure 2: Most productive sources



Source: authors Development

When it comes to the quantity of papers produced within a certain research subject, the graph shows which sources are the most productive. With 32 publications, the Journal of

Cleaner Production takes the lead and is the most active source of research in this field. With 13 publications, Business Strategy and the Environment comes in second, demonstrating its importance despite producing fewer articles than the top journal.

A moderate number of papers are contributed by other journals, indicating their prominence in the subject. Examples of these journals are Technological Forecasting and Social Change (6 publications) and the World Review of Entrepreneurship, Management, and Sustainable Development (5 publications). Administrative Sciences, Corporate Social Responsibility and Environmental Management, Entrepreneurship and Sustainability Issues, and Business Strategy and Development are the remaining journals with the highest number of publications: four each for Business Strategy and Development, International Journal of Entrepreneurial Behaviour and Research, and Journal of Business Research; the remaining journals have three publications each.

In addition, a linear trend line on the graph displays a sharp drop following the top two journals, suggesting that most research is focused in a small number of top journals, with contributions from other sources being more widely dispersed. This figure probably makes up a portion of a bibliometric analysis that aims to identify the main journals in this field of study.

Table 4 highlights the most cited articles in a specific research domain, showing that the Journal of Cleaner Production is the most influential, with the highest h_index (309), total citations (1611), and 32 publications since 2015. Business Strategy and the Environment and Entrepreneurship: Theory and Practice also show significant impact, with high h_indices (147 and 198) and total citations (362 and 1158), respectively. Despite publishing fewer articles, they demonstrate considerable influence in the field. Technological Forecasting and Social Change also ranks high in terms of CiteScore (21.3) and total citations (260) with only 6 publications. Newer journals like Business Strategy and Development and Journal of Business Research have quickly made a mark, contributing fewer but highly cited articles. Overall, these results reveal that while some journals, like the Journal of Cleaner Production, lead in productivity, others with fewer publications maintain strong influence, underscoring the evolving nature of the research domain.

Table 4: Most cited articles in a specific research domain.

SOURCE	h_index	CiteScore	TC	NP	PY_start
Journal of Cleaner Production	309	20.4	1611	32	2015
Business Strategy and the Environment	147	22.5	362	13	2015
Technological Forecasting and Social Change	179	21.3	260	6	2017
Business Strategy and Development	23	5.8	119	4	2018
International Journal of Entrepreneurial Behaviour and Research	91	10.2	164	4	2018
Journal of Business Research	265	20.3	176	4	2020
Entrepreneurship and Sustainability Issues	40	5.6	34	3	2018

Entrepreneurship: Theory and Practice	198	19.0	1158	3	2011
International Journal of Business and Globalization	22	0.7	18	3	2013
International Journal of Entrepreneurship and Small Business	46	12.6	33	3	2016

Source: Authors' development using Biblioshiny (R-Studio).

Occurrence of authors' keywords by Thematic map

In context to *RQ5,* the thematic map of key terms from the bibliography highlights the interconnections between "sustainable development," "entrepreneurship," and "digital innovation. The diagram presented is a network visualization created with VOSviewer, illustrating the connections between several concepts associated with "sustainable development." The magnitude of each node corresponds to the frequency or significance of the accompanying phrase, with larger nodes denoting more pivotal concepts. The lines that connect the nodes represent the co-occurrences or connections between these topics in the literature or data set. The key terms "sustainable development," "social entrepreneurship," and "sustainable development goals" are highly significant, underscoring their pivotal importance. The various hues symbolize clusters of interconnected phrases, indicating theme categorizations within the broader sustainable development framework.

