

Global Trends of Digitization in the Face of Creativity and Innovation

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Abstract. *With the advent of the New Millennium, the digitalization process emerged as a phenomenon that progressively impacted, to a greater or lesser extent, all the developed countries. In this context, key elements such as Creativity and Innovation prompted the implementation of multiple theoretical-conceptual frameworks that led to the diversification of digitalization as such, in terms of its objectives and scope. To explain the trinomial relationship digitalization-creativity-innovation, this work has carried out an exhaustive bibliometric analysis based on Ardia & Cuccurullo's procedure since it can perform a study of the field based on the essential dimensions of digitalization: the social, the conceptual and the intellectual structures. Following these guidelines, our work has established its analysis period of 22 years (1999-2021), by conducting an exhaustive bibliometric analysis of the keywords "digitalization", "creativity" and "innovation", of all the works indexed in the SCOPUS database throughout the previously indicated time period. Among many other aspects, we have highlighted the number of citations, their intertemporal evolution, those authors and publications with the greatest impact, the most common keywords, and the leading countries in the study of the digitalization underlying creativity and innovation. Finally, our study, based on a conceptual map, has allowed us to carry out a complete classification of the main trends in this research according to four categories of themes: niche themes, emerging themes, basic themes, and motor themes. The latter indicate which new lines of research should be undertaken and, in this particular case, these should be based on the "acquired knowledge", the homogenization of shared data, and the emergence of studies that emphasize the qualitative and quantitative aspects of research.*

Keywords: *Digitalization; Creativity; Innovation; Digital economy; Bibliometric analysis*

JEL classification: *O30; O31; M10*

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1. Introduction

Digital and Smart technologies, Augmented Reality, Virtual Reality, Mixed Reality, Metaverse, 3D modeling and printing, Internet of Things, Artificial Intelligence, Big data, Blockchain, and Robotics shape the current digital era suggesting a global digital transition. The fourth Industrial Revolution has brought digitalization causing transformation in business processes, and reshaped the relationship with customers (Panait et al., 2022; Parida, 2018). Subsequently, the global digital economy is forming given the significance of the digital technological advancements (Pinheiro et al., 2019). New digital technologies enable human and machine intelligence to deal with complicated problems in almost all areas of economic, social, or cultural dimensions (Gigauri & Vasilev, 2022).

Digital transformation especially accelerated due to the Covid-19 pandemic as digitalization has helped businesses to continue operations while people moved online for shopping or communication reasons. Recent tremendous changes caused challenges for society and economics around the globe leading to a speedy digital transition process (Almeida et al., 2020; Martín-Cervantes, Rueda López, et al., 2020; Palazzo et al., 2022). Enhanced Digitalization has forced organizations to become agile, and flexible, adopting automation and digital technologies to respond adequately to customers' shifting demands (Almeida et al., 2020; Ciucan-Rusu et al., 2022). Consequently, new business models emerged to follow alterations with agility, and take advantage of opportunities in a rapidly changing environment (Gigauri, 2021; Parida, 2018; Vasile et al., 2022) emphasizing innovation and creativity as underlying notions.

Digitalization is defined as a way of restructuring many social domains centered on digital communication and digital infrastructure (Brennen & Kreiss, 2016). It includes integrating advanced technologies into social life (Gray & Rumpe, 2015). Digitalization implies using digital technologies and transforming business models towards more digitalized operations. Therefore, it is focusing on data that can be accessed through the Internet and analyzed in the cloud life (Gray & Rumpe, 2015). Thus, its main part is Big Data. Moreover, Augmented reality (AR) and Virtual reality (VR) can be used not only for entertainment reasons but also integrated into business for achieving better results. For instance, AR/VR is beneficial for human resource management in recruitment and selection efforts, staff adaptation and training, and organizing an online working environment, as well as for improved management of logistics, distribution, and marketing activities (Zhao et al., 2019; Surugiu et al., 2018). Previous research analyzed the influence of digitalization on social relations, marketing, and technology and found that the trend is growing inspiring the creation of new digital products and services, remote working encourages the attraction of talents regardless of their geographical locations, and accordingly, cybersecurity and privacy issues moved into the foreground (Almeida et al., 2020).

