WORKING PAPER

Digital Divide in the European Union

Nataša Kovač [a]***, Katarzyna Żmija*** [b]***, Jewel Kumar Roy*** [c]***, Rafał Kusa*** [d*]***, Jerzy Duda*** [e]

[a] *University of Donja Gorica, Faculty of Applied Sciences, Oktoih 1, 81000 Podgorica, Montenegro, natasa.kovac@udg.edu.me, ORCID: 0000-0002-6671-2938*

[b] *Krakow University of Economics, Institute of Informatics, Accounting and Controlling, Rakowicka 27, 31-510 Krakow, Poland, e-mail: zmijak@uek.krakow.pl, ORCID: 0000-0002-4119-8012*

[c] *Doctoral School of Regional and Business Administration Sciences, Széchenyi István University, Egyetem tér 1, Győr-9026, Hungary, e-mail: roy.jewel.kumar@sze.hu, ORCID: 0000-0002-9881-5915*

[d] *AGH University of Krakow, Faculty of Management, Gramatyka 10, 30-067 Krakow, Poland, e-mail: rkusa@agh.edu.pl, ORCID: 0000-0002-9819-897X*

[e] *AGH University of Krakow, Faculty of Management, Gramatyka 10, 30-067 Krakow, Poland, e-mail: jeduda@agh.edu.pl, ORCID: 0000-0002-9225-7123*

** corresponding author: Rafał Kusa, e-mail: rkusa@agh.edu.pl*

Acknowledgements

The publication was co-financed by the European Union under the Horizon Europe Framework Programme (HORIZON-MSCA-2021-SE-01-1); Project Number: 101086381; Project title: Overcoming Digital Divide in Europe and Southeast Asia.

Abstract

This paper explores the evolving landscape of digitization research within the European Union (EU) and Western Balkan (WB) countries over the past five years. Employing a detailed selection methodology and leveraging the extensive Scopus database, the study analyzes 1119 articles from EU countries and 277 articles from WB countries. The multidisciplinary nature of ongoing digitization research is evident, encompassing diverse fields such as technology, agriculture, law, and education. Key findings highlight the spatial distribution of publications within the EU, revealing varying levels of digitalization across member states. The collaborative nature of EU universities is emphasized, with a diffuse distribution of research efforts. In the WB, Serbia emerges as a research powerhouse, particularly affiliated with the University of Belgrade and the University of Novi Sad. However, a notable observation is the localized focus of WB countries on regional research topics. Keyword network analysis unveils distinct research priorities, with the EU focusing on digital technologies, economic advancements, and sustainable development, while the WB emphasizes societal inquiries, digital domains, and gender-diverse research. The differing research priorities underscore the need for tailored strategies to bridge digital disparities. Despite these insights, the study has limitations related to database selection and the evolving nature of bibliometric data. This research provides a foundation for future studies, offering perspectives on digitization trends and guiding policy considerations for both the EU and WB regions.

Keywords: digitalization, digital divide, European Union, bibliometric analysis

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

1. Introduction

Digitalization has been widely identified as the most significant technological megatrend [Reis et al., 2020]. It involves the continuous integration of digital technologies and digitized data throughout the economy and society, accelerating the pace of change affecting all aspects of our socio-economic life. According to Valenduc and Vendramin [2017], the term "digitalization" is not the irruption of a new revolution, but the pervasive synergy of digital innovations in the whole economy and society. It enables to create and harvest value in new ways [Gobble, 2018].

Digital transformation is one of the European Union's priorities, providing opportunities to strengthen Europe's capacity for new digital technologies, creating new opportunities for businesses and citizens and supporting the EU's green transformation to achieve climate neutrality by 2050. To guide the EU's digital transformation, the European Commission has implemented the Europe's Digital Decade policy programme, which contains concrete targets and objectives for the year 2030 in areas such as skills, secure and sustainable digital infrastructures, the digital transformation of businesses and the digitalization of public services. To track the progress in the implementation of the programme, the Commission has developed trajectories at EU level. The baseline trajectories set out how the EU will progress according to current trends, while the projected trajectories present a path showing annual progress towards the 2030 targets. The difference between the estimated trends and the ideal path will allow the Commission to monitor the gap and take the necessary efforts. Individual EU countries have also to prepare their national roadmaps, presenting their approach to achieving Digital Decade's targets [European Parliament, 2022].

Digital transformation is extremely important. There is evidence, that the difference in countries' economic performances and their global competitiveness greatly depends on the level of acceptance, availability, and use of ICT, which plays a decisive role in improving almost every aspect of our societies and economies [Borowiecki et al., 2021]. ICT supports new types of interactions, services and business practices, such as e-commerce, e-government, e-health, e-learning, e-banking, e-finance, freelance, and crowdfunding [Vicente & Gil-de-Bernabe, 2010; Vicente & Lopez, 2010; Cilan et al., 2009; Selwyn & Facer, 2007]. It accelerates also the progress of various transactions, allows to overcome barriers to market access, eliminates spatial constraints, and creates alternative commercial platforms and new industries, that generate new employment opportunities [Vicente & Gil-de-Bernabe, 2010, Vicente & Lopez, 2010]. Moreover, it changes the way people interact with each other, educate and obtain information thanks to ICT-based actions and technologies like Internet surfing, YouTube, social networks, online job seeking, email or access to online libraries [Brooks et al., 2005].

However, with the rise of the digital economy and society an important and evolving problem, emerging not only in the EU but also worldwide, has become the digital divide, highlighted in recent years increasingly by a number of organizations, policy makers and academics from different fields [Van Dijk, 2020]. In addition, the coronavirus pandemic has had a huge impact in exposing the enormous importance of this issue. The pandemic has forced people to the unique transformation of their daily living practices, while demonstrating even more clearly the phenomenon of digital exclusion resulting from a lack of resources and effective use of digital technologies [De et al., 2020, Aissaoui, 2021].

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Digital divide is most commonly interpreted as the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to access to, use of or impact of information and communication technology (ICTs) [OECD, 2001, Van Dijk & Hacker, 2003, Aissaoui, 2021]. The Digital Divide is a factor that can exacerbate social and economic inequalities, created by increasing reliance on technology, the Internet, and related solutions [Rogers, 2016, Manduna, 2016, Setthasuravich & Kato, 2020]. It can reduce or improve citizens' social and economic capital and their ability to participate in social and economic life [Ragnedda, 2017].

The digital divide, initially understood in a dichotomous way as a state of having or not having access to ICT, is treated today as a complex and multidimensional phenomenon [Cruz-Jesus et al., 2012, Vassilakopoulou & Hustad, 2021]. In the spatial context it is generally considered at two levels: at an international level it reflects various differences among different countries and at an intranational level it results from differences within a single country. However, there are also other geographic divide dimensions considered: among the developed countries, between the developed and developing countries, between the regions, as well as between the rural and urban areas. Recent literature on the digital divide distinguishes also between three main types of divide: the access divide associated with access and equipment problems, the usage divide associated with digital literacy and the performance / capacity divide associated with ICTs including benefits of using ICTs and more specifically the Internet [Aissaoui, 2021]. It can be concluded that digital gaps between countries, regions or groups of individuals are caused not only by differences regarding access to the Internet and ICT but also by differences in digital skills and digital usage, conditioned by the presence of specific characteristics, related to different sociodemographic and socioeconomic determinants [Hidalgo et al, 2020] or more specific individuals' characteristics such as motivation, culture or personality [Venkatesh et al., 2014]. This underlines that the digital divide is a multi-faceted concept covering several aspects (access, use, performance) and which can be analyzed at various levels and in different dimensions (global, national, regional, economic, social, technical, etc.).

Understanding the digital divide concept requires an in-depth recognition of the nature, course and outcomes of digitization processes, as well as an examination of the specific issues and problems these processes raise. This will help to identify and develop more coherent frameworks and policies to address this issue in order to diminish and bridge the digital gaps, which is a critical condition for ensuring sustainable development. Therefore, we intend to provide a complete and updated literature review, which aims to analyze the research conducted on digitalization issues in European countries, i.e. EU countries and countries of the Western Balkan region.

This paper is therefore a review with two objectives: (1) to study the main characteristics of the research carried out on digitalization between 2018 and 2023, presenting them taking into account the year of publication of the research, the spatial distribution of the research carried out and the university affiliation, as well as the publication patterns occurring, (2) to examine the focus of the research, the main issues addressed and how these have evolved over time. Achieving both of these objectives will allow us to formulate conclusions on the scope and nature of research conducted in the field of digitalization in European countries in two distinct groups of countries – in EU and the Western Balkan region, as well as to point out similarities and differences in the two groups of countries. The analysis of recent research is important because digitalization is continuously progressing, thus influencing the evolving concept of the digital divide and its causes, manifestations and implications. This review

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

therefore contributes to the literature by identifying the most important and recent areas of digitalization research, thus allowing us to go beyond the current digital divide research framework and to point to possible new aspects of this phenomenon. In this way, it contributes to better understanding of the digital divide, what could help to develop strategies and policies to tackle the divide more effectively.

2. Theoretical background

2.1. The role of digitalization in economic and social development

Digitalization is seen as the integration of data and the Internet into production processes, new forms of consumption within households and the public sector, capital formation, cross-border flows and finance [Borowiecki et al., 2021]. The digital transformation is cited as the foundation of growth in the twenty-first century. The information and communication technology (ICT) sector plays a particular role in this regard. The global ICT market, one of the largest industries, is forecast to reach a size of 6 trillion EUR in 2023. However, the EU's position in the global ecosystem is not the best and is deteriorating - the EU's share in global revenues on the ICT market has decreased dramatically over the last decade, including from 21.8% in 2013 to 11.3% in 2022, while the US share increased from 26.8% to 36,0% [European Commission, 2023].

The discussion about the course, effects and challenges of digitalization has been going on for years, involving scientists, political decision-makers, consulting companies and international organizations [Stankovic et al., 2021, Servoz, 2019, OECD, 2019, UN, 2021]. Many researchers attempt to recognize various aspects of the impact of digitalization on enterprises, economy, society or institutions. Researchers agree that today the digital economy is the main element of transformation in many countries. On the one hand, it creates new opportunities for solving existing problems, but on the other, it also brings a number of challenges. The impact of the broadly understood digital transformation on the economy and society results from the structural changes in the operating model of enterprises, economy and society, that are its consequence. Countries and supranational organizations, such as the European Union, reshape their traditional economic and social landscapes by promoting broadband use and internet usage, delivering online services for citizens, facilitating investments related to different aspects of the digital economy and society as well as implementing new business models appropriate for digital economy development [Laitsou et al., 2020].

