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Exploring the Landscape of Digital Divide Research : A bibliometric analysis of scientific productivity

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ABSTRACT :

This study investigates digital divide research output from 2000 to 2023, analyzing qualitative and quantitative literature growth using bibliometric measures. It aims to identify document types, annual growth rates, country productivity, collaborative citation networks, authorship patterns, and top authors Data for this research was gathered from the Web of Science database by conducting a search using the term "Digital Divide" spanning from 2000 to 2023.. This search yielded a total of 1,295 publications. These publications were then meticulously filtered to align with the study's specific objectives and to facilitate a detailed facet-wise analysis. The filtered data were subsequently analyzed using a combination of advanced bibliometric software tools, including VOSviewer, Biblioshiny, and CRExplorer. These methods were used to extensively analyze different facets of the gathered data, offering a complete comprehension of the research trends, primary topics, and collaborative trends concerning the digital divide during the specified period.The analysis of digital divide literature spanning from 2000 to 2023 reveals significant trends across various dimensions. Document types primarily consist of articles, accounting for 60.3% of the total, with notable variations including book reviews and editorial materials. The yearly growth depicts a gradual increase, with a substantial surge observed in 2020 and 2021, followed by a peak in 2023, suggesting heightened scholarly engagement. Top journals such as "New Media & Society" and "Journal of Medical Internet Research" significantly contribute to the discourse, showcasing substantial citations and impact. Productive authors like James J and Oliveira T demonstrate significant contributions, with varying degrees of impact.. The predominant use of English underscores international collaboration, despite contributions in other languages. Gender disparities persist, with male authors dominating the literature.

Introduction

Information and Communication Technology (ICT) holds significant potential to enhance the overall quality of life for individuals across the globe. Its pervasive influence has become deeply ingrained in various facets of society, yet the persistent issue of the digital divide continues to impede effective participation for those with limited or no access to ICT resources. This gap, as highlighted by Cruz-Jesus, Vicente, Bacao, and Oliveira (2016), represents a crucial barrier preventing certain segments of society from fully engaging in social, political, and economic spheres. In recent years, the rapid evolution of digital technologies has presented remarkable opportunities for innovation and advancement, as noted by Nishijima, Ivanauskas, and Sarti (2017). These developments have promoted broader inclusiveness and engagement among individuals, enhancing their participation across various aspects of society. This is especially relevant for developing nations, where information and communication technology (ICT) is increasingly acknowledged as a tool for advancing the Sustainable Development Goals (SDGs) set forth by the United Nations (UN, 2015). the role of technology in fostering progress cannot be overstated. However, despite the strides made in technological development, the digital divide persists, as elucidated by Wardhani, Dugis, and Saad (2018). This gap, as described by Rogers (2016), represents a critical issue of social justice in the modern era. Despite the rapid pace of technological advancement, significant disparities in access to ICT resources persist, further exacerbating existing inequalities.

Efforts to address the digital divide necessitate focused actions aimed at reducing the disparity between individuals with sufficient access to ICT resources and those without. As technology advances swiftly, it remains crucial to prioritize initiatives that mitigate this gap. Wardhani et al. (2018) underscore the importance of incorporating ICT education into strategic initiatives to optimize the potential benefits of these technologies, enabling universal participation in the digital era.

The digital divide refers to a notable discrepancy among different groups in terms of how information and communication resources are distributed and effectively utilized. Our rapidly changing world, characterized by the emergence of the ubiquitous Society, brings forth remarkable benefits and opportunities alongside new challenges. The capacity to generate and employ information holds substantial sway over the socio-economic fabric of our lives. However, this progress is marred by a profound digital gap between developed and developing nations, posing a serious challenge to global ICT advancement. The digital gap has a disproportionate impact on numerous developing countries, involving challenges such as insufficient financial support, lack of necessary computer and internet skills, and limited proficiency in the English language. These factors collectively hinder the growth and effective utilization of digital information resources (Dubey, 2010). Factors contributing to the digital divide differ across regions, amplifying discrepancies in the utilization of communication resources among countries and regions. Broadly speaking, the digital divide refers to inequalities among individuals, households, businesses, and geographical areas across various socio-economic levels regarding their access to ICTs and internet usage for various purposes. As the internet increasingly permeates nearly all facets of the global economy, the concept of the "digital divide" primarily concerns internet accessibility, exacerbating core economic and social inequalities both globally and domestically. This divide, as highlighted by Singh

(2012), not only threatens to widen existing inequalities but also perpetuates and reinforces socio-economic divides on a global scale.

Drawing upon various definitions that describe the digital divide, a comprehensive and all-encompassing definition is provided by Gourova in a report for the Digital Opportunity Initiative, prepared on behalf of the Joint Research Centre of the European Commission. Gourova defines the digital divide as the gap between countries and individuals who can afford and benefit from technology and those who cannot. It encompasses disparities between businesses and consumers in accessing the advantages of the Information Age, particularly affecting disadvantaged groups such as the poor, illiterate, rural residents, and non-English speakers (Gourova et al., 2001, p. 8).Manuel Castells (2001) offers a concise definition, describing the digital divide as simply the "inequality of access to the Internet." This definition focuses on the basic issue of accessibility. Pippa Norris identifies three types of digital divides: global, social, and democratic. The global digital divide refers to the gap in Internet access between developed and developing nations, emphasizing its international dimension. The social digital divide concerns disparities within countries between those who have access to information and those who do not, highlighting inequalities within societies. Lastly, the democratic digital divide addresses differences in using digital tools for civic engagement and participation in public life, emphasizing the role of technology in democratic processes (Norris, 2001, p. 4).