Digitalization trends offer advantages such as data transfer, communication, cost savings (e.g., Yli-Viitala et al., 2019; Surugiu et al., 2020), developing customer loyalty, and reaching various markets (e.g., Banalieva & Dhanaraj, 2019). However, it also presents disadvantages such as cybersecurity and privacy issues (e.g., van Rest et al., 2014), and digital fraud (e.g., Zabala Aguayo & Ślusarczyk, 2020) suggesting the need for digital risk management for adaptation to digitalization (Jansen & Jeschke, 2018; Ragulina et al., 2021; Zambrano Farias et al., 2021). The threat to lose business can occur if not aligned with the innovative environment (Ivanova et al., 2019).

Digitalization is characterized by innovation which portrays creativity. Furthermore, innovation within the framework of digitalization offers companies a competitive advantage (Fransman, 2018), and global competitiveness through open and collaborative innovation producing tangible results (Brown et al., 2020).

Digital transformation, innovation, and creativity are unified by the workforce. People with their skills create digital technologies and develop innovation because of their exceptional creativity. Consequently, education plays in this regard a crucial role to prepare a workforce capable for the introduction of disruptive technological advancement and flexible to adapt to the new digital era with innovation and creativity (Gigauri et al., 2022; Gigauri & Vasilev, 2022; Sergi et al., 2022). Developing creative ideas into innovation under the conditions of constraints and boundaries can bring a competitive advantage to companies (Acar et al., 2019). For this reason, organizations are striving to encourage creativity for innovative solutions. In addition, innovation also contributes to economic growth (Apostu et al., 2022; Martín-Cervantes, Rueda López, et al., 2020).

Creativity as a multidimensional concept includes cognitive abilities, individual characteristics, educational facets, and social and cultural dimensions (Müceldili et al., 2020; Nakano & Wechsler, 2018). Creativity serves as the basis for innovation that can be a result of creative ideas. While creativity can be new ideas, for innovation a valuable product or process must be created (Bledow et al., 2009; Cropley et al., 2011). The main difference between the two concepts is the practical application. In particular, innovation relates to the outcome, which can be a new or improved product, service, or process, whereas creativity is not concerned with the practical use of the generated ideas (Nakano & Wechsler, 2018; Ramírez-Montoya et al., 2022). Creativity affects the design and commercialization of innovation and hence, facilitates the efficiency of companies (Ek Styvén et al., 2022; Stojcic et al., 2018). In this regard, both innovation and creativity are essential vehicles for the performance of a company (Lee et al., 2019; Wolniak & Jonek-Kowalska, 2022). Furthermore, the adoption of available digital technologies and using them in an innovative and creative way have an important impact on organizations (Ji et al., 2022; Ntasis et al., 2021) but also influence economic and societal development.

The purpose of this paper is to explain the relationship Digitalization-Creativity-Innovation based on an exhaustive bibliometric analysis. The study covers 22 years, from 1999 to

2021, searching for the keywords "Digitalization", "Creativity" and "Innovation" in publications from the Scopus database. The paper presents the number of citations, their intertemporal evolution, those authors and publications with the greatest impact, the most common keywords, and the leading countries in the study of the digitalization underlying creativity and innovation. In addition, our study, based on a conceptual map, has allowed us to carry out a complete classification of the main trends in this research according to four categories of themes: niche themes, emerging themes, basic themes, and motor themes. The latter indicates new lines of research and the emergence of trends.

The paper is organized as follows. After the Introduction, data and methodology is described. Next, the results are presented and finally, conclusions are reached.

2. Methodology and data

This research has employed the SCOPUS database as the source of data on which the selected methodology will be implemented. In this sense, this data source has been specifically used instead of others (e.g., WOS) since it constitutes the database of scientific literature that compiles the largest number of contributions and disciplines, covering bibliographic items from 1823 to the present day.