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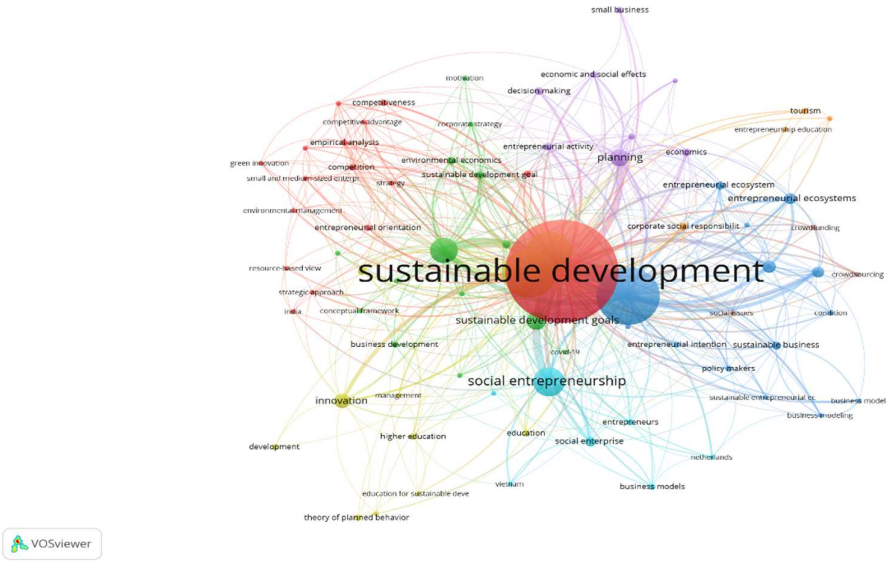
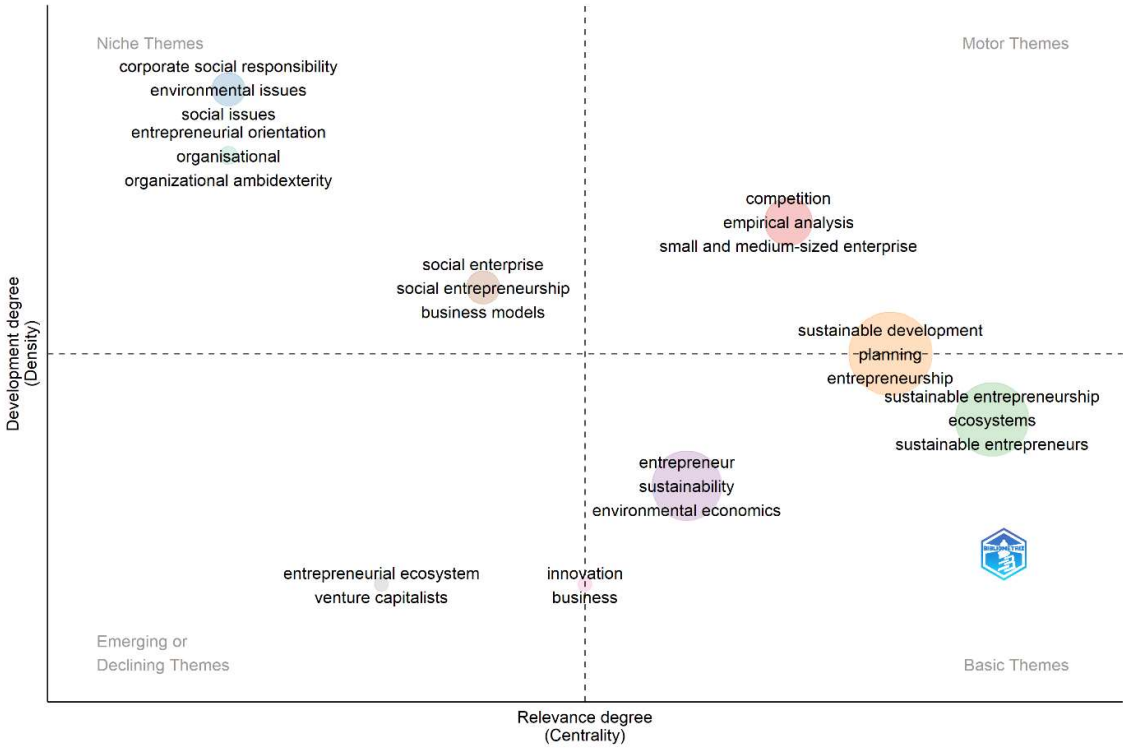
Figure 3: Thematic analysis



Source: Authors' development using VOSviewer.