ICT is a new general-purpose technology that has a broad and deep impact on the economy, generating a wide range of new products, production processes and services, as well as giving rise to new industries, both in the manufacturing and service sectors. Due to its vast and diverse impact on various economic sectors such as agriculture, industry, trade, education, health, transport and many others, the digital economy is now seen as one of the most important factors for the growth, development and prosperity of countries, supporting job creation work, entrepreneurship and innovation [Jamil, 2021, Oloyede, 2023]. It is a factor that has allowed many countries, such as China, to transform into one of the largest economies in the world [Wu & Yu, 2022]. Digitalization contributes to changing the structure of the economy by increasing the share of the digital economy in GDP, thus supporting economic growth [Zhang et al., 2022, Myovella et al., 2020]. The digital transformation of sectors and markets supports the production of higher quality goods and services at reduced costs [Karlsson et al., 2008]. Digital technologies are also changing the way companies do business and interact with customers and

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

suppliers [Fröhlich & Steinbiß, 2020, Nambisan, 2017]. They also enable to introduce new business models and create innovations [Audretsch et al., 2016]. Digital solutions raise the efficiency of processes, resulting in increased productivity [Bouwman et al., 2019]. Digitalization also facilitates access to new markets and new customers around the world, leading to an increase in exports [Dethine et al., 2020]. Remote work and distance education support professional activity in the labor market [Urbaniec & Żmija, 2022]. According to Ershova et al. the development of digital economy depends on public policy, strategic planning, digital transformation monitoring, effective and efficient leadership, proper institutions, effective legal framework, human capital development, research, development and innovation, enabling business environment, as well as digital infrastructure [Ershova et al., 2018].

Digital economy is closely linked to digital society, as the infrastructure created within the economy is the basis for the creation of a digital society. Digital society can be described as "a modern, progressive society that is formed as a result of the adoption and integration of Information and Communication Technologies (ICT) at home, work, education and recreation, and supported by advanced telecommunications and wireless connectivity systems and solutions [Sandulescu Budea, 2021]. Digitalization can also benefit society, similarly as the economy, by providing easy access to public services, better employment opportunities, and greater economic growth, which can lead to well-being [Galindo-Martín et al., 2019]. Nevertheless, in the digital context, adverse negative effects on society may also occur. Countries that are unable to digitally transform quickly enough face the problem of digital inequalities, and the related digital divide, manifesting in both social and economic dimensions. The existence of significant disparities between and within countries in access to and use of ICT may hinder the achievement of sustainable development goals, such as economic growth, decent work, well-being and the reduction of poverty [Jamil, 2020].

The place of digitalization in the EU policy

Digital transformation is one of the key elements of the EU's socio-economic development. That's why the EU is working on a range of issues to support Europe's digital future. Already in 2010, in line with the Lisbon Strategy, the 10-year *Digital Agenda for Europe* identified for the first time the key role of ICT in achieving Europe's goals [European Commission, 2010]. In 2015, the *Digital Single Market Strategy* developed the *Digital Agenda*, focusing it on three pillars aimed at ensuring a fair, open and secure digital environment, providing better access to digital goods and services for consumers and businesses, creating appropriate conditions for the development of digital networks and services and maximizing the growth potential of the digital economy. In 2020, the second five-year digital strategy - *Shaping Europe's digital future* - was launched with the focus on three key digital goals: technology that works for people, a fair and competitive economy and an open, democratic and sustainable society [European Commission, 2020]. In 2021, the strategy was reinforced with the 10-year *Digital Compass: Europe's path to the digital decade*, which concretes the EU's digital ambitions for 2030, setting four digital targets related to skills, businesses, infrastructure and public services [European Commission, 2021]. *The Digital Decade policy programme 2030* is based on an annual cooperation mechanism involving the Commission and Member States, consisting of:

- monitoring of annual progress in achieving each of the 2030 goals, based on the Digital Economy and Society Index (DESI),
- an annual report prepared by the Commission, including the evaluation of progress and recommendations for actions,

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

- Digital decade strategic roadmaps, in which member states present adopted or planned actions to achieve the 2030 goals (prepared every two years)
- the European Digital Infrastructure Consortium, which is a mechanism to support the implementation of multi-country projects.

In addition, in 2021 the *Digital Europe program* has been established - a new EU digital financing program with a planned total budget of EUR 7.5 billion for the years 2021-2027, which will provide strategic financing for projects in five areas: supercomputing, artificial intelligence, cybersecurity, advanced digital skills and ensuring the broad use of digital technologies across the economy and society [European Parliament, 2021].

The current EU's digital strategy has a very wide scope and covers many key issues, the most important of which are [https://www.consilium.europa.eu]:

- The Digital Decade - a governance framework to achieve the 2030 digital goals,
- Declaration of Digital Rights and Principles - defining citizens' rights in the digital space and creating a framework of principles that the EU and Member States agree to follow during the digital transformation,
- Digital services - the EU legal framework for digital services,
- Data-driven economy - the European data strategy that will create a single data market that is consistent with common EU values and allows data to be shared and reused more widely across sectors and countries
- Taxation of digital activities – the legal framework adapting the tax systems of EU countries to the requirements of the digital era,
- Artificial intelligence - establishing a comprehensive and future-proof European legal framework of ethical principles for the development, deployment and use of AI, robotics and related technologies,
- Connectivity - developing harmonized regulations for connectivity services in the EU,
- Cybersecurity - EU cybersecurity strategy, increasing Europe's resilience to cyber threats and ensuring that all citizens and businesses can benefit from trusted digital tools and services,
- European Digital Identity (eID) - EU-wide framework for a secure public electronic identity,
- Digitalization of the justice system - digitalization of Member States' judicial systems, expanding access to justice for citizens and companies and increasing the effectiveness and efficiency of court proceedings,
- Digital information exchange - increasing the exchange of digital information between national authorities and Eurojust in terrorism cases.

Success in achieving the Digital Decade goals will be crucial for the EU's future prosperity and will require a significant acceleration and deepening of action by Member States to reform and improve the business environment, as well as to create incentives and boost investment in digital technologies, skills and infrastructure. The European strategies and recommendations intend to narrow digital disparities, achieving similar conduct between and within countries, but there is still work to be done. An important role in this respect is played by researchers who, through their research, describe the current state of advancement of digitalization processes and highlight many important issues related to digitalization. Analysis of research results allows to identify problem areas and point to the potential for improvement activities to counteract the digital divide.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

3. Methodology

3.1. Method

In the methodology section of this scientific paper, we conducted a comprehensive bibliometric analysis to explore the landscape of scientific publications. To assemble a robust dataset, various bibliometric databases housing scholarly papers were considered. After careful evaluation, the Scopus database was chosen for its extensive coverage, multidisciplinary scope, and international representation of scholarly works. The decision to opt for Scopus was guided by its reputation for providing a comprehensive and reliable platform for bibliometric analysis. On November 23, 2023, we performed a data download from the Scopus database, utilizing specific search terms to focus on relevant content. The initial search utilized keywords "digit*" AND "EU" in the searchable fields for article title, abstract, and keywords, yielding a substantial set of 4116 records.

Similarly, the outlined methodology was replicated for the Western Balkan countries, encompassing Montenegro, Serbia, Bosnia, Macedonia, Albania, and Kosovo. The search query applied to the Scopus database targeted articles with the keywords "digit*" AND "Montenegro OR Serbia OR Bosnia OR Macedonia OR Albania OR Kosovo" appearing in the article title, abstract, or keywords. This focused search strategy resulted in the retrieval of 1121 records in our dataset. The observed dataset is freely available at Zenodo [Kovač, 2023]. This approach ensures a region-specific examination, allowing us to discern trends and developments related to digital topics within the context of the Western Balkan countries. The consistent application of the Scopus database and the tailored search criteria maintains methodological rigor and comparability across different geographical scopes, fostering a comprehensive analysis of the digital landscape.

To streamline both datasets and ensure precision in our analysis, we employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. This systematic approach aids in refining the dataset by applying rigorous inclusion and exclusion criteria, facilitating a more focused examination of pertinent scientific literature.

3.2. Sources of data and procedure

PRISMA is a set of guidelines developed to improve the transparency, completeness, and quality of reporting systematic reviews and meta-analyses. It has become widely recognized and endorsed within the scientific community as a valuable tool for promoting the transparency and reliability of systematic review reporting. PRISMA was established to address the growing need for a standardized approach to presenting the findings of systematic reviews, which are critical tools in evidence-based practice and research synthesis. By adhering to the PRISMA guidelines, we aimed to enhance the credibility and utility of our systematic review.

In order to facilitate separate comparisons between countries associated with the European Union (EU) and those outside the EU, we categorized European countries into two distinct sets. The first set comprises countries already within the EU, including Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, and Sweden. The second set consists of countries in the Western Balkan region, namely Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia. This division enables a focused analysis of research trends and outcomes in these distinct geographical clusters.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Research began with two datasets: one related to the EU, containing 4116 records, and the other related to the Western Balkan countries with 1121 rows. Both datasets were subjected to the PRISMA methodology, implemented using Python. As is presented in Figure 1, the PRISMA methodology consists of a structured approach involving four key steps: identification, screening, eligibility, and reporting.

Upon observation, it was identified that due to co-authorship, certain records were duplicated in both datasets. Consequently, the initial step involved reducing the number of records in the EU dataset. After detecting and addressing 38 duplicates, the EU dataset was refined, resulting in a total of 4078 records.

To focus exclusively on scientific papers, we refined the dataset by including only articles. This additional restriction led to a further reduction in the dataset, resulting in 2430 rows for the EU dataset, comprising only articles, and 659 rows for the Western Balkan (WB) dataset. Subsequently, our analysis specifically targeted recent articles, limiting the timeframe to those published in the last five years, spanning from 2018 to 2023. Within this temporal scope, we obtained 444 rows pertaining to the WB countries and 1695 for EU countries.