The diverse viewpoints on the digital divide demonstrate its complex nature, spanning economic, social, and political dimensions. Gourova, Castells, and Norris offer definitions that collectively emphasize the depth and breadth of this divide, underscoring the need to bridge it to achieve fair access to technology and information for all, regardless of geographic location or social background.

The term "digital divide" rose to prominence not so much for its precise definition but for its catchy sound. It broadly suggests that developing nations lag behind wealthy ones in utilizing information and communication technologies (ICTs), which could impede their future development prospects. However, academic discussions reveal at least four distinct interpretations of the digital divide: disparities in the effects of ICT use, actual levels of ICT usage, the capability to utilize ICTs, and access to these technologies. Generally, the term "digital divide" primarily refers to discrepancies in ICT access among nations (Fink and Kenny, 2003). The concept emerged in the 1990s and has since garnered significant attention. Contemporary studies often narrow down the definition of "digital" to focus predominantly on internet technologies and devices, despite the broader spectrum of ICT technologies, which encompass digital communication tools like landline phones, computers, the internet, and mobile devices. The understanding of "divide" and the concept of the "digital divide" itself continue to evolve alongside advancements in information technology and communication methods (Lu et al., 2023).

Literature Review

Over the past two decades, substantial scholarly effort has been devoted to exploring the concept of digital divides, with researchers presenting a wide range of perspectives. Recently, Barik (2023) conducted a comprehensive analysis using the Web of Science database to study research output on the "digital divide" from 2001 to 2020. This study identified a total of 5,518 publications on the digital divide, authored by 14,277 individuals from 130 countries and published across 2,843 different sources. The findings indicated a significant annual growth rate of 38.43% in publications addressing this topic worldwide.

Lythreatis et al. (2022) reviewed 50 studies conducted between 2017 and 2021, proposing that categorizing the digital divide into access, capability, and outcome dimensions offers a more coherent framework for understanding the phenomenon. Similarly, Mubarak et al. (2020) conducted statistical analyses across 191 nations, revealing correlations between income, education levels, and ICT adoption, highlighting poverty as a major driver of the global digital divide.

Van Deursen and Helsper (2015) emphasized the critical role of education, technical skills, and self-confidence in shaping the skills divide among internet users, focusing on these factors over age. Notten et al. (2009) adopted a hierarchical approach to examine usage patterns and social disparities in accessing and utilizing digital information. Other scholars, including Dodel (2014), Wei et al. (2011), Selwyn (2010), and DiMaggio and Hargittai (2001), expanded the digital divide paradigm to encompass the interaction between access, usage, and the appropriation of technologies, considering their implications for individual outcomes.

Tsatsou (2011) provided a comprehensive exploration of sociocultural dynamics influencing technological innovations, particularly examining the intersection of ICTs, sociocultural factors, and decision-making processes. Coria et al. (2013) conducted an in-depth analysis of internet penetration in households and its usage among scholars, government officials, and business leaders, uncovering notable trends across different social strata. Bach et al. (2013) meticulously reviewed papers indexed in the Social Sciences Citation Index (SSCI) pertaining to the digital divide, revealing key dimensions such as the ICT adoption cycle, inequality determinants, and various facets of the divide.

Swain and Pearson (2002) underscored the need for rigorous research and improved technology standards to narrow the digital gap in US schools. Antonio and Tuffley (2014) contributed insights into gender disparities in ICT usage, aiming to mitigate the digital divide. Abdelfattah et al. (2010) and Alam and Imran (2015) investigated factors contributing to the divide, including disparities between digitally disadvantaged individuals and prolific internet users, as well as migrants' adoption of digital technologies.

Dolan (2016) highlighted the complexities of the digital divide, particularly concerning unequal utilization of information technology among K-12 students. Scholars such as Ginossar and Nelson (2010), Miller and Shrum (2011), Zhang (2013), Dahlberg (2015), Blank (2016), and Luo and Chea (2018) delved into various aspects of the digital divide, including media technologies, social media usage, and innovative technological models.

Ziemba and Becker (2019) explored levels of ICT access and technological disparities contributing to the digital divide in Western Europe. Bucea et al. (2020) addressed different dimensions of e-services and social networks in European contexts, highlighting specific challenges and opportunities. Gibson (2020) examined diverse aspects of the digital divide through the lens of WhatsApp, presenting insights from young people on instant messaging, social networking, and barriers to ICT access.

Anand et al. (2021) used bibliometric methods to analyze trends and patterns in sustainable entrepreneurship research, identifying focal areas and gaps in the field. Vassilakopoulou and Hustad (2021) argued for the critical need to bridge the digital divide for sustainable modern societies, exploring various models of digital inequalities and emerging variables.

Finally, Inegbedion (2021) investigated the potential convergence of the digital divide across major world regions, noting higher growth rates in

internet usage in some digitally disadvantaged areas attributed to increased smartphone access and the advent of 5G technology, illustrating the evolving landscape of digital inclusion.