On the SCOPUS database, we have conducted the following Boolean search:

(ABS ("Digital Economy") AND ABS (creativity) OR ABS (innovation)) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBSTAGE , "final")). In other words, we searched for any type of work included in this database that contained "Digital Economy", "Creativity", and "Innovation" as keywords. The search was restricted to published works in English, regardless of whether or not they had been previously accepted by the respective publishing houses. Likewise, the query did not establish any time restriction, which resulted in the following time horizon: from 1999, the date on which the first register that meets the above-mentioned search criteria appears (Douglas, 1999), to 2021, since we decided not to include the year 2022 as it had not been completed at the time of writing this research.

The Boolean search resulted in a total of 855 documents. However, in some cases the bibliographic records presented anomalies (mainly they were incomplete because they did not present all the fields required for the subsequent analysis or duplicated records could be detected). In these circumstances, it was necessary to clean and restructure data to obtain a homogeneous database of 665 bibliographic items.

The Ardia & Cuccurullo's procedure (Aria & Cuccurullo, 2017), was subsequently implemented on this database, considering that it is capable of performing a complete bibliographic dissection of any analyzed phenomenon on three differentiated but complementary structures: the social, the conceptual and the intellectual dimensions. This procedure has been previously employed in multiple knowledge domains such as the Public Administration (Martín-Cervantes, Valls Martínez, et al., 2020b), or the Corporate Social

Responsibility (Martín-Cervantes, Valls Martínez, et al., 2020a). Table 1 displays the main stylized facts of the research.

As can be noted, this research is highly popularized among the scientific community in which, curiously, papers based on conferences (265) predominate over scientific articles (248). This type of research tends to be remarkably dominated by more than a single author (in more than 90% of the cases). Similarly, the average number of citations can be considered relatively high (more than 7 per contribution). A fact to be taken into account is the high annual growth rate of scientific production in this field (22.38%). It should be borne in mind that if this rate remains constant, it would take just over 3 years for the scientific production to double (approximately 3.43 years).

Table 1. Main characteristics of the investigation

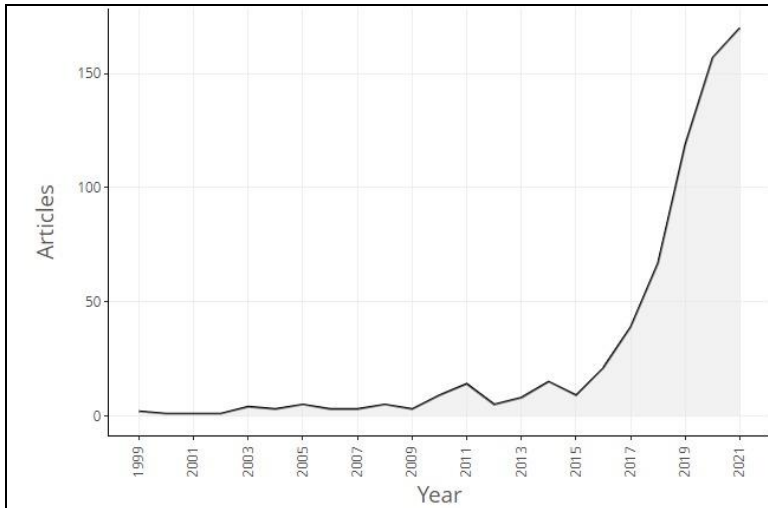
| FEATURES OF THE ANALYZED DATABASE | | DOCUMENT TYPES | |
|-----------------------------------|-----------|--------------------------------|-------|
| Timespan | 1999:2021 | Articles | 248 |
| Origin of sources | Scopus | Books | 29 |
| Sources (Journals, Books, etc.) | 405 | Book chapters | 98 |
| Documents | 665 | Conference papers | 265 |
| Annual Growth Rate % | 22.38 | Editorials | 1 |
| Document Average Age | 3.8 | Errata | 1 |
| Average citations per doc | 7.402 | Notes | 2 |
| DOCUMENT CONTENTS | | Reviews | 18 |
| Keywords Plus (ID) | 2,170 | Short surveys | 2 |
| Author's Keywords (DE) | 1,897 | AUTHORS COLLABORATION | |
| AUTHORS | | Single-authored docs | 163 |
| Authors | 1,664 | Co-Authors per Doc | 2.72 |
| Authors of single-authored docs | 153 | International co-authorships % | 13.68 |

Source: Authors' analysis from the Scopus database, based on keywords

3. Research results

The bibliometric analysis presents a comprehensive picture of the literature regarding Digitalization, Creativity, and Innovation by investigating all published papers in the SCOPUS database between 1999 and 2021. The results include 405 publications related to the words “digitalization”, “innovation”, and “creativity”. The number of published papers has slowly increased over the years since 1999, a sharp increase can be observed since 2017, and a jump in 2021 (Figure 1). Thus, the interest in the field has dramatically increased in the last few years.