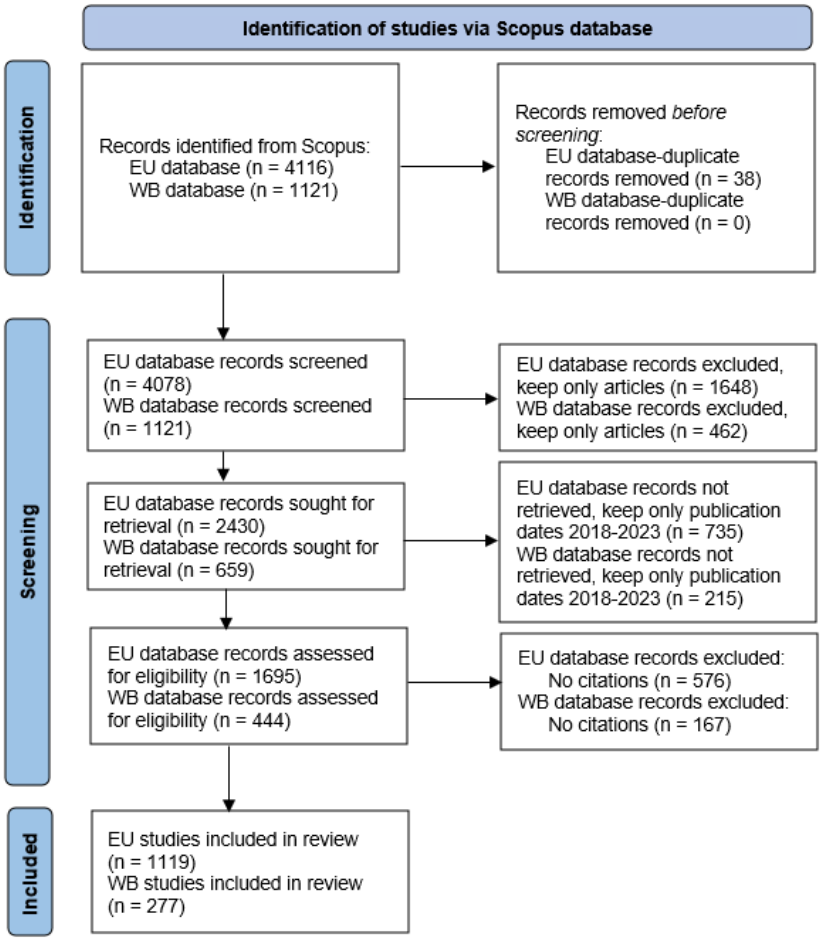


Figure 1. PRISMA flow diagram applied on EU and WB datasets

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

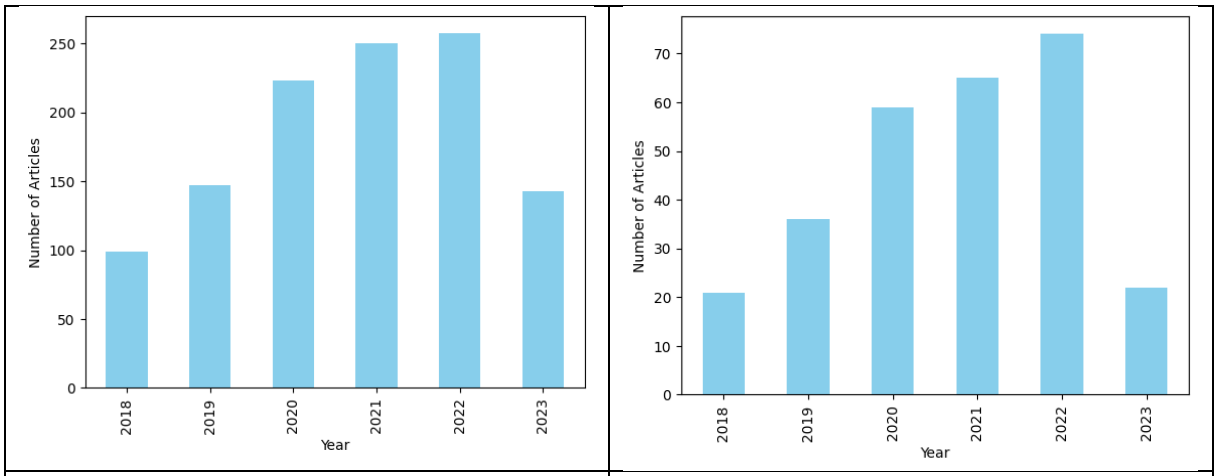
Finally, to underscore the research significance of the records in the dataset, we opted to include only those with at least one citation. This refinement resulted in a dataset comprising 1119 rows for the EU and 277 rows for the WB countries. The subsequent plots will delve into the analysis of these newly formed datasets.

4. Results and discussion

4.1. Documents by year

In the EU dataset, the number of articles with more than zero citations has exhibited an upward trend over the observed years. In 2018, there were 99 such articles, followed by increases in subsequent years, reaching 147 in 2019, 223 in 2020, 250 in 2021, 257 in 2022, and 143 in 2023. This suggests a general rise in the impact and visibility of scholarly publications, with a peak in 2022 (see Figure 2.).

Turning to the WB countries, a similar positive trend is observed, albeit with lower absolute numbers. In 2018, there were 21 articles with more than zero citations, which increased to 36 in 2019, 59 in 2020, 65 in 2021, 74 in 2022, and 22 in 2023. Although the numbers are smaller compared to the EU dataset, the trend remains consistent, indicating a growth in the impact and citation rates of articles from Western Balkan countries. The parallel trends across both datasets suggest a shared trajectory in the increasing recognition of scholarly work, reflecting a broader engagement and influence of research from both the EU and Western Balkan regions.



a) b)

Figure 2. Number of articles by year in a) EU and b) Western Balkan Countries

Interestingly, a notable observation in both datasets is a decrease in the number of articles with more than zero citations in the year 2023 compared to the previous years (the analysis covered 10.5 months of 2023). While the trend in the EU dataset showed a decline from 257 articles in 2022 to 143 articles in 2023, the Western Balkan dataset similarly experienced a drop from 74 articles in 2022 to 22 articles in 2023. This decline in 2023 might suggest a unique influence, possibly related to external factors such as the past global COVID-

Co-funded by the European Union

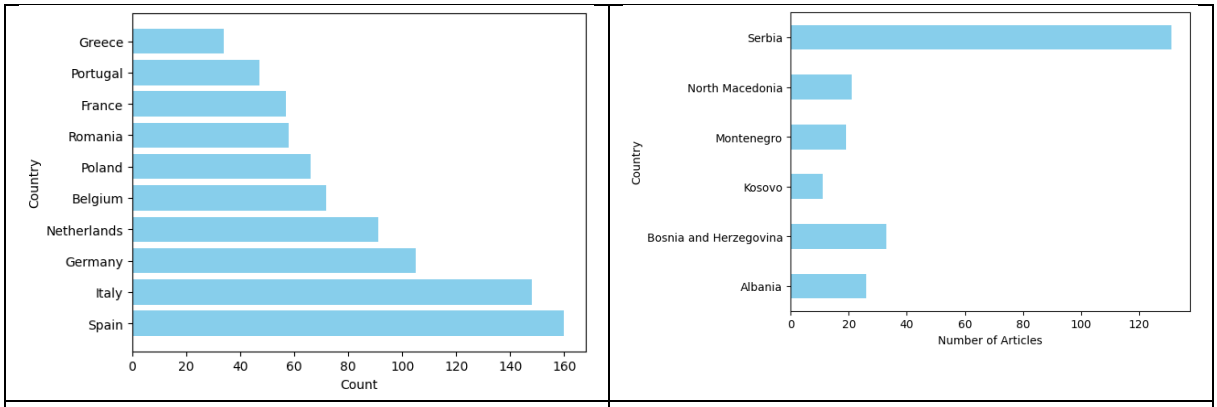
Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

19 pandemic. It appears that the years heavily impacted by the pandemic, notably 2020 and 2021, were more fruitful in terms of research output.

4.2. Documents by country

The data on the number of articles with more than zero citations in the EU and in the WB, countries reveal interesting trends, as is shown in Figure 3. In the EU, the top 10 countries contributing to research output are led by Spain with 160 articles, followed closely by Italy with 148 articles and Germany with 105 articles. Other notable contributors include the Netherlands, Belgium, Poland, Romania, France, Portugal, and Greece.

In the Western Balkan countries, the distribution is more varied. Serbia emerges as the leading contributor with a substantial 131 articles. Other countries, such as Bosnia and Herzegovina, Albania, Montenegro, and North Macedonia, also contribute significantly, with citation counts ranging from 11 to 33 articles.



a) b)

Figure 3. Number of articles per countries in a) EU and b) Western Balkan

A comparative analysis of these trends suggests that certain EU countries have higher individual research outputs compared to the combined research outputs of multiple Western Balkan countries. However, the presence of a leading contributor like Serbia in the Western Balkans indicates a concentration of research activity in specific countries within the region. These insights can inform discussions on collaborative research efforts and potential areas for further exploration.

Croatia and Slovenia, although geographically located in the Balkan region, have already become integral members of EU. When considering their research output within the EU context, Croatia stands at the 13th position with 31 articles, showcasing a competitive presence in EU research endeavors. On the other hand, Slovenia occupies the 22nd place with 17 articles, reflecting a slightly lower research output compared to some other EU member states.

These rankings emphasize the diverse contributions of EU member countries, with Croatia demonstrating a competitive standing and Slovenia still making notable contributions, albeit at a somewhat lower scale. The inclusion of Croatia and Slovenia in the EU research landscape underscores the collaborative and integrated nature of scientific endeavors within the European Union. Further analysis of the factors influencing research productivity in these countries could provide valuable insights into the dynamics of scientific collaboration and innovation within the EU framework.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

The observed disparity in research output among WB countries, with Serbia emerging as a leading contributor, may be attributed to various factors. One plausible explanation is the demographic aspect, as Serbia has a larger population compared to other countries in the region. A larger population often translates into a greater pool of researchers and, consequently, a higher research output.

However, it's essential to consider other factors that contribute to this phenomenon. The concentration of research activity in Serbia could also indicate a higher level of investment in research and development within the country. Governments and institutions in Serbia may have prioritized and allocated resources to foster a robust research environment, leading to increased scholarly contributions.

This observation underscores the multifaceted nature of research disparities, incorporating demographic factors, investment in research infrastructure, and strategic policy decisions. Further exploration into these factors could provide valuable insights for policymakers, funding agencies, and researchers seeking to enhance research collaboration and productivity across the Western Balkan region.

4.3. Documents by affiliations

The university affiliation counts for EU countries showcase (see Figure 4.) the distribution of research articles among various universities in the dataset. Notably, the University of Craiova takes the lead with 16 articles, emphasizing its significant role in contributing to scientific knowledge. Following closely are the University of Amsterdam and the West University of Timisoara, each with 11 and 10 articles, respectively. Other prominent institutions include the Bucharest University of Economic Studies, the Silesian University of Technology, and the University of Zagreb. This analysis provides valuable insights into the research output of these universities, highlighting their diverse contributions and underlining the collaborative nature of academic sector within the European Union.

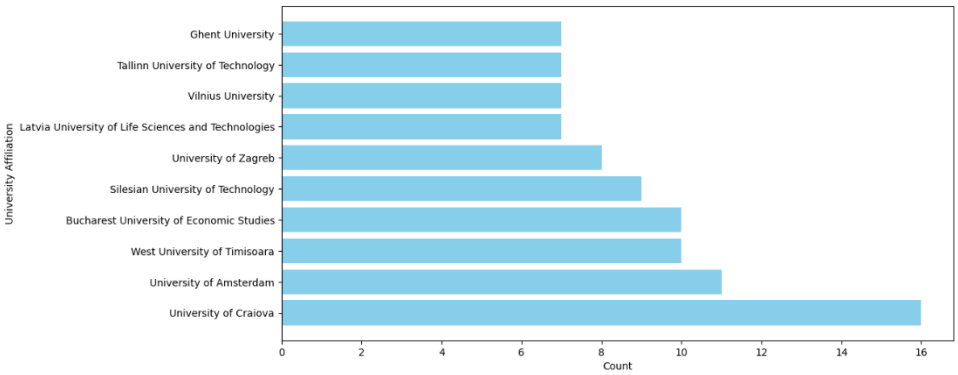


Figure 4. Number of articles by universities in EU Countries

The surprising observation in the university affiliation counts for EU countries is the absence of universities with a large number of articles, indicating a diffuse distribution of research efforts across various institutions. This can indicate that themes related to the digitalisation are not frequently chosen by researchers. The absence of universities with a substantial number of articles in this domain suggests that the digital gap may not be the primary focus of academic research within the European Union. This observation raises questions about

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

the level of attention and priority given to issues surrounding digital disparities in the academic community. The diffuse distribution of research across various institutions further emphasizes the need to encourage and promote more studies in this critical area to better understand and address the challenges posed by the digital divide in the European context.

Figure 5. illustrates the distribution of research articles across various universities in WB countries. The dataset includes the count of articles associated with each university, providing insights into the research output of academic institutions in the region. Notably, the University of Belgrade emerges as the leading contributor with 58 articles, followed by the University of Novi Sad with 35 articles. Other universities, such as the University of Sarajevo, the University of Montenegro, and the University of Prishtina, also make significant contributions, highlighting the diverse academic landscape in the Western Balkans.