Figure 4: Evolution of themes

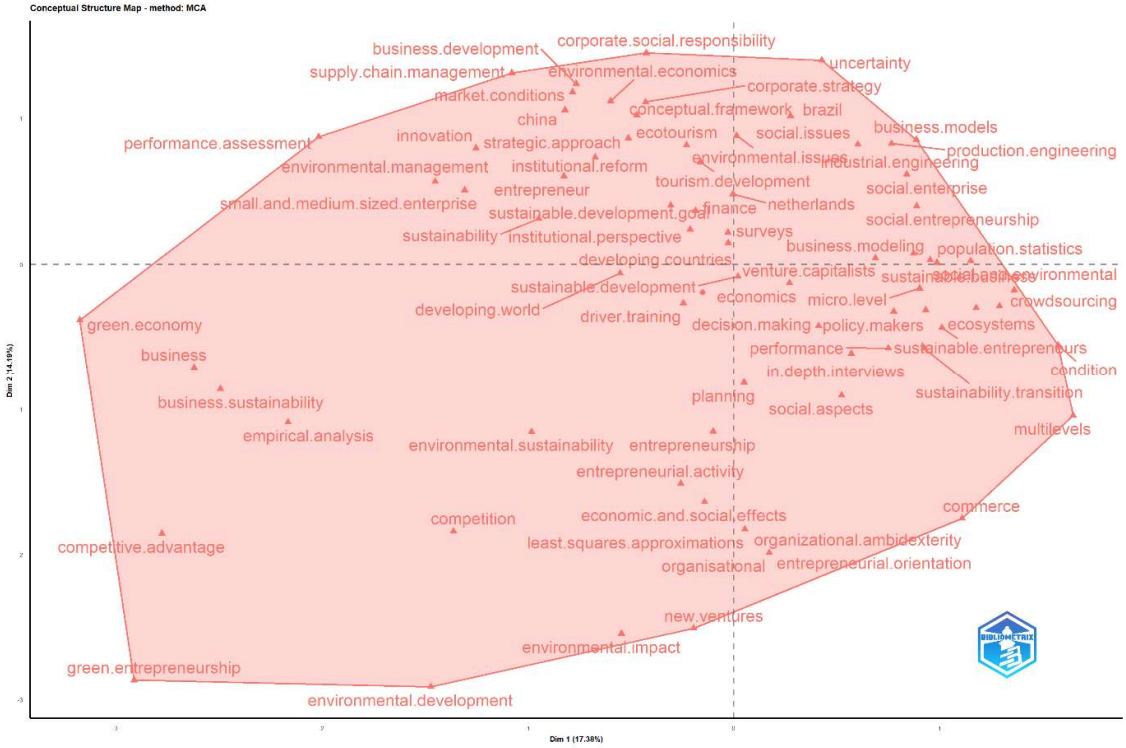


Source: Authors' development using Biblioshiny (R-Studio)

Primary factors that influence the relationship between "sustainable development," "entrepreneurship," and "innovation".

A factorial map, created using Multiple Correspondence Analysis (MCA), visualizes the relationships between various concepts associated with sustainable development. Each point represents a different concept, with the positioning indicating their correlation. The map is partitioned into two dimensions: Dimension 1, which accounts for 17.38% of the variation, and Dimension 2, which accounts for 14.91% of the variance. Proximity between concepts indicates a higher level of correlation. The cluster centred around the term "sustainability" encompasses various ideas, including "sustainable development," "environmental sustainability," "sustainable development goals," and "environmental impact." These concepts are crucial in discussions regarding preserving ecological equilibrium and long-term sustainability. The primary emphasis in this cluster is on implementing strategies and doing measures that guarantee that the present development requirements do not undermine the capacity of future generations to fulfil their demands. Additional synonymous terms encompass "strategizing," "decision-makers," "natural systems," "innovative endeavours," and "financial and societal impacts." This suggests that sustainability is perceived as a field encompassing various disciplines, including policy-making, economic analysis, and entrepreneurial endeavours, to promote sustainable practices.

Figure 4: Conceptual structure map of Sustainability, innovation, SDGs.



Source: Authors' development using Biblioshiny (R-Studio).

Discussion

Theoretical Contributions

This research provides multiple theoretical contributions to digital innovation, entrepreneurship, and sustainability. An examination of scientific output reveals a significant increase in research activity from 2013 to 2020. This indicates an increasing acknowledgement of the significance of digital innovation and entrepreneurship in attaining sustainability objectives. The study highlights influential authors, such as Van Rijnsoever, Hall, and Shepherd, and examines their contributions using measures such as citations and fractionalized authorship. This can provide guidance for future research trajectories and opportunities for collaboration. The thematic map and factorial analysis demonstrate the robust correlations among sustainable development, entrepreneurship, and digital innovation.

The text highlights concepts such as "social entrepreneurship" and "sustainable development goals," indicating a concentration on companies that have a significant impact. The considerable increase in research effort witnessed from 2013 to 2020 suggests the development and advancement of the discipline. This trend emphasizes the increasing recognition of digital innovation and entrepreneurship as crucial catalysts for sustainable development. Additional studies can investigate the underlying causes for the probable decrease beyond 2020. The study recognizes notable authors and examines their contributions. The existing theoretical landscape can be comprehended, and collaboration among prominent scholars can be promoted by utilizing this information base. Subsequent investigations may examine the simultaneous presence of these authors' publications to detect possible collaborations and research areas that are currently lacking.

The thematic map and factorial analysis demonstrate the prominent significance of terms such as "social entrepreneurship" and "sustainable development goals." This indicates a

prioritization of influential endeavours that directly tackle sustainability concerns. Additional investigation could delve into the dynamic changes occurring in the language and underlying conceptual frameworks within this domain.