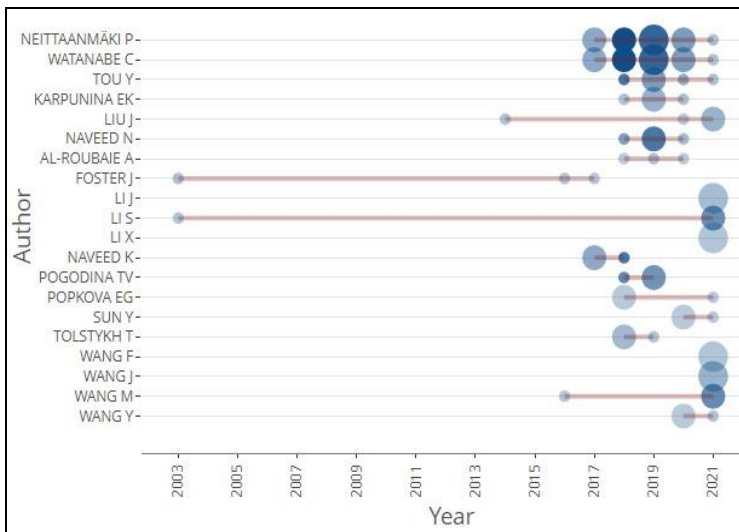
Figure 1. Annual Scientific Production



Source: Authors' analysis from the Scopus database, based on keywords

The number of authors and papers published by them has considerably increased since 2019 representing the growing focus on the subject (Figure 2). Figure 2 reflects the 20 most productive authors on the topic of Digitalization, Creativity, and Innovation between 2003 and 2021.

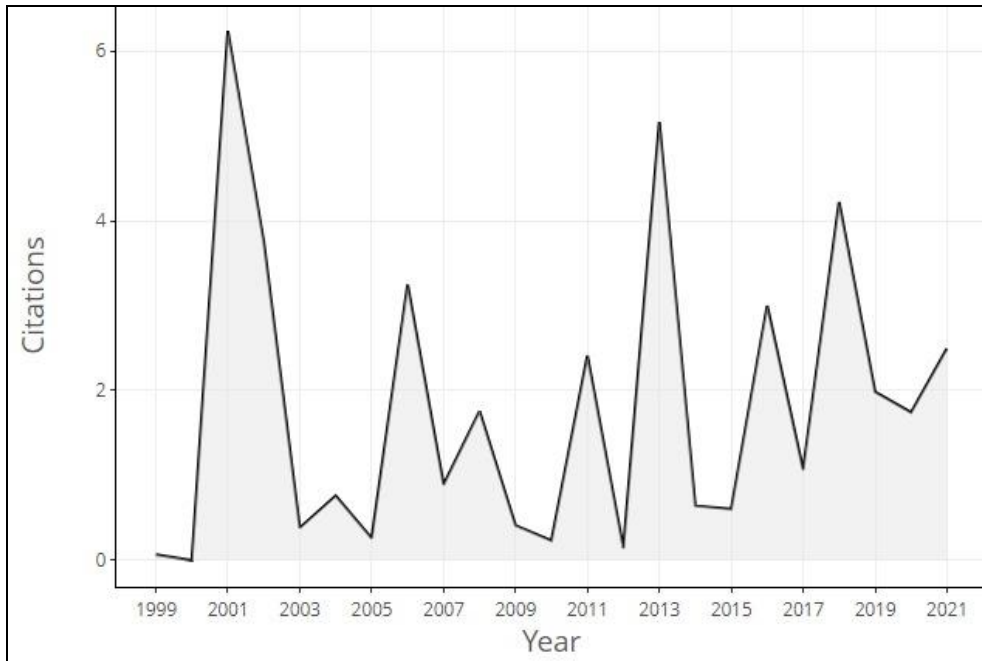
Figure 2. Authors and Publications over Time



Source: Authors' analysis from the Scopus database, based on keywords

Remarkably, a huge number of citations have received those scientific articles published in 2001 (Figure 3), which can be explained by rising interest among scholars concerning the subject, who have cited previous works.