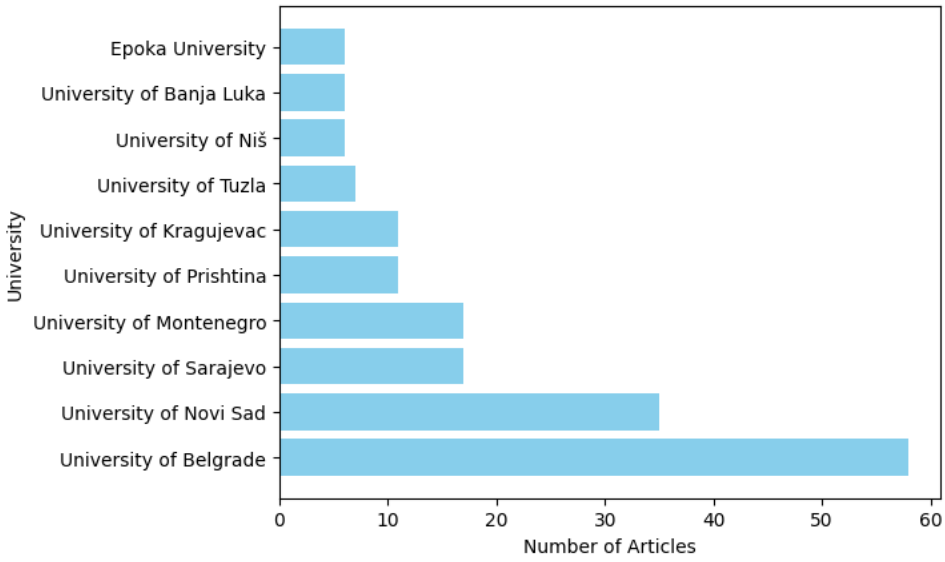


Figure 5. Number of articles by universities in Western Balkan Countries

The University of Belgrade and the University of Novi Sad, both situated in Serbia, stand out as significantly more productive in publishing scientific research compared to other universities in the Western Balkan region (as well as in the EU). This notable gap in productivity among Western Balkan universities underscores the need for fostering stronger research collaborations and networks within the region. Establishing more robust connections between scientists from leading institutions, such as the University of Belgrade and the University of Novi Sad, with researchers from less active universities could prove beneficial. Moreover, bridging the gap between Western Balkan institutions and those at the forefront of scientific advancements in the European Union could contribute to a more cohesive and collaborative research environment, ultimately addressing shared challenges and fostering academic excellence across the region.

4.4. Documents by source

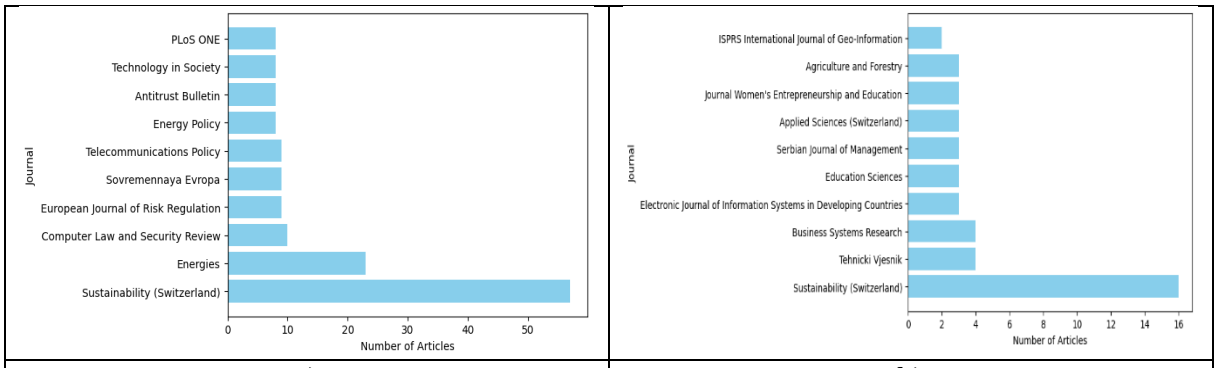
The top journals in the datasets for both the EU and the WB countries provide valuable insights into the research focus areas and publication patterns within these regions (see Figure 6). For the EU dataset, the most popular journal is "Sustainability (Switzerland)" with a substantial count of 57 articles. This suggests a prevalent emphasis on sustainability-related

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

topics within EU research. Other prominent journals include "Energies" and "Computer Law and Security Review," indicating a diverse range of research interests, spanning energy-related studies and legal aspects of computer security.

In the Western Balkan dataset, the journal "Sustainability" also takes the lead with 16 articles, showcasing a shared interest in sustainability research with the EU. "Tehnicki Vjesnik" and "Business Systems Research" hold multiple articles, indicating a focus on technical and business-related subjects. Notably, "Education Sciences" and "Serbian Journal of Management" contribute to the diversity of research topics within the WB dataset.



a) b)

Figure 6. Top 10 Most Popular Journals in a) EU and b) Western Balkan Datasets

A commonality between the two regions is the prominence of "Sustainability" reflecting a shared emphasis on sustainable development and environmental considerations. The popularity of the "Sustainability" journal could be attributed to several key factors. The journal's wide multidisciplinary scope allows researchers from various fields to publish their work, making it an attractive platform for a diverse range of studies. The open-access nature of the journal promotes accessibility, ensuring that research findings reach a broader audience. The journal's high impact factor indicates its influence and significance in the scientific community, further contributing to its popularity.

These important parameters play a crucial role in shaping the preferences of researchers and scholars when selecting journals for publication. The widespread adoption of "Sustainability" in both datasets suggests that researchers in the EU and WB value these characteristics, aligning with the journal's commitment to fostering impactful and accessible research in various scientific domains. Additionally, both datasets encompass a mix of journals covering diverse fields, ranging from technology and agriculture to law and education. These insights underscore the multidisciplinary nature of research in both the EU and the Western Balkans, highlighting the collaborative efforts and varied interests of researchers across different domains within these regions.

4.5. Keywords networks

Figure 7. shows the proportion of keywords related to sustainable development, adult education, and economic and social consequences in the European Union. The majority of keywords (37.7%) focus on the European Union, indicating extensive research on these topics in Europe. Other important keywords include “human” (11.0%), “humans” (7.2%), “digital storage” (7.1%), and “economic and social effects” (4.7%). These keywords reflect a growing

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

interest in the relationship between sustainable development and the economy and society in Europe.

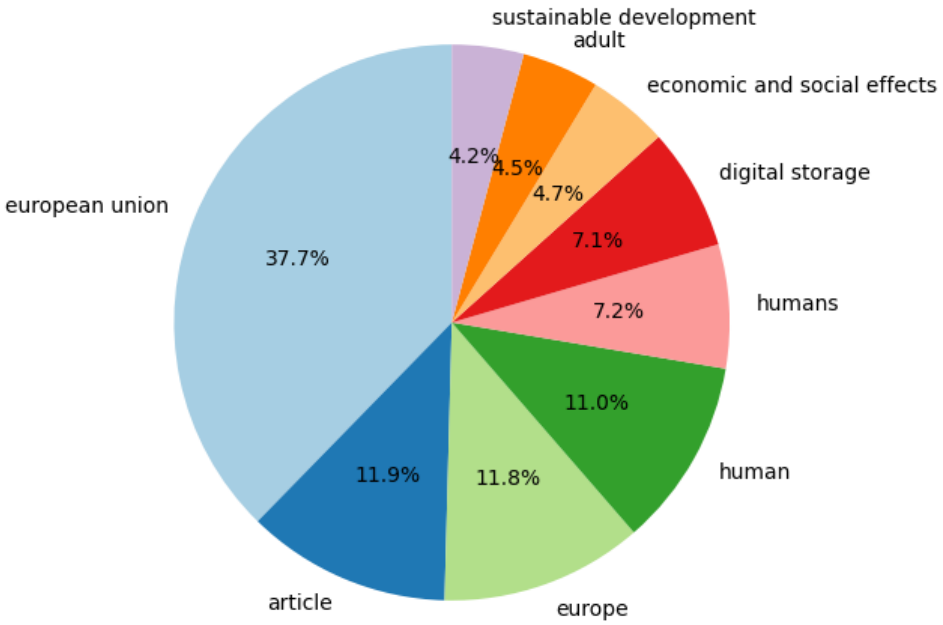


Figure 7. Keywords used in EU dataset

Figure 8. shows the percentage of different studies observed in Western Balkan countries. Serbia has the largest share (12.0%), indicating its leading role in the research domain. Bosnia and Herzegovina have the next largest share (5.3%), followed by Greece (4.8%), Kosovo (3.7%), and Albania (3.5%) showing that research is focused on topics and questions related mainly to the local regions. These countries are all involved in research but to a lesser extent than Serbia. The pie chart also indicates that the latest research in the Western Balkans is focusing on topics that include the word female (11.8%), and to a smaller extent the word male (10.2%).

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

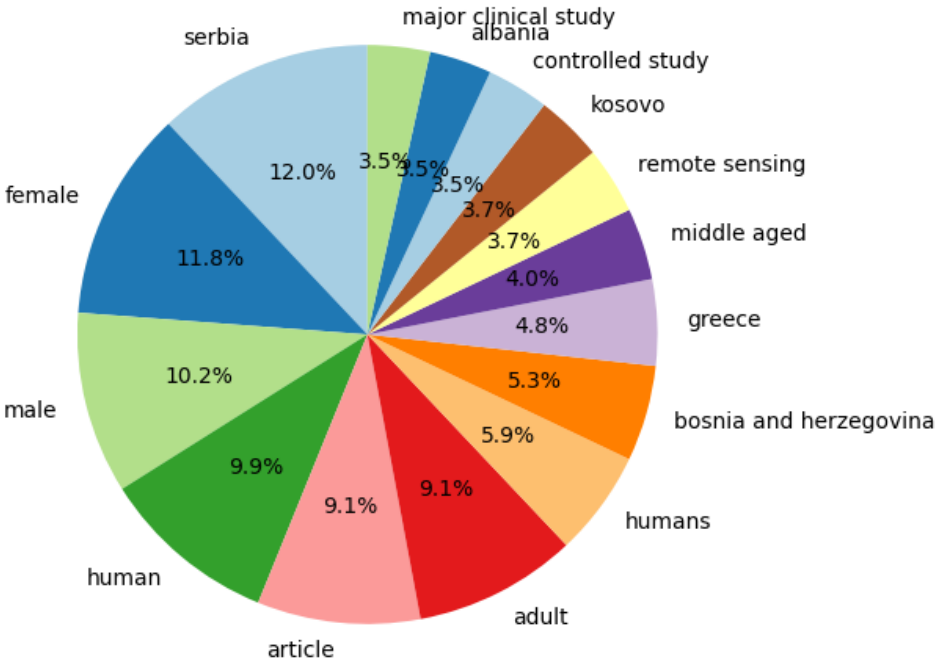


Figure 8. Keywords used in WB dataset

Figure 8 underscores the predominant research focus of WB countries on societal inquiries, with a particular emphasis on the electronic domain, including remote sensing. The pronounced concentration on countries within the region, such as Serbia, Bosnia and Herzegovina, and Albania, emphasizes a localized approach to addressing societal challenges. The research also displays a gender-diverse nature, evident in the significant appearance of the words "female" and "male". This trend indicates an exploration of gender-specific roles and contributions within research domains in the Western Balkans. The research exhibits a focus on the middle-aged demographic, suggesting an orientation toward societal domains, given the typical engagement of this age group in the labour force. Further investigation into these trends could yield valuable insights into the intersectionality of gender, age, and research focus in the region.