Objectives

The objectives of this study encompass the following:

- Analysis of the range of publications addressing the digital divide.
- Assessment of the yearly increase in global literature on the digital divide from 2000 to 2023.
- Identification of the countries making the most significant contributions to the literature on the digital divide.
- Exploration of prolific authors, influential journals, authorship patterns, and gender distribution within publications on the digital divide.
- Visualization and mapping of the intellectual structure through co -authorship networks and citation networks.

Methodology of the study

The study employed a meticulous search strategy to ensure comprehensive coverage of the digital divide topic, emphasizing precision and recall. Researchers opted for the "AND" search operator over "OR" to encompass all relevant documents without excluding significant ones. This approach was executed through the advanced search feature of the Web of Science database, specifying search terms and restricting the timeframe from 2000 to 2023. As a result, 1,295 records meeting the inclusion criteria were identified as highly relevant, forming the foundation for the study's data analysis and interpretation.

TITLE-TOPIC-KEY (“Digital Divide” AND “Digital Divide”) AND PUBYEAR > 2000 AND PUBYEAR < 2023

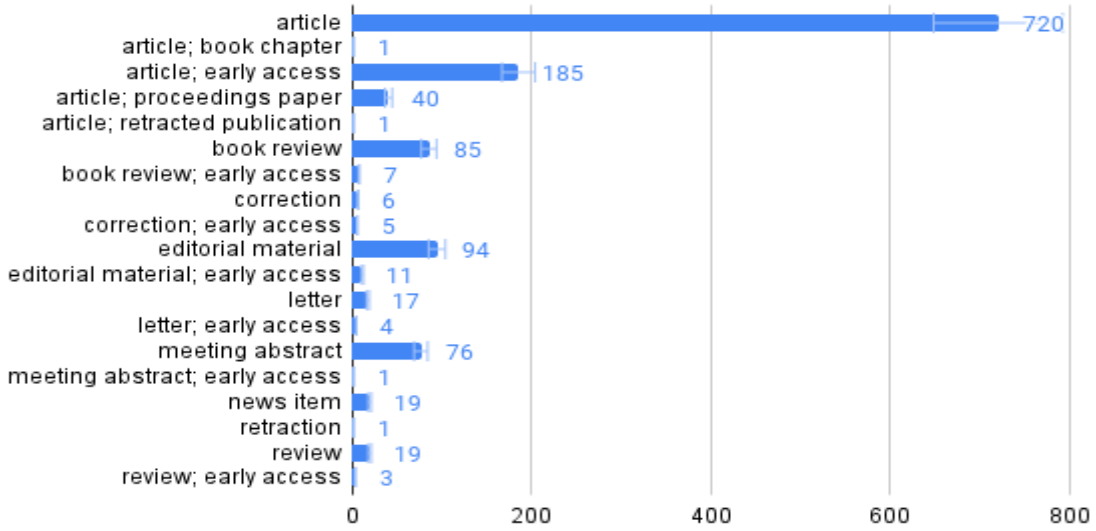
For visualizing network relationships, the study utilized VOSviewer version 1.6.19 (van Eck and Waltman, 2010), a tool that generated detailed graphical maps of connections and relationships within the dataset. Additionally, the study employed the R-Studio Biblioshiny Web interface (Aria and Cuccurullo, 2017) for network analysis and visualization purposes. Integrated within the R-Studio environment, Biblioshiny provided robust functionalities for general network analysis and visualization.The study employed a suite of bibliometric visualization software tools to conduct a thorough analysis of the digital divide literature. Initial analyses using VOSviewer and Biblioshiny were complemented by additional software tools to further enrich the depth and scope of the study. This multifaceted approach enabled a comprehensive understanding of the research landscape surrounding the digital divide, identifying trends, influential authors, significant publications, and emerging areas of interest within the field.

Data analysis and interpretation

Document Type

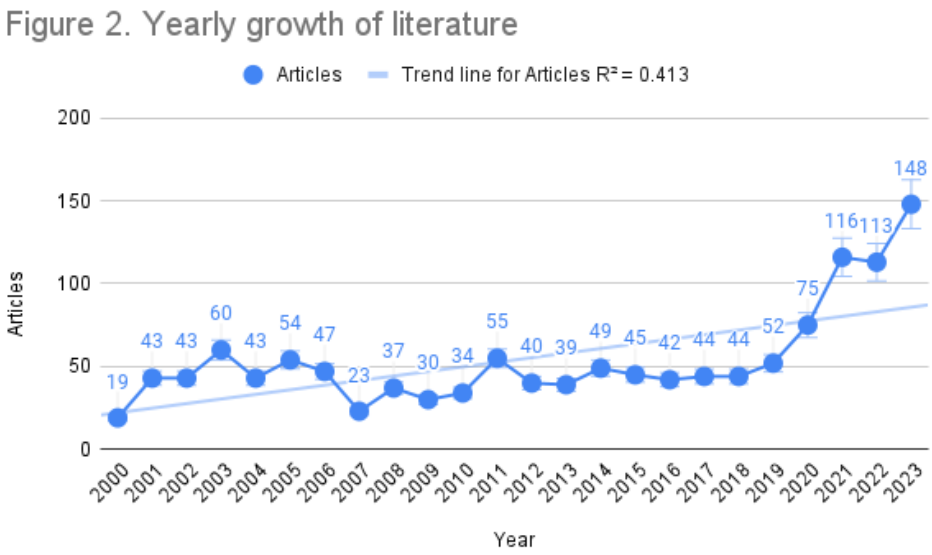
A bibliometric study was conducted to analyze global research trends on the digital divide. The study encompassed a wide range of document types, with the majority being articles, accounting for 720 instances, which represent approximately 60.3% of the total document count. Among the articles, there were variations such as those combined with book chapters (1 instance), designated as early access (185 instances), or classified as proceedings papers (40 instances). Additionally, there was a single instance of an article marked as a retracted publication. Book reviews constituted a notable portion, with 85 instances, comprising around 7.1% of the total documents. Some of these book reviews were available as early access (7 instances). Corrections and their early access versions were minimal, with 6 and 5 instances, respectively. Editorial materials were also present in the dataset, with 94 instances (approximately 7.9%), and 11 of these were accessible as early access.