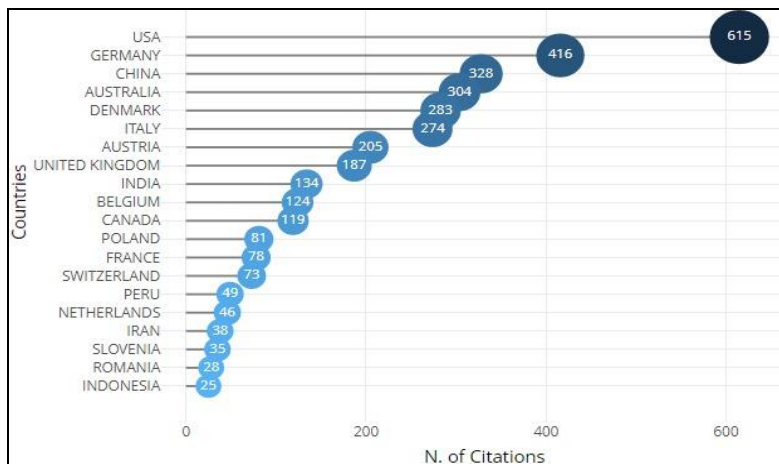
Figure 3. Average Citation per Year



Source: Authors' analysis from the Scopus database, based on keywords

The most influential countries receiving the most citations on the topic Digitalization-Innovation-Creativity are the USA and Germany having 615 and 416 citations respectively (Figure 4), followed by China with 328 citations, Australia with 304, Denmark with 283, and Italy with 274 citations. Authors from Austria received 205 citations and those from the United Kingdom – 187. India, Belgium, and Canada have 134, 124, and 119 citations, correspondingly. Authors from Poland received 81 citations, while researchers from France and Switzerland received 78 and 73 citations, respectively. Below 50 citations have scholars from the following countries: Peru, the Netherlands, Iran, Slovenia, Romania, and Indonesia.

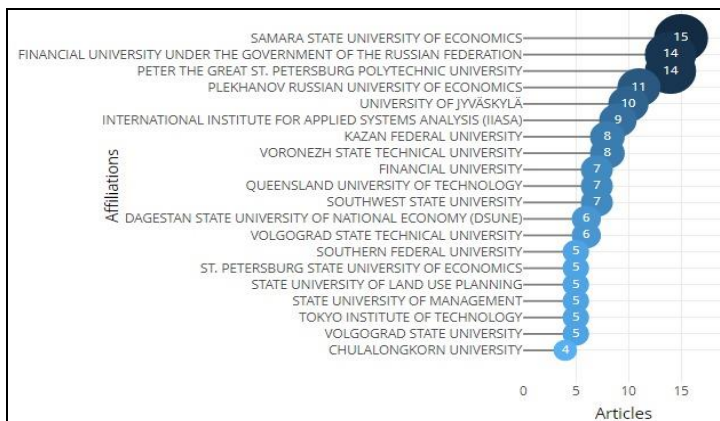
Figure 4. Most Cited Countries



Source: Authors' analysis from the Scopus database, based on keywords

Most relevant affiliations include mainly Russian Universities producing a great number of publications in the field (Figure 5). Samara State University of Economics has published 15 papers, while Financial University under the Government of the Russian Federation (Moscow) and St. Petersburg Polytechnic University published 14 papers each. Scholars affiliated with Queensland University of Technologies published 7 articles, and researchers from Tokyo Institute of Technology published 5 papers concerning the selected keywords.