Figure 9. shows that the most common keyword related to digital EU data is “digital storage” (41.7%). This implies that digital storage is a significant focus of research and discussion on digital EU data. Other notable keywords include “digitization” (12.3%), “digitalization” (8.6%), “digital transformation” (6.7%), “digital technologies” (5.5%), and “digital divide” (5.5%). These keywords suggest that there is a wide range of research on digital EU data, covering topics such as the economic and social impacts of digitalization, the development and use of digital technologies, and the storage and management of digital data.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

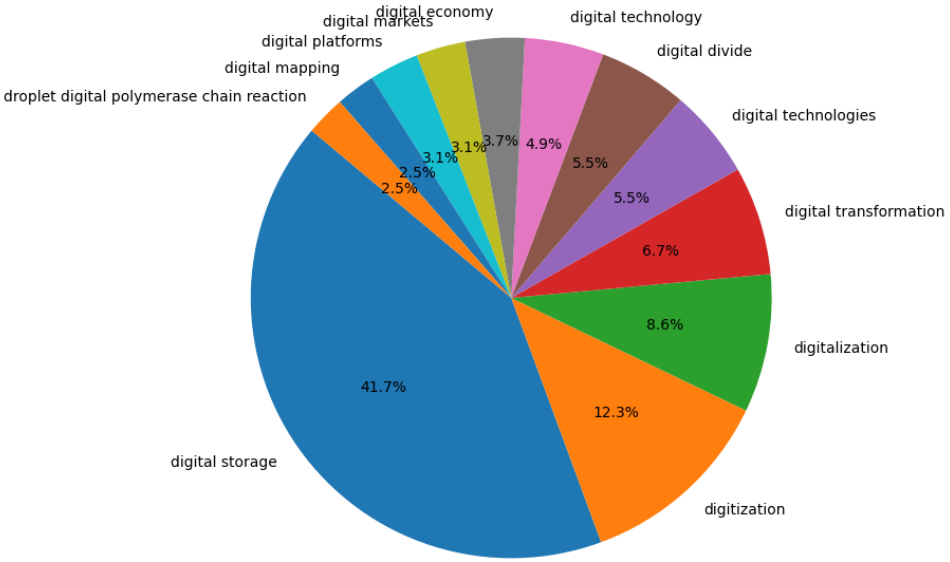


Figure 9. Keywords related to the digit in the EU dataset

Figure 10. illustrates the primary keyword associated with digital web data in Western Balkan countries as “digital storage” (22.2%), indicating the significant emphasis on the digital divide in research and discussion. Additional noteworthy keywords comprise “digital elevation model” (20.0%), “digital mapping” (8.9%), and “digitization” (6.7%), illustrating a wide range of topics encompassing the impact of the digital web on society, the utilization of digital technologies for marketing and business, and the storage and management of digital web data.

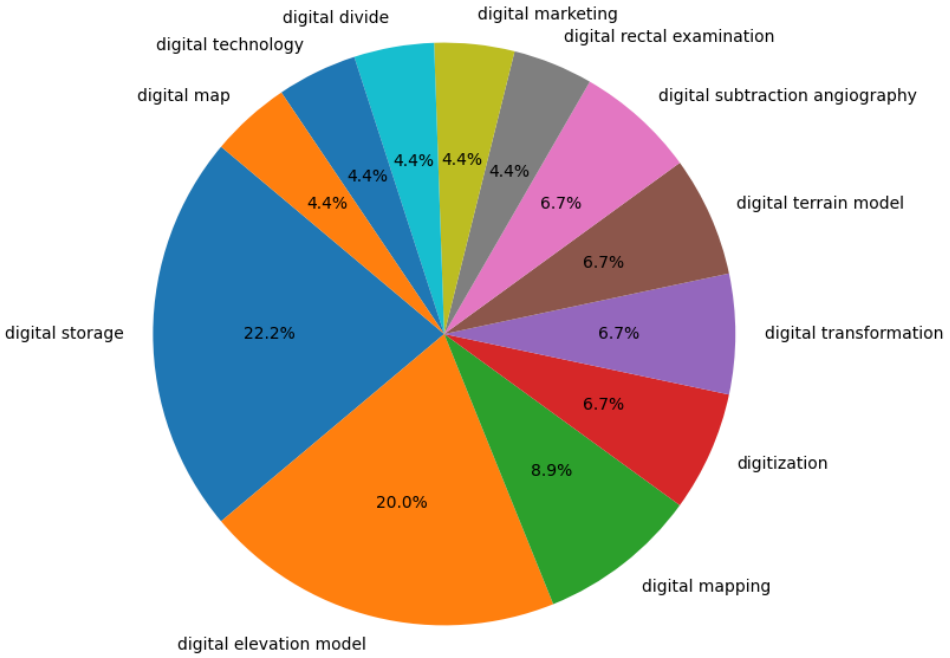


Figure 10. Keywords related to the digit in the WB dataset

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

Examining digital data-related keywords in the EU (Figure 9) and WB (Figure 10) reveals distinct areas of focus. In the EU, "digital storage" takes precedence (41.7%), emphasizing the significance of storage infrastructure in discussions around digital EU data. Additional keywords like "digitization", "digitalization", and "digital transformation" underscore the multifaceted nature of research, covering economic and social impacts, technological advancements, and data management. The WB region places a notable emphasis on the digital domain, particularly digital storage, which stands out as the primary keyword (22.2%). The research in WB countries exhibits a well-distributed focus, with almost equal percentages dedicated to themes such as the "digital elevation model". This signifies a balanced exploration of societal impact, business applications, and data management within the digital web domain.

In comparison, the EU demonstrates a distinct research landscape, with almost half of the research dedicated to "digital storage" and "digitization". The higher percentage allocated to digital storage in the EU suggests a heightened focus on data management, while the emphasis on digitization indicates a comprehensive exploration of the broader societal and economic impacts of digital technologies. These observations underscore the different research priorities in the EU and WB regions, with both regions exploring the multifaceted dimensions of the digital landscape while allocating emphasis differently across specific themes.

The final datasets for the EU and WB regions, obtained through the application of the PRISMA selection methodology, were subjected to in-depth analysis using Visualization of Similarities Viewer (VOSviewer) software. VOSviewer is a tool used for creating and visualizing bibliometric overlays, which are graphical representations of the relationships between items, such as documents, authors, or keywords. In the ensuing visualizations, each node's size corresponds to its frequency of occurrence within the datasets. The connecting curves between nodes denote their co-occurrence in the same publication. The proximity of nodes on the plot reflects the strength of the co-occurrence relationship, with shorter distances indicating a higher frequency of shared occurrence between two keywords. This approach provides a comprehensive and visually interpretable representation of the relationships and patterns within the selected datasets, highlighting the significant themes and interconnections present in the research landscape of the EU and WB regions.

The conclusive datasets, comprising 277 rows for the WB and 1119 rows for the EU, underwent thorough analysis using VOSviewer, employing the entire spectrum of keywords as defined by the authors. The analysis adhered to specific settings tailored for each region. In the EU dataset, a minimum keyword occurrence threshold of 5 was set, resulting in 118 keywords meeting the established criterion out of a total of 3880 keywords. On the other hand, the WB dataset employed a minimum keyword occurrence threshold of 3, leading to 50 keywords meeting the threshold out of the initial 1116 keywords. Four keywords were identified as disconnected and subsequently eliminated from the analysis, leaving a total of 46 connected keywords for further exploration in the research landscape of the Western Balkans. These carefully chosen thresholds ensure a focused and meaningful exploration of the keyword co-occurrence patterns within the datasets.

As shown in Figure 11., in the EU-related dataset, a total of 118 keywords have been categorized into 8 clusters, with the largest cluster comprising 19 keywords. This prominent cluster is centered around key themes such as digital economy, digital transformation, digitalization, sustainable development, economic growth, and innovation. The cohesiveness of these keywords within a substantial cluster suggests a significant focus on the intersection of

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

digital technologies, economic advancements, and sustainable development in the research landscape.

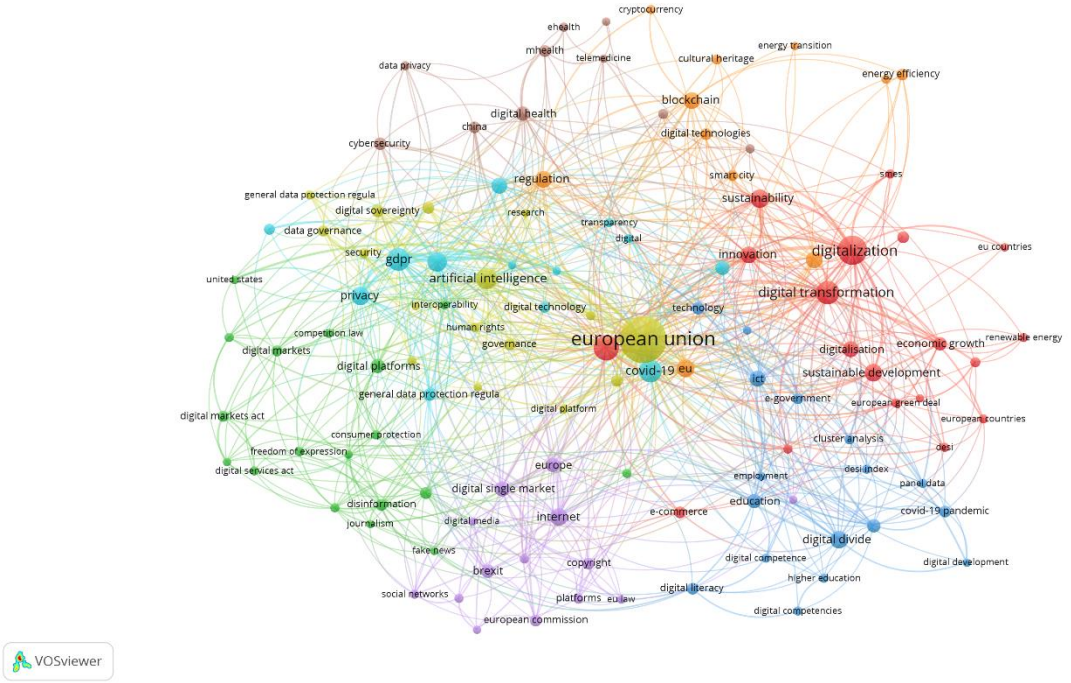


Figure 11. Co-occurrence of keywords in EU dataset publications

The exploration of digitalization within the European Union is multifaceted, involving synergies with various critical domains. In this analysis, digitalization is intricately linked with key areas such as the digital divide, artificial intelligence, blockchain, the impact of COVID-19, education, and the single digital market. The examination extends to include the DESI index in conjunction with aspects like digital skills, e-commerce, and economic growth. Furthermore, the study delves into the digital divide, with a specific focus on dimensions such as digital literacy, digital competence, social media, internet accessibility, and e-government. This comprehensive approach underscores the interconnected nature of digitalization, considering both its broad implications and specific facets within the European context.