Figure 1 .Document type



Yearly Growth of Literature

The distribution of documents concerning the digital divide over the years illustrates an intriguing trend, indicating the evolving interest and engagement of researchers in this field. The year 2000 marked the beginning of scholarly exploration, with 19 documents, gradually increasing to 43 in 2001 and maintaining a relatively stable count until 2004. However, there was a notable rise in 2005, reaching 54 documents. From 2006 to 2010, there were fluctuations in the number of documents, with peaks observed in 2006 (47 documents) and 2011 (55 documents), while 2007 witnessed a dip to 23 documents. Despite these fluctuations, the overall trajectory exhibited a gradual increase in scholarly output. In the following years, from 2012 to 2019, the number of documents remained relatively consistent, fluctuating between 39 and 52 documents annually. However, a significant surge was observed in 2020, with 75 documents, marking a notable increase compared to previous years. This surge continued into 2021, where the number of documents more than doubled to 116, indicating a substantial rise in research activity and interest in the digital divide. The most striking observation is the considerable peak in 2023, with 148 documents, suggesting a significant surge in scholarly engagement and research output, possibly reflecting heightened awareness and interest in understanding and addressing the digital divide. When considering the percentage distribution over the years, it's evident that there's been a gradual increase in the number of documents over time, with fluctuations in some years but a general upward trend. The percentage increase from 2000 (the earliest year with available data) to 2023 is substantial, indicating a growing interest and focus on the digital divide within scholarly



Characteristics of Journals with the Most Related Publications and Citations

. Research trends in the field of digital divide have been extensively explored across numerous academic journals, with significant contributions from the top 10 journals. This study utilized several bibliometric indices—such as the h-index, g-index, and m-index—to assess the scholarly impact and citation influence of these journals. The h-index, devised by Jorge Hirsch, integrates both the quantity and visibility of publications by identifying the number of papers that have at least h citations each (Egghe, 2006).In contrast, the g-index evaluates the overall impact of a researcher's works based on the distribution of citations among their publications, focusing on the highest number of articles that collectively accumulate g^2 citations (Awan and Abbas, 2023; Abramo et al., 2013). Meanwhile, the m-index provides a normalized metric by dividing the h-index by the number of years since the researcher's first publication, thereby accounting for variations in career duration (Awan and Abbas, 2023; Sanyal et al., 2020).This study's application of these indices offers a comprehensive evaluation of the contributions and citation influence of journals in digital divide research. Notably, "New Media & Society" emerges as a leading journal with a significant total of 3,284 citations, reflecting substantial interest and engagement in the field. With an impact factor (IF) of 6.9, this journal underscores its influence in shaping research on digital inequalities. Similarly, the "Journal of Medical Internet Research" demonstrates considerable impact with 1,334 citations, highlighting the critical role of digital technologies in healthcare and medical research. These top journals, alongside others listed, play pivotal roles in advancing knowledge and addressing challenges related to digital disparities, emphasizing their collective impact in the scholarly community.

Element	h_index	g_index	m_index	TC	NP	IF
TELECOMMUNICATIONS POLICY	19	32	0.76	1563	32	4.4
NEW MEDIA & SOCIETY	18	26	0.818	3284	26	6.9
INFORMATION SOCIETY	16	29	0.696	1984	29	1.4
GOVERNMENT INFORMATION QUARTERLY	13	17	0.591	869	17	8.4
TECHNOLOGICAL FORECASTING AND SOCIAL CHANGE	12	15	0.75	457	15	12
JOURNAL OF MEDICAL INTERNET RESEARCH	11	16	0.524	1334	16	7.0

SOCIAL SCIENCE COMPUTER REVIEW	10	19	0.435	647	19	3.2
COMPUTERS & EDUCATION	9	11	0.391	639	11	3.6
COMPUTERS IN HUMAN BEHAVIOR	9	10	0.818	330	10	9.9
INFORMATION COMMUNICATION & SOCIETY	9	18	0.6	776	18	6.0

Table 1 ***journals with the highest numbers of related publications and citations***