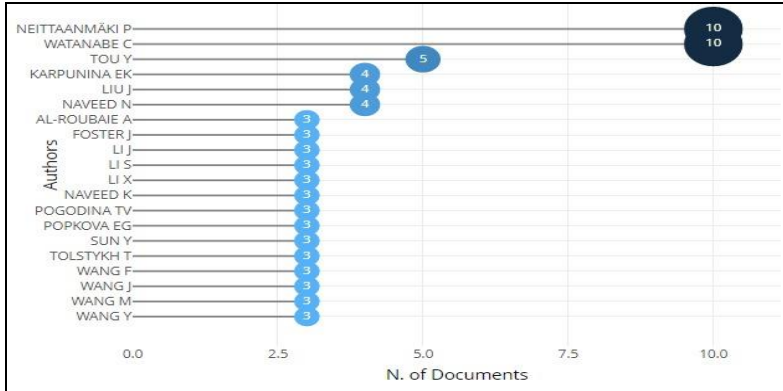
Figure 5. Most Relevant Affiliations



Source: Authors' analysis from the Scopus database, based on keywords

As Figure 6 details, two authors have published 10 papers each on the topic Digitalization-Innovation-Creativity, while most authors have 3 publications. Tou Y. published 5 papers, and 3 researchers – Karpunina EK., Liu J., and Naveed N. have 4 publications each.

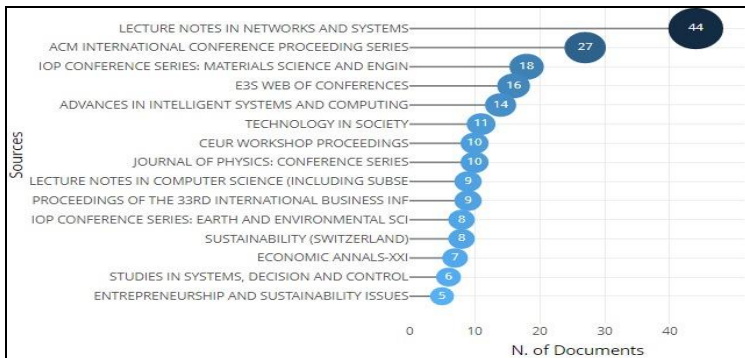
Figure 6. Most Relevant Authors



Source: Authors' analysis from the Scopus database, based on keywords

The majority of publications are lecture notes (44) and conference papers (Figure 7). 27 articles have been published in ACM International Conference Proceeding Series, 18 in the IOP Conference Series, and 16 in the E3S Web of Conference. Sustainability published 8 articles suggesting the connection between sustainability issues and digitalization-innovation-creativity.