Within the WB dataset, comprising 46 keywords, the identified terms are categorized into 7 clusters based on their interconnections, as is shown in Figure 12. The largest cluster, encompassing 12 items, revolves around the term COVID-19 and prominently explores topics related to education and learning. This cluster includes keywords such as students, teachers, education, online learning, media, digital skills, media literacy, as well as the term Serbia. Similarly, clusters associated with the terms Montenegro and Albania delve into comparable themes, incorporating elements like pandemic, skills, and innovation. Another cluster focuses on digitization within the context of business, entailing terms like sustainability, entrepreneurship, industry 4.0, and digital platforms. Digital technologies are further explored in the domain of e-education and the Internet. Notably, research in Bosnia and Herzegovina centres around GIS technologies, digital elevation models, and spatial distribution studies.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

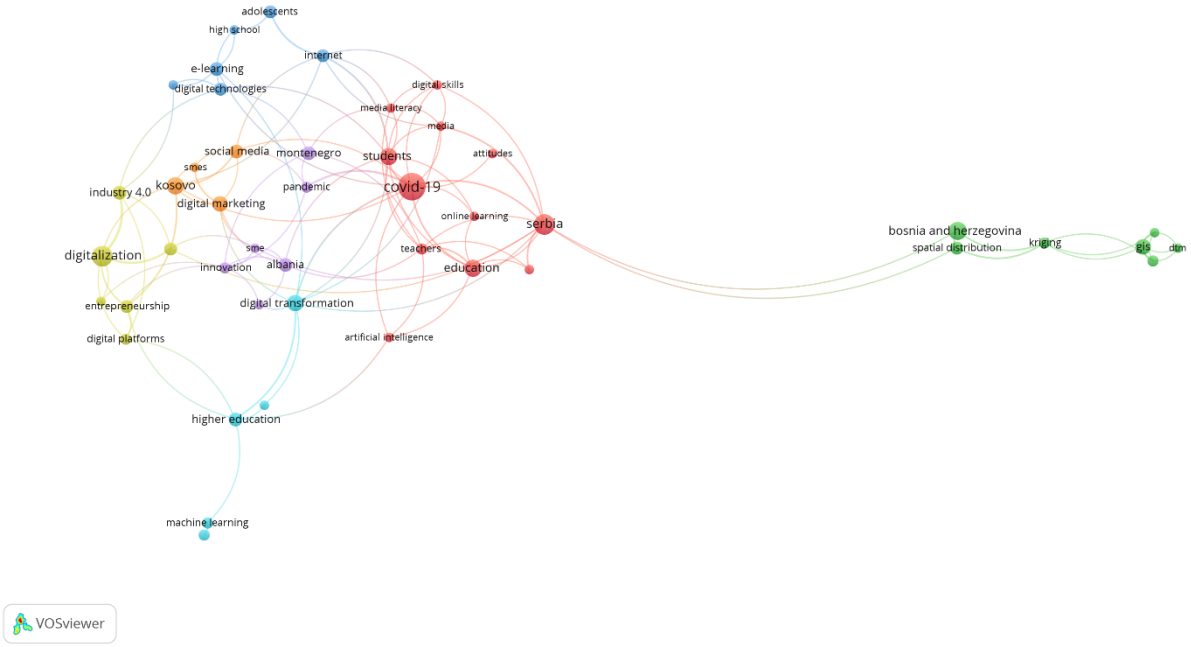


Figure 12. Co-occurrence of keywords in WB dataset publications

Examining Figure 12 provides a clear understanding that the WB region exhibits a significant emphasis on digitization in education, driven by the impact of the coronavirus pandemic and the shift to unconventional teaching methods. Moreover, there is a notable focus on studying digitization in the domain of business, reflecting regional aspirations for the modernization of business processes and enhancement of economic infrastructure. While the WB region demonstrates relative cohesion in terms of research, there is evident stratification of topics at the level of individual countries within the region.

4.6. Overlay visualization

The overlay view in VOSviewer enriches the exploration of intricate networks by integrating supplementary information through color-coded nodes, fostering a more nuanced comprehension of the underlying data. The indicator denotes the current publications, transitioning from purple to yellow. Blue keywords signify an earlier appearance compared to yellow ones. The size of the circles corresponds to the frequency of keyword appearance, while the distance between circles reflects their correlation.

The network map (see Figure 13. and 14.) delineates trend topics based on keywords utilized between January 2018 and November 2023. Evolving away from the digital single market, copyright, higher education, fake news, and online platforms, recent studies in EU demonstrate a heightened focus on circular economy, digital sovereignty, internet governance, digital policy, strategic autonomy, and panel data (see Figure 13.).

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

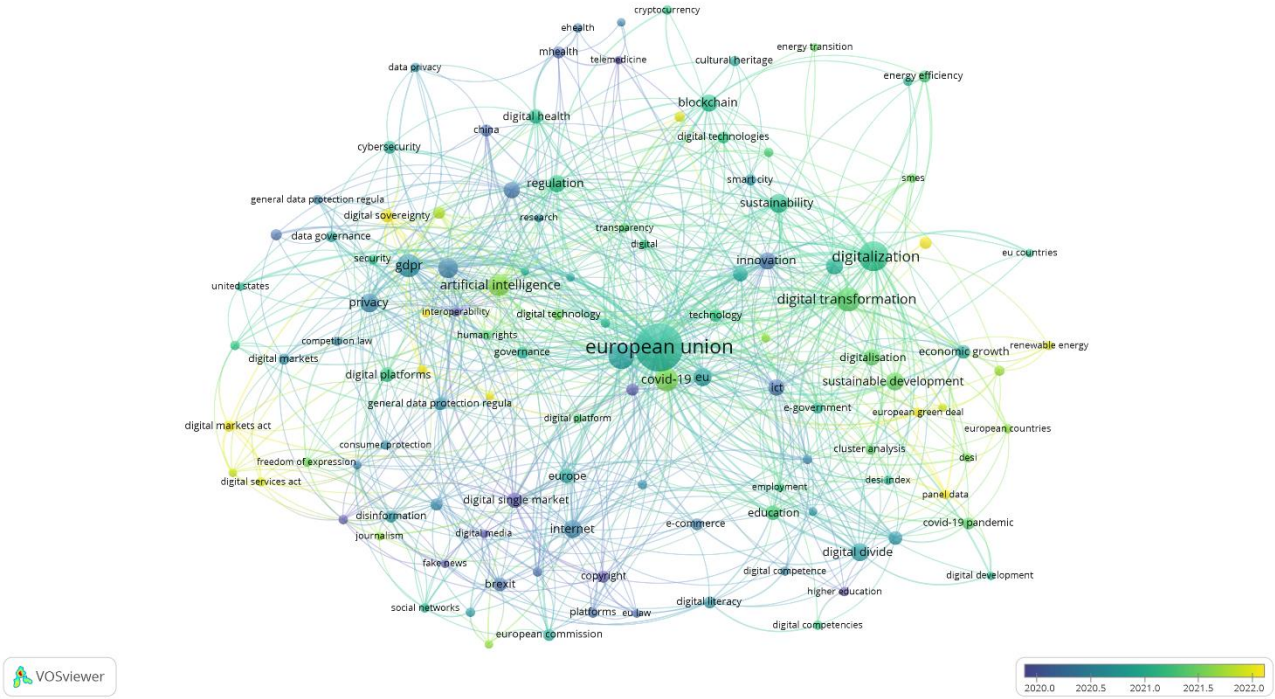


Figure 13. Network map of the trend topics according to the keywords in the EU dataset

As indicated in Figure 13., initially, during the period from 2018 to 2023 in WB countries, the research primarily centered around COVID-19. However, as time progressed, there was a shift in focus towards online learning, the pandemic, and media. In the most recent period, the research has prominently highlighted topics related to digital transformations, specifically in the digital marketing, e-learning, and higher education, as well as firm performance, particularly in the context of innovation and entrepreneurship.

These trends likely mirror the broader global context, where societies and economies are navigating the multifaceted impacts of technological advancements, public health challenges, and the evolving digital landscape. The observed shift in research focus in the EU and WB countries over the period considered can be attributed to dynamic changes in societal and technological landscapes. In the EU, the heightened attention to circular economy, digital sovereignty, internet governance, digital policy, strategic autonomy, and panel data suggests an adaptation to evolving priorities and challenges in the EU. In WB countries, the initial emphasis on COVID-19 reflects the immediate response to a global crisis. The subsequent shift towards online learning, the pandemic, and media suggests a continuous adaptation to changing circumstances and evolving research needs. The increased focus on digital transformations, encompassing digital marketing, e-learning, higher education, and firm performance, signals a recognition of the growing significance of digital technologies in shaping various aspects of the business landscape governed by national strategies influenced by the Smart Specialization Strategy (S3).

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

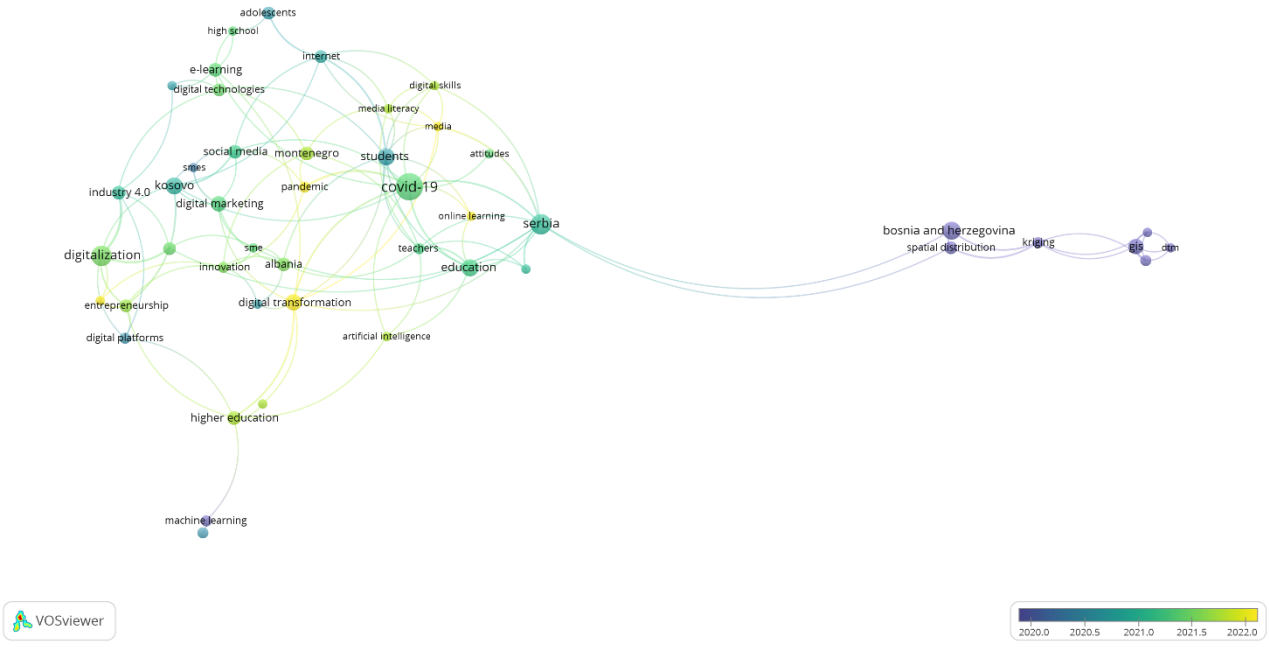


Figure 14. Network map of the trend topics according to the keywords in the WB dataset