Practical Contributions

The research emphasizes the capacity of digital technology to help entrepreneurs tackle sustainability concerns, offering significant insights for practitioners and policymakers. This information can facilitate the creation of innovative business models, and enterprises specifically focused on sectors such as clean energy or circular economy. The paper proposes prioritizing future research efforts by identifying areas with limited attention, such as the potential drop in research beyond 2020. Identifying highly productive publications, such as the Journal of Cleaner Production, offers entrepreneurs and policymakers a crucial tool to remain informed about the newest achievements in this industry. The report highlights the significant capacity of digital technologies to enable entrepreneurs.

This knowledge can be utilized to create training programs, funding mechanisms, and support systems specifically designed to promote innovation in sustainable ventures. Policymakers can deliberately invest resources and stimulate research efforts in vital yet under-explored aspects of the subject by identifying areas that have received insufficient research attention. For instance, if there is a dearth of research on the societal consequences of digital sustainability initiatives, governments should incentivize investigations in this domain to enhance the basis for policymaking.

Identifying highly productive journals is a great asset for businesses and governments. Furthermore, research discoveries can be transformed into practical toolkits and instructional tools to provide entrepreneurs with the knowledge and abilities to utilize digital innovation for sustainability effectively. The spread of this knowledge can be assisted through workshops, internet platforms, and relationships with business incubators. The study showcases the need to utilize performance analysis and scientific mapping techniques to deepen our comprehension of the influence of digital innovation and entrepreneurship on sustainability.

Conclusion

This study utilized bibliometric analysis to examine the convergence of digital innovation, entrepreneurship and their influence on attaining Sustainable Development Goals (SDGs). Through an examination of papers spanning from 2008 to 2023 in the Scopus database, the study unveiled a substantial and expanding corpus of research in this domain. The key findings emphasize the significant impact digital technologies such as AI, IoT, and blockchain can have on furthering different Sustainable Development Goals (SDGs), including climate action, sustainable cities, education, and healthcare. Entrepreneurs play a vital role in utilizing these technologies to establish enduring business models, foster social inclusivity, and stimulate innovation to accomplish these objectives. The investigation also identified obstacles that require attention. The digital divide can worsen pre-existing disparities and impede the inclusive advantages of digital innovation for sustainable development. In addition, careful attention must be given to ethical concerns related to data privacy, algorithmic bias, and responsible usage of AI.

The research identifies potential areas for future research and provides a comprehensive understanding of the current situation. The findings provide useful insights for policymakers, researchers, and entrepreneurs to expedite progress toward a more sustainable future by connecting digital innovation, entrepreneurship, and the SDGs.

This study analyzed academic publications and analyzed the correlation between digital innovation, entrepreneurship, and sustainability. The results of our research provide valuable information about significant patterns and understandings. The research field has significantly

increased research interest, specifically from 2018 to 2020. This indicates an increasing acknowledgement of the capacity for digital innovation and entrepreneurship to contribute to achieving sustainable development goals. A select set of authors has been exceptionally prolific in this field. Moreover, several prominent papers have received substantial citations, underscoring their impact on the ongoing discussion. Specific publications have established themselves as prominent forums for researching this particular subject. Some examples of these publications are the Journal of Cleaner Production and Business Strategy and the Environment. An examination of keywords found robust thematic correlations among "sustainable development," "entrepreneurship," and "digital innovation".

There has been a significant increase in scholarly interest in the study field, especially between 2018 and 2020 (George, Lakhani, et al., 2020; Kardos, 2012) suggesting a growing realization of the power of digital innovation and entrepreneurship to contribute to sustainability goals. Some authors have been highly productive in this field (Haldar, 2019)), and a few influential journals, like the Journal of Cleaner Production and Business Strategy and the Environment, have become prominent platforms for discussing this topic (George, Lakhani, et al., 2020; Sun & He, 2023)

The examination of keywords uncovered thematic solid connections between "sustainable development," "entrepreneurship," and "digital innovation," highlighting the intrinsic interdependence of these concepts in achieving sustainability objectives (Kamaludin, 2023).This highlights the interconnectedness of these principles in attaining sustainability objectives. The report highlights sustainability as a complex topic requiring solutions incorporating policy, economics, and entrepreneurial initiatives.

The results of our research not only emphasize the promise of this area of study but also draw attention to a significant pattern: the growing significance of the entrepreneurial ecosystem. The focus on the entrepreneurial ecosystem indicates a change in perspective toward recognizing sustainability as a joint endeavour. The statement recognizes the significance of creating a conducive atmosphere that encourages and cultivates entrepreneurs with inventive concepts capable of tackling sustainability issues. Further investigation is needed to examine the collaborative efforts of many entities in the entrepreneurial ecosystem, including universities, investors, and mentorship programs, to drive the success of sustainable businesses with significant positive effects.

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