Most productive and impactful Authors

In examining research trends in the digital divide, certain authors emerge as particularly productive and impactful contributors to the field. Table 2 Among the listed authors, James J from the Netherlands emerges as one of the most productive and impactful, with an h-index of 11 and a total citation count (TC) of 309 across 18 publications. Following closely is Oliveira T from Lisbon, Portugal, with an h-index of 5 and a TC of 374 across 5 publications. Both authors demonstrate significant productivity and impact in their respective fields.Additionally, Van Dijk JAGM, also from the Netherlands, stands out with the highest TC of 1862 among the listed authors, indicating a substantial body of work with considerable influence. Similarly, Cruz-Jesus F from Lisbon, Portugal, despite a lower h-index, demonstrates impact with a TC of 380 across 6 publications.While authors like Huang J from China and Sasaki H from Japan exhibit lower TCs, their contributions may still hold importance within specific research niches. Overall, these authors represent a diverse range of geographic locations and scholarly outputs, collectively enriching the research landscape on topics related to digital technologies and society.

Element	**h_index**	**Country**	**TC**	**NP**
JAMES J	11	Netherland	309	18
CRUZ-JESUS F	6	Lisbon, Portugal	380	6
VAN DEURSEN AJAM	5	Netherlands	1163	6
HUANG J	4	CHINA	281	6
KVASNY L	4	United states	215	6
SASAKI H	2	Japan	10	6
OLIVEIRA T	5	Lisbon, Portugal	374	5
VAN DIJK JAGM	5	Netherland	1862	5
COTTEN SR	4	United states	123	5
RICE RE	4	United states	563	5

Table 2. ***Productive and impactful Authors***

The top 10 most-cited articles

The analysis of research trends in the digital divide through bibliometric mapping highlights several pivotal articles that have significantly influenced scholarly discourse in this field. Among the top 10 most-cited articles in the Web of Science (WoS) database, several key themes emerge, including the conceptualization of the digital divide, its impact on different demographic groups, and factors influencing digital inclusion.Leading this list is Van Dijk JAGM's 2006 article titled "Digital divide research, achievements and shortcomings," published in Poetics, which has garnered 778 total citations, emphasizing its foundational role in understanding the digital divide phenomenon. Other influential works include Livingstone S's exploration of digital inclusion among children and young people, as well as Selwyn N's reevaluation of political and popular perceptions of the digital divide, both published in New Media & Society.Additionally, research by scholars such as Van Deursen AJAM and Friemel TN addresses specific facets of the digital divide, such as internet skills and their impact on older adults, contributing to a nuanced comprehension of digital inequalities. Studies by Choi NG and Neter E in the Journal of Medical Internet Research extend the discourse to include topics like eHealth literacy and internet usage patterns among elderly populations. These highly cited articles collectively illustrate the diverse dimensions of the digital divide and its implications across various sectors, serving as crucial references for researchers and policymakers alike. With a cumulative total of over 5,000 citations, these seminal works continue to guide and inform scholarly investigations into digital disparities on a global scale.

Author ,Publishing year	Title	Total Citations	TC per Year	journal
VAN DIJK JAGM, 2006,	Digital divide research, achievements and shortcomings	778	40.95	**Poetics**
VAN DIJK J, 2003	The Digital Divide as a Complex and Dynamic Phenomenon	736	33.45	**The Information Society**
LIVINGSTONE S, 2007,	Gradations in digital inclusion: children, young people and the digital divide	623	34.61	New Media & Society
SELWYN N, 2004	Reconsidering Political and Popular Understandings of the Digital Divide	615	29.29	New media &society
VAN DEURSEN AJAM, 2011	Internet skills and the digital divide	473	33.79	New media

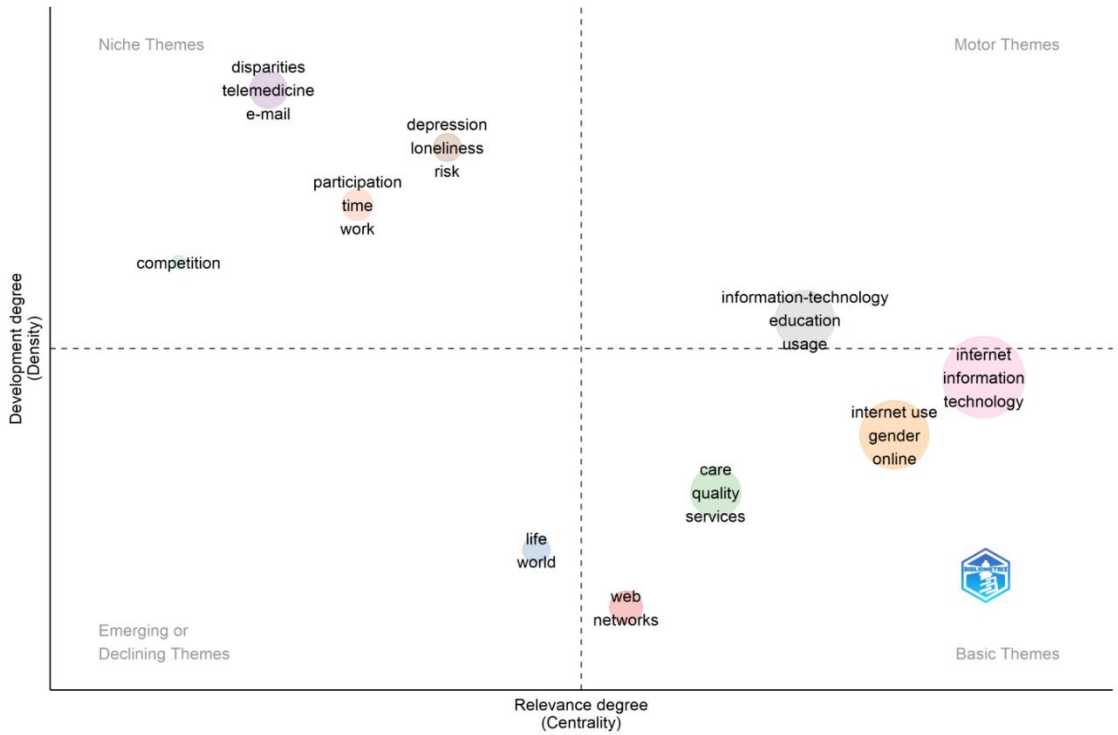
				&society
SCHEERDER A, 2017	Determinants of Internet skills, uses and outcomes. A systematic review of the second- and third-level digital divide	456	57	Telematics and Informatics
FRIEMEL TN, 2016	The digital divide has grown old: Determinants of a digital divide among seniors	454	50.44	New media &society
CHOI NG, 2013,	The Digital Divide Among Low-Income Homebound Older Adults: Internet Use Patterns, eHealth Literacy, and Attitudes Toward Computer/Internet Use	419	34.92	Journal of Medical Internet Research
NETER E, 2012	eHealth Literacy: Extending the Digital Divide to the Realm of Health Information	413	31.77	Journal of Medical Internet Research