4.7. Density visualization

VOSviewer's density visualization is a graphical representation that provides insights into the concentration and distribution of keywords or elements within a network. The density visualization assigns varying shades or colors to different regions of the network, indicating the level of density or interconnectedness. Higher density implies that keywords in a particular region are more interconnected, forming a cluster of related terms. Darker or more intense colors represent areas with higher density, while lighter or less intense colors indicate less interconnected regions. Density visualizations depicting the distribution of keywords in the analyzed EU and WB datasets are presented in Figures 15. and 16., respectively.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

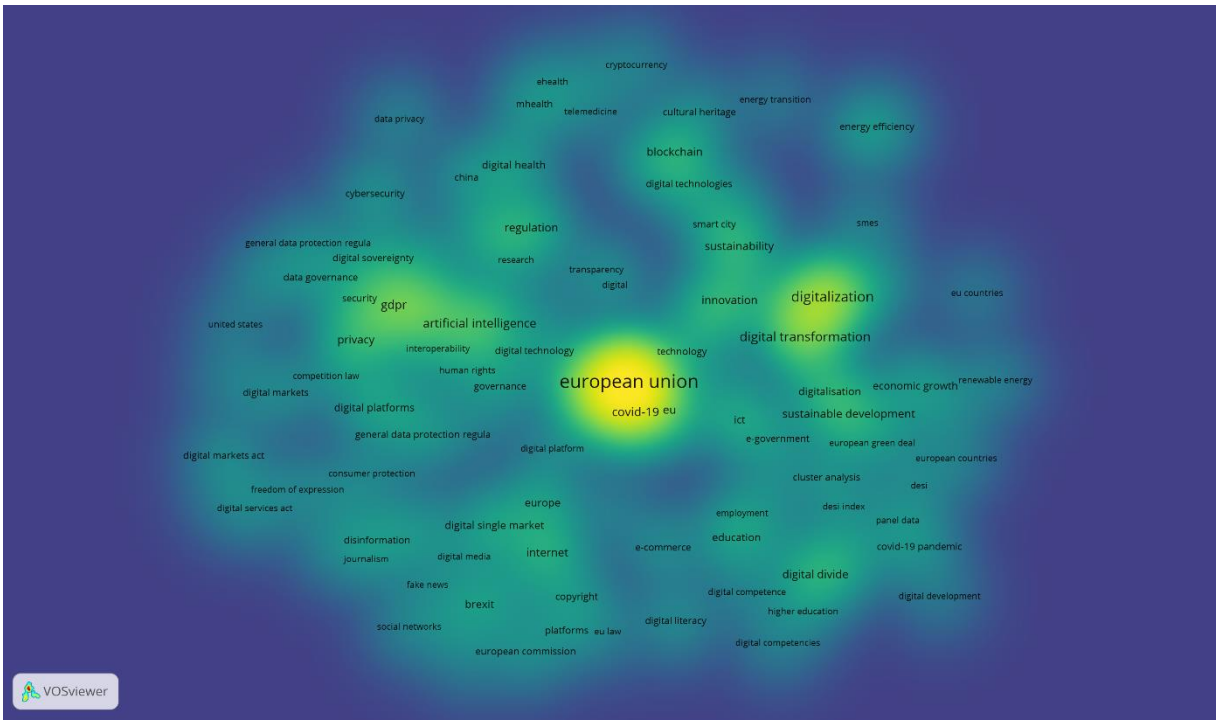


Figure 15. VOSviewer visualization of the keyword density in the EU dataset

Analyzing the density visualization of the EU dataset in VOSviewer reveals that key influencers shaping the clustering of the EU datasets primarily include "European Union" and "COVID-19," followed by "digitalization," "digital transformation," "GDPR," and "artificial intelligence." While other themes or elements may appear in the research, their involvement in forming patterns, trends, and relationships within the dataset is comparatively lesser.

In alignment with the EU dataset, the WB dataset exhibits a significant research emphasis on COVID-19-related themes, as can be viewed in Figure 16. Additionally, the research is concentrated in the domains of digitalization, digital marketing, digital transformation, and digital technologies. A noteworthy observation is the strong orientation of WB countries toward local or regional research topics, as evidenced by prominent keywords that include country names such as Serbia, Bosnia and Herzegovina, Albania, and Kosovo.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

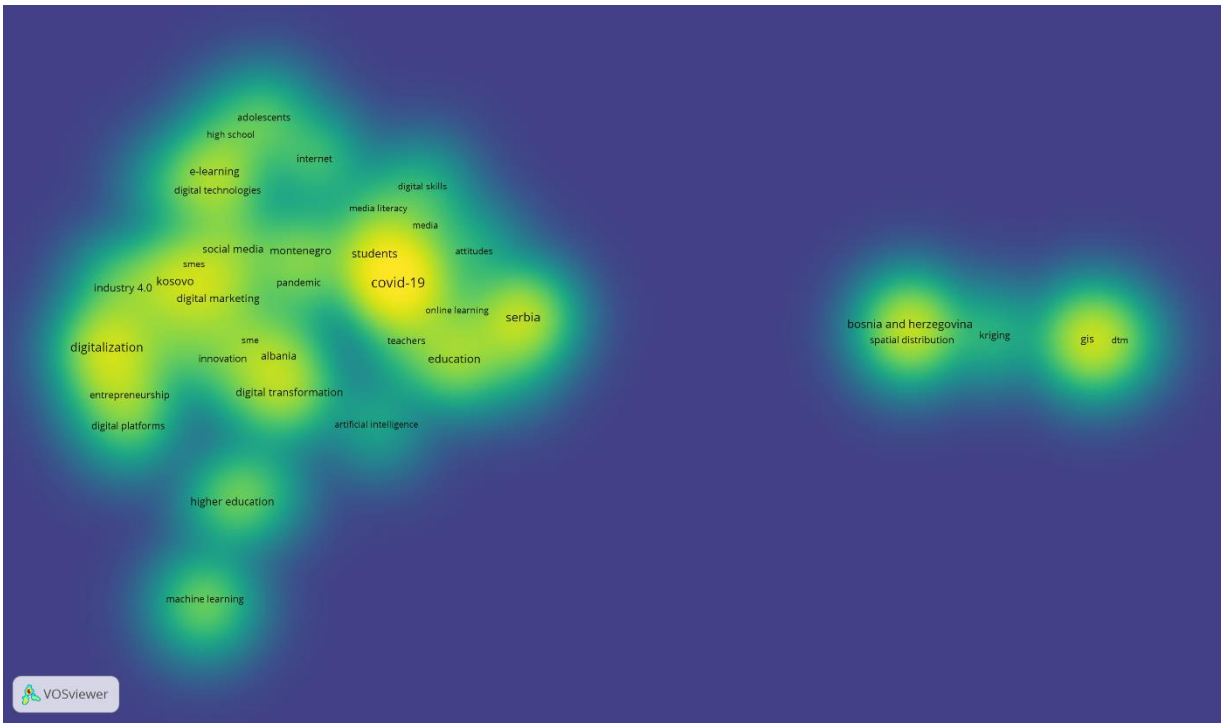


Figure 16. VOSviewer visualization of the keyword density in the WB dataset

This comparative examination suggests similarities in thematic concentrations between the EU and WB datasets, with COVID-19 and digital-related topics taking center stage in both regions.

5. Conclusions

Contribution

The primary focus of this study is to investigate the recent trends and research conducted on digitization over the past 5 years in both EU and WB countries. Our objective is to explore the nature of digitization efforts and understand the factors contributing to the digital gap, particularly in European countries. The study distinctively examines two geographical regions, the EU countries and the WB region, which includes non-EU countries. The significance of digitization as a widely discussed and transformative subject is acknowledged, influencing various facets of society, the economy, and daily life. The crucial step of data selection is approached meticulously, with Scopus chosen as the preferred database due to its extensive coverage of diverse journals. The review process adheres to the PRISMA guidelines, incorporating specific inclusion and exclusion criteria. Ultimately, a total of 1119 articles from EU countries and 277 from WB countries have been selected for comprehensive review and bibliometric analysis.

The analysis of publications from the years 2018-2023 indicates the growing interest of scientists in issues related to digitalization in the following years, both in the EU and the Western Balkan countries. Both data sets demonstrate the multidisciplinary nature of ongoing digitalization research, spanning fields ranging from technology and agriculture to law and education, highlighting the diverse interests of researchers across disciplines in both regions.

The analysis of the spatial distribution of publications show that the issue of digitalization is present in research carried out in EU countries characterized by different levels

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

of digitalization in the economy and society - the top ten countries with the highest publication rate include countries that are both EU leaders in the field of digitalization (the Netherlands), present a level above the EU average (Spain, France, Germany), as well as slightly below (Portugal, Belgium, Italy) and well below the EU average (Poland, Greece, Romania). The affiliation-based analysis provides valuable insights into the research output of universities, highlighting their diverse contributions and underlining the collaborative nature of the academic sector within the European Union. Both these phenomena should be assessed positively. Conclusions and recommendations from research in countries with different experiences in digital transformation and having different academic background can provide guidance on measures that can narrow digital disparities and help to achieve the 2030 goals assumed for the EU's Digital Decade.

In the Western Balkan countries, research on digitalization is conducted primarily by scientists from Serbia, affiliated most often with the University of Belgrade and the University of Novi Sad, who stand out as significantly more productive in publishing scientific research compared to scientists from other universities in the Western Balkan region. A noteworthy observation is the strong orientation of Western Balkan countries toward local or regional research topics, which means that digitalization issues are considered narrowly, without reference to the wider European context. This observation should encourage governments and institutions of Western Balkan countries to discover the reasons for the small presence of their scientists and universities among those publishing in the Scopus Database and taking actions to foster a robust research environment and to enhance research collaboration and networks across the Western Balkan region and with EU countries in order to increase scholarly contributions.

Our research underscores the different research priorities in the EU and WB regions, with both regions exploring the multifaceted dimensions of the digital landscape while allocating emphasis across specific themes. There is a visible focus in research done by EU scientists on the intersection of digital technologies, economic advancements and sustainable development. The exploration of digitalization within the European Union links it with various critical domains, covered by the EU's digital strategy. Greater attention to the circular economy, digital sovereignty, internet governance, digital policy, strategic autonomy and panel data suggests alignment with changing priorities and challenges in the EU. Research focusing directly on the digital divide places particular emphasis on aspects such as digital literacy, digital competence, education, social media, internet accessibility, and e-government, what indicated that all types of digital divide are studied, but with particular focus on the usage divide associated with digital literacy.

In turn, digitalization research in the Western Balkans region focuses on the term "COVID-19" and significantly explores topics related to education and learning. skills and innovations. They also explore digitalization in a business context, covering concepts such as sustainability, entrepreneurship, industry 4.0 and digital platforms, as well as examining digital technologies in the areas of e-learning and the Internet. The focus on Covid-19 reflects researchers' response to the global crisis, and the gradual shift towards topics related to online learning and media means constantly adapting to changing circumstances and changing research needs. Research directions including digital marketing, e-learning, higher education and company performance signal the recognition of the growing importance of digital technologies in shaping various aspects of the business landscape regulated by national strategies, including Smart Specialization Strategy (S3).

The analysis of publications on digitalization in the EU and Western Balkan countries shows a growing research landscape. The focus on the digital divide, policy implications, and

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

technological advancements reflects the multifaceted nature of digitalization. EU countries have more publications, but Western Balkan countries are improving. This study adds to the discourse on digitalization and provides a foundation for future research and policy considerations. The study has limitations, including potential bias in the chosen databases and search criteria, which should be acknowledged for a nuanced interpretation of the findings.