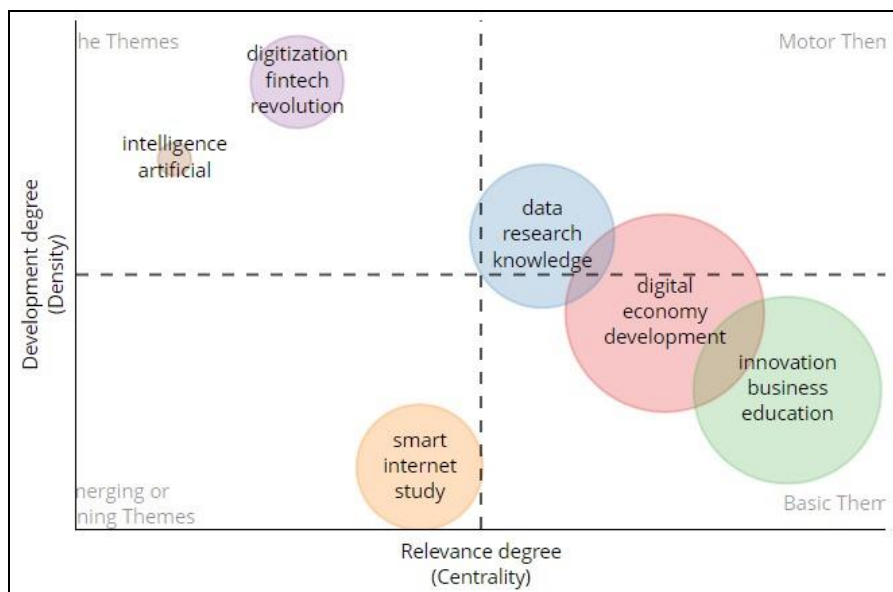
Figure 7. Most Relevant Sources



Source: Authors' analysis from the Scopus database, based on keywords

The thematic map (Figure 8) portrays patterns of subject matter and visualizes keywords in relation to their centrality and density. The upper-right quadrant includes the Motor Themes represented by high centrality and high density suggesting that “data research knowledge” is more developed in the literature. “Digital economic development” is overlapping with Basic Themes, the lower-right quadrant, showing the transversal themes. Therefore, “Innovation business education” and “Digital economic development” are strongly connected with the term Digitalization-Innovation-Creativity. With respect to the upper-left quadrant, it demonstrates high density themes and low centrality, which means that “Digitization fintech revolution” and “Artificial intelligence” are unimportantly linked to the field. In regard to the lower-left quadrant, the emerging or declining themes display “Smart internet study”.

Figure 8. Thematic Map



Source: Authors' analysis from the Scopus database, based on keywords

In reference to the most common words in the content of published articles associated with Digitalization-Innovation-Creativity, Word Cloud visually represents word frequency (Figure 9). The terms “Economics”, “Competition”, “Digital transformation”, “Digital technologies”, “Commerce”, “Electronic commerce”, “Industrial economics”, “Information system” appear frequently within the publications. It is worth noting that Sustainable Development is related to the selected words – Digitalization, Innovation, Creativity – in the literature.

Figure 9. Word Cloud: Most common words in scientific publications' content

Source: Authors' analysis from the Scopus database, based on keywords

4. Conclusion

The findings corroborate and extend prior studies that have revealed that the digitalization trend is in connection with innovation, and creativity (e.g., Almeida et al., 2020; Brown et al., 2020; Fransman, 2018; Sergi et al., 2022). These three concepts have shaped our digital age (Parida, 2018) and paved the way for further advancement of the digital economy (Ji et al., 2022; Ntasis et al., 2021; Pinheiro et al., 2018). In this respect, both innovation and creativity play a crucial role in digitalization to improve organizational performance (Lee et al., 2019; Wolniak & Jonek-Kowalska, 2022).

Our results resonate with recent seminal research that also found that innovation in Industry 4.0 offers digital transformation for businesses (Panait et al., 2022). In the same way, it can be inferred that innovation does not have to be derived from "novelty" in itself, but from the mere creativity accompanied by the necessary dose of technology (Martín-Cervantes et al., 2020).

The results presented in this paper may be taken into account by policymakers and practitioners. First, education policies should go hand in hand with the current transformation processes and offer sustainability programs as well as the improvement of digital, innovative,

and creativity skills. The rapid development of technologies triggered changes in every area of the economy and society, altering the traditional business models (Akkaya et al., 2022). It is noteworthy that many organizations are not prepared for complex changes and encounter difficulties to achieve digital transformation (Aslam et al., 2020). Consequently, education on innovation and creativity can improve young generations' ability to solve problems and support transformation strategies.

Moreover, technological advancements force social and economic structures to move towards digitalization, which impacts organizational operations (Darehshiri et al., 2022). Therefore, government support in this regard is required to shift successfully toward digitalization and also sustainability. Likewise, the technological infrastructure developed by governments will further facilitate this transition.

Furthermore, the demand for both managers and employees with innovative, creative, and digital skills is increasing. Thus, digital literacy should be emphasized while developing innovative and creative skills and capabilities of employees in order to deal with digital transformation (Ndou et al., 2023). Involvement in the innovation process promotes responsibility among managers and employees (Aslam et al., 2020).

The themes discussed in the paper echoes the modern tendency of digital sustainability, as technologies underpinning digitalization can be integrated into social and economic aspects in order to achieve sustainable development (Sharma et al., 2021).

Further empirical studies will be dedicated to the relevant issues of digitalization, sustainability, creativity, and innovation highlighted in this paper, and demonstrate their interrelationship with Sustainable Development.

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