Table 3. Most-cited articles

Thematic map

thematic map illustrating the research landscape of the Digital Divide is generated using centrality and density metrics. Centrality signifies the importance of a theme within the research field, while density indicates the level of development or prominence of each theme.. As research evolves, so do the themes explored, with recent publications potentially highlighting different themes compared to older ones. The thematic map of Digital Divide research, illustrated in Figure 3, categorizes themes into four distinct categories using author keywords. This visualization offers insights into the changing research priorities and focal points within the study of the Digital Divide. It provides a comprehensive overview of the thematic trends influencing agricultural research worldwide. Specifically, the "Motor Theme," positioned in the upper right quadrant, represents pivotal themes characterized by high density and centrality. This indicates a strong foundation and importance in current research, highlighting areas that merit further exploration and development in future studies.. A single cluster comprising information technology , education and usage themes emerges within this quadrant, indicating significant potential for exploration and expansion. *Niche Theme:* Positioned in the upper left quadrant, this quadrant showcases specific and rare themes with high development but low centrality. There are four cluster within this quadrant in silver color Disparities, Telemedicine and email ,in Mauve color Depression , loneness and risk representing specialized areas of research with notable relevance and potential for focused investigation. *Emerging/Declining Theme*. Located in the lower left quadrant, this section encompasses themes that have been historically prominent but are now showing a decline in centrality. Within this quadrant, a single cluster, featuring life and world, is identified as an emerging or declining theme, suggesting a necessity for revitalizing or redirecting research efforts in this area. *Basic Theme:* Found in the lower right quadrant, this section includes essential themes characterized by high centrality but low density. Within this quadrant, there are four clusters identified. One cluster highlighted in pink focuses on themes related to the Internet, information, and technology, while another cluster in orange encompasses topics such as internet usage, gender, and online activities. These clusters provide valuable insights into key research areas and potential directions for further exploration within the research landscape of the Digital Divide.

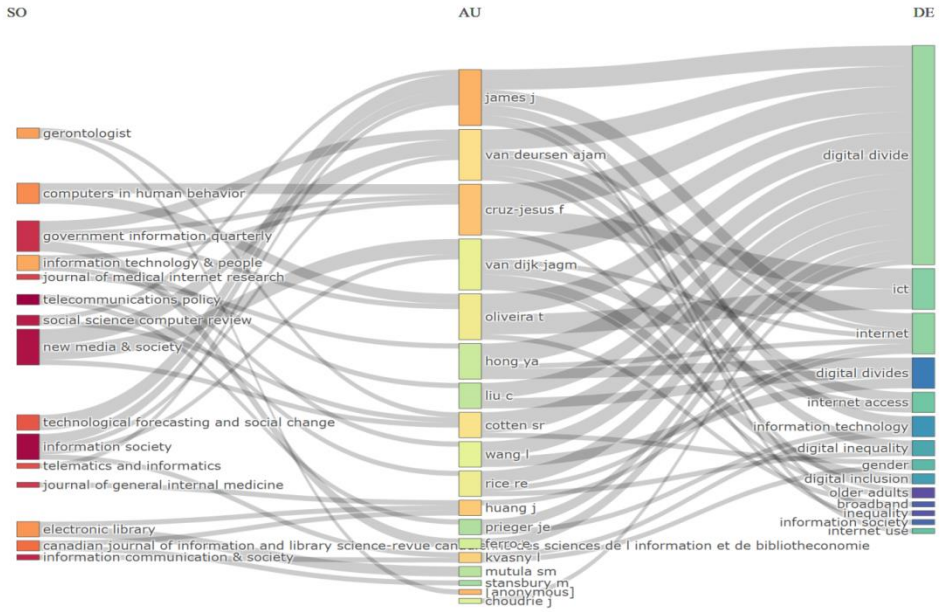
Figure 3 .A thematic map



Sankey diagrams (three-field plot)

A Sankey diagram, which is also referred to as a three-field plot, serves as a powerful visualization tool for illustrating the flow of values from one set to another. These plots are particularly effective in depicting the relationships and transitions of data between three distinct categories, offering a comprehensive, three-dimensional perspective on the evolution and exchange of information among these categories. The graphical representation in a Sankey diagram involves using lines to represent the connections between the fields, with the width of these lines corresponding to the quantity or strength of these connections.In the context of this study, Figure 4 employs a Sankey diagram to illustrate the intricate relationships among authors, the sources of their publications, and the keywords they have selected. This visual approach allows for a clear depiction of how these three categories interact and intersect. For instance, the diagram highlights the publication activity of a specific author, James J, who has contributed articles to five different journals. This indicates not only a prolific output but also a diverse range of publication venues, showcasing the breadth of James J's scholarly engagement.The Sankey diagram thus provides a nuanced view of how individual authors contribute to various journals and the thematic focus of their research as represented by their chosen keywords. By visualizing these connections, the diagram helps to identify patterns and trends within the data, making it easier to understand the distribution and impact of research activities across different fields. The use of varying line widths in the diagram further enhances the clarity of these relationships, emphasizing the relative significance of each connection in terms of the quantity or strength of the data flow.Overall, the Sankey diagram in Figure 4 offers a detailed and visually engaging method to explore the dynamics of authorship, publication sources, and research keywords, shedding light on the interconnected nature of scholarly work in the field.

Figure 4 . The connection between authors, the sources where they publish their work, and the keywords they select.



Co-occurrence of keyword of research hotspots

Through bibliometric mapping, key research hotspots in the exploration of the digital divide emerge. Figure 5 These hotspots encompass various themes, including internet access, adoption, and use, reflecting the fundamental aspects of digital inequality. Additionally, terms such as technology and information underscore the technological dimensions of the digital divide, while keywords like gender and inequality highlight its social and demographic implications. The co-occurrence of these keywords indicates the interconnected nature of research in this field, emphasizing the multidimensional approach required to address and understand the complexities of digital disparities in contemporary society.

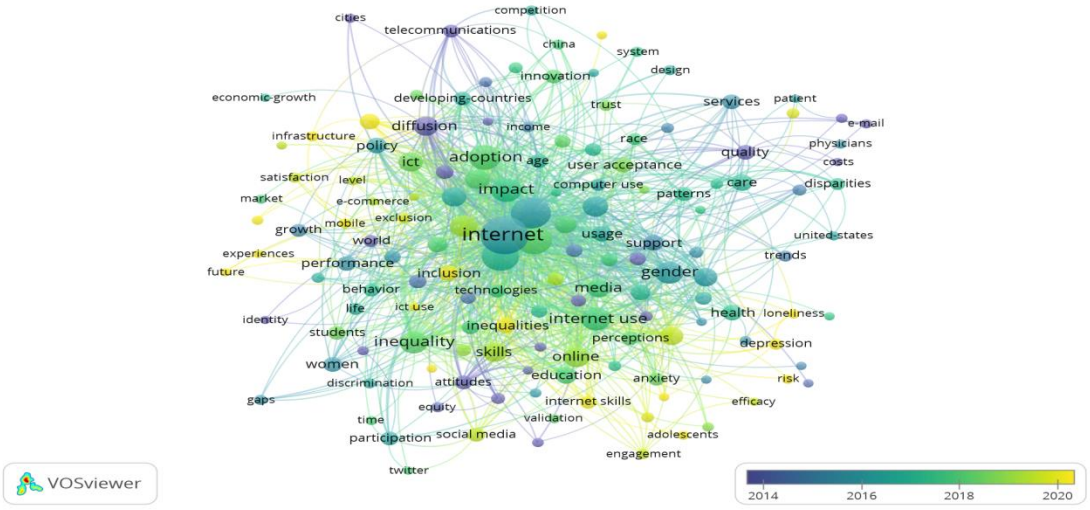
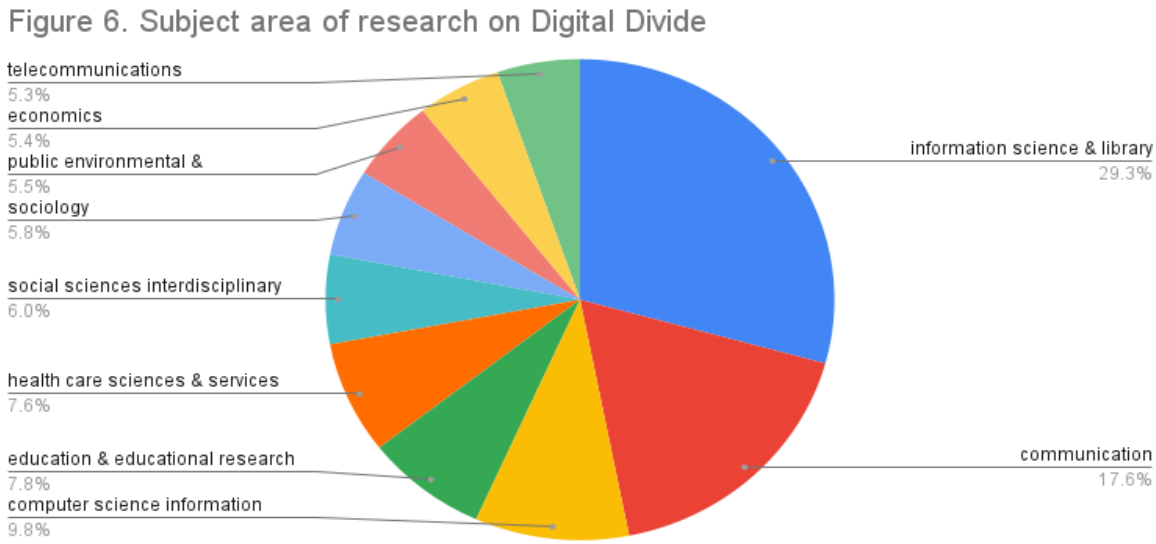


Figure 6. Co-occurrence of keyword of research hotspots

Subject area of research on Digital Divide

Research on the digital divide encompasses a wide range of disciplines and fields of study. , reflecting its interdisciplinary nature and broad societal implications. Figure 6 Information science and library science emerge as the primary subject area with the highest frequency, indicating a significant focus on understanding digital disparities in accessing and utilizing information resources. Communication and computer science information systems follow closely, highlighting the technological and communicative aspects of the digital divide. Moreover, education, healthcare, social sciences, and sociology represent key domains where researchers investigate the impact of digital inequalities on learning, health outcomes, and social inclusion. Additionally, subjects like public health, economics, and telecommunications contribute to examining policy implications, economic ramifications, and infrastructural challenges associated with bridging the digital divide. Overall, the diverse subject areas involved in digital divide research underscore the multifaceted nature of this phenomenon and the need for comprehensive interdisciplinary approaches to address it effectively.

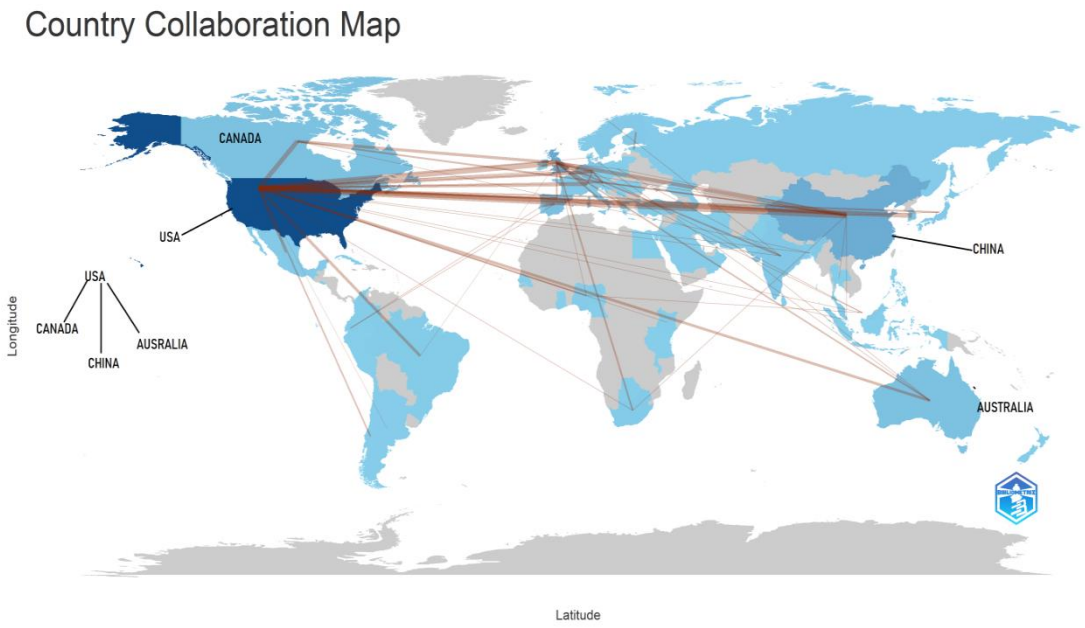


Collaboration map of countries across the globe

Figure 7 presents an illustration of international collaboration among nations using various colors such as blue, dark blue, and grey. The intensity of blue shades indicates each nation's level of scientific productivity, with darker shades representing higher productivity and grey indicating lower productivity. Red lines on the figure denote collaborative networks between different publishing nations.Collaboration among countries in digital divide research is evident, with the United States (USA) serving as a central hub for such collaborations. Significant collaborative efforts are observed between the USA and China, occurring 21 times, underscoring global interest in understanding and addressing digital disparities. Moreover, collaborations between the USA and Canada (12 occurrences) as well as the USA and Australia (5 occurrences) demonstrate international partnerships aimed at exploring trends in digital divide research.This international collaboration highlights the recognition of the digital divide as a global challenge

necessitating collective action and cooperation among nations. By collaborating across borders, researchers can harness diverse perspectives, resources, and expertise to develop comprehensive strategies for reducing digital inequalities and promoting digital inclusion worldwide.