Limitations

This study provides bibliometric insights into a diverse range of research articles within the EU and WB regions, encompassing both broad research topics and those specifically focused on the digital domain. The data were sourced from the Scopus database. While the study aims for objectivity and comprehensiveness, it is not without limitations. Firstly, non-English articles, though valuable, may not be present in the Scopus database, potentially limiting the scope of the analysis. Bibliometric data are subject to change over time, and conclusions drawn in this study may evolve accordingly. Regular updates are recommended to maintain relevance. The nature of bibliometric analysis may not capture real-time situations, particularly regarding recently published articles that may not have accumulated substantial citations yet. Consequently, the analysis might not fully represent the unfolding trends and impact of such articles over time.

References

1. Aissaoui, N. (2021). The digital divide: a literature review and some directions for future research in light of COVID-19, *Global Knowledge*. Memory and Communication, DOI:10.1108/GKMC-06-2020-0075
2. Audretsch D.B., Lehmann E.E., Paleari S., Vismara S. (2016). Entrepreneurial finance and technology transfer, *Entrepreneurial finance and technology transfer*, *41*(1),1–9, https://doi.org/10.1007/ s10961-014-9381-8.
3. Borowiecki, R., Siuta-Tokarska, B., Maroń, J., Suder, M., Thier, A. Żmija, K. (2021). Developing Digital Economy and Society in the Light of the Issue of Digital Convergence of the Markets in the European Union Countries, *Energies, 14*, 2717. https://doi.org/10.3390/en14092717.
4. Bouwman H., Nikou S., de Reuver. M. (2019). Digitalization, business models, and SMEs: how do business model innovation practices improve performance of digitalizing SMEs? *Telecommunication Policy, 43*(9):101828. https://doi.org/10.1016/j.telpol.2019.101828
5. Brooks S., Donovan P., Rumble C. (2005). Developing nations, the digital divide and research databases, *Serials Review, 31*, 270–278.
6. Cilan A., Bolat B.A., Coskun E. (2009). Analyzing digital divide within and between member and candidate countries of European Union, *Government Information Quarterly, 26*, 98–105.
7. Cruz-Jesus F., Oliveira T., Bacao F. (2012). Digital divide across the European Union, *Information & Management, 4*, 278–291.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

8. De R., Pandey N., Pal A. (2020). Impact of digital surge during Covid-19 pandemic: a viewpoint on research and practice, *International Journal of Information Management, 55*, 102171.
9. Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030, Official Journal of the European Union, L 323/4.
10. Dethine B., Enjolras M., Monticolo D. (2020). Digitalization and SMEs' export management: impacts on resources and capabilities, *Technology Innovation Management Review, 10*(4):18–34. https://doi.org/10.2221/timreview/1344
11. Ershova T.V., Hohlov Y.E., Shaposhnik S.B. (2018). Methodology for digital economy development assessment as a tool for managing the digital transformation processes, Eleventh International Conference" Management of Large-Scale System Development"(MLSD. 2018. IEEE).
12. European Commission. (2010). Communication from the European Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions setting out A Digital Agenda for Europe, COM (2010) 245 final/2.
13. European Commission. (2020). Shaping Europe's digital future, *Luxembourg:* Publications Office of the European Union.
14. European Commission. (2021). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, 2030 Digital Compass: the European way for the Digital Decade, COM/2021/118 final.
15. European Commission. (2023), 2030 Digital Decade. Report on the state of the Digital Decade 2023, https://digital-strategy.ec.europa.eu/en/library/2023-report-state-digital-decade [accessed: 27.11.2023].
16. Fröhlich, E., Steinbiß, K. (2020). Supplier Relationship Management Goes Digital: First Empirical Insights. *Universal Journal of Management,* 8, 63-73. 10.13189/ujm.2020.080303.
17. Galindo-Martín M.-Á., Castaño-Martinez M.-S., Méndez-Picazo M.-T. (2019). Digital transformation, digital dividends and entrepreneurship: a quantitative analysis, *Journal of Business Research, 101,* 522-527, 10.1016/j.jbusres.2018.12.014.
18. Gobble, M. (2018). Digitalization, digitization, and innovation, *Research-Technology Management*, 61(4), 56–59.
19. Hidalgo, A., Gabaly, S., Morales-Alonso, G., Urue˜na, A. (2020). The digital divide in light of sustainable development: an approach through advanced machine learning techniques, *Technological Forecasting and Social Change, 150*, 119754.
20. https://www.consilium.europa.eu/pl/policies/a-digital-future-for-europe/ [accessed: 27.11.2023]
21. https://www.europarl.europa.eu/factsheets/en/sheet/64/digital-agenda-for-europe [accessed: 27.11.2023]

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

22. Jamil S. (2020). Ethnic news media in the digital age: The impact of technological convergence in reshaping journalists' practices in Pakistan, *Journal of Multicultural Discourses, 15* (2), 219-239, https://doi/abs/10.1080/17447143.2020.17563.
23. Jamil S. (2021). From digital divide to digital inclusion: challenges for wide-ranging digitalization in Pakistan, *Telecommunication Policy, 45*(8):102206. https://doi.org/10.1016/j.telpol.2021.102206.
24. Karlsson Ch., Maier G., Trippl M., Siedschlag I., Owen R., Murphy G. (2008). ICT diffusion, innovation systems, globalisation and regional economic dynamics: Theory and empirical evidence, ESRI Working Paper, 233, *The Economic and Social Research Institute (ESRI)*: Dublin.
25. Kovač, N. (2023). WB-bibliometric analysis. https://doi.org/10.5281/zenodo.10223064
26. Laitsou E., Kargas A., Varoutas D. (2020). Digital Competitiveness in the European Union Era: The Greek Case, *Economies, 8,* 85. https://doi.org/10.3390/economies8040085
27. Manduna, W. (2016). Empirical study of digital poverty: a case study of a University of Technology in South Africa, *Journal of Communication, 7*(2):317-323.
28. Myovella G., Karacuka M., Haucap J. (2020). Digitalization and economic growth: a comparative analysis of Sub-Saharan Africa and OECD economies, *Telecommunication Policy, 44*(2): 101856, https://doi.org/10.1016/j.telpol. 2019.101856
29. Nambisan S. (2017). Digital entrepreneurship: toward a digital technology perspective of entrepreneurship, *Entrepreneurship Theory and Practice, 41*(6) (2017), pp. 1029-1055, 10.1111/etap.12254.
30. OECD. (2001). *Understanding the digital divide*, OECD Digital Economy Papers, No. 49, OECD Publishing, Paris.
31. OECD. (2019). Measuring the Digital Transformation: A Roadmap for the Future, *OECD Publishing:* Paris, https://doi.org/10.1787/9789264311992-en [accessed: 27.11.2023]
32. Oloyede A.A., Faruk N., Noma N., Tebepah E., Nwaulune A.K. (2023). Measuring the impact of the digital economy in developing countries: A systematic review and meta-analysis, *Heliyon, 9* (7), e17654, https://doi.org/10.1016/j.heliyon.2023.e17654.
33. Ragnedda, M. (2017). The Third Digital Divide: A Weberian Approach to Digital Inequalities, *Abingdon:* Routledge.
34. Regulation (EU) 2021/694 of the European Parliament and of the VCouncil of 29 April 2021 establishing the Digital Europe Programme and repealing Decision (EU) 2015/2240, Official Journal of the European Union, L 166/1.
35. Reis, J., Amorim, M., Melão, N., Cohen, Y., Rodrigues, M. (2020). Digitalization: A Literature Review and Research Agenda. In: Anisic, Z., Lalic, B., Gracanin, D. (eds) Proceedings on 25th International Joint Conference on Industrial Engineering and Operations Management – IJCIEOM. IJCIEOM 2019. Lecture Notes on Multidisciplinary Industrial Engineering. Springer, Cham. https://doi.org/10.1007/978-3-030-43616-2_47.
36. Rogers, S.E. (2016). Bridging the 21st century digital divide, *TechTrends, 60*(3), 197–199.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.

37. Sandulescu Budea A.M. (2021). An approximation in the study of communication research: Digital evolution and the study of this subject in spanish academic journals. In: Improving University Reputation through Academic Digital Branding; Del Pino, A.D., Romero, N.L. (Eds.), *IGI Global:* Hershey, PA, USA.
38. Selwyn N., Facer K. (2007). Beyond the digital divide: rethinking digital inclusion for the 21st century, *Futurelab*.
39. Servoz M. (2019). AI. The Future of Work? Work of the Future! On How Artificial Intelligence, Robotics and Automation Are Transforming Jobs and the Economy in Europe, *European Commission:* Brussels, Belgium.
40. Setthasuravich, P., Kato, H. (2020). The mediating role of the digital divide in outcomes of short-term transportation policy in Thailand, *Transport Policy, 97*, 161–171.
41. Stankovic J., Marjanovic J., Drezgic S., Popovic Z. (2021). The Digital Competitiveness of European Countries: A Multiple-Criteria Approach, *Journal of Competitiveness, 13*(2), s. 117–134, DOI:10.7441/joc.2021.02.07.
42. UN. (2021). Digital technologies for a new future, https://www.cepal.org/sites/default/files/publication/files/46817/S2000960_en.pdf [accessed: 28.11.2023].
43. Urbaniec M., Żmija D. (2022). Flexible Forms of Employment in the Age of Digital Transformation, [in:] Industrial Revolution 4.0: Economic Foundations and Practical Implications, Mazur S. (ed.), *New York:* Routledge, 2022.
44. Valenduc, G., Vendramin, P. (2017). Digitalisation, between disruption and evolution, *Transfer: European Review of Labour and Research*, *23*(2), 121–134.
45. Van Dijk, J.A. (2020). The Digital Divide, *Polity Press:* Cambridge
46. Van Dijk, J., Hacker, K. (2003). The digital divide as a complex and dynamic phenomenon, *The Information Society*, *19* (4), 315–326.
47. Vassilakopoulou, P., Hustad, E. (2021). Bridging digital divides: a literature review and research agenda for information systems research, *Information Systems Frontiers*, *25*, 955–969.
48. Venkatesh, V., Sykes, T.A., Venkatraman, S. (2014). Understanding e-Government portal use in rural India: role of demographic and personality characteristics, *Information Systems Journal*, *24* (3), 249–269.
49. Vicente M.R., Gil-de-Bernabe´ F. (2010). Assessing the broadband gap: from the penetration divide to the quality divide, *Technological Forecasting and Social Change 77*, 816–822.
50. Vicente M.R., Lopez A.J. (2010). A multidimensional analysis of the disability digital divide: some evidence for internet use, *The Information Society: An International Journal*, *26*, 48–64.
51. Wu H.X., Yu C. (2022). The impact of the digital economy on China's economic growth and productivity performance, *China Economic Journal, 15* (2), 153-170
52. Zhang J., Zhao W., Cheng B., Li A., Wang Y., Yang N., Tian Y. (2022). The Impact of Digital Economy on the Economic Growth and the Development Strategies in the post-COVID-19 Era: Evidence from Countries Along the "Belt and Road", *Front. Public Health 10*:856142. doi: 10.3389/fpubh.2022.856142.

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or European Research Executive Agency. Neither the European Union nor the granting authority can be held responsible for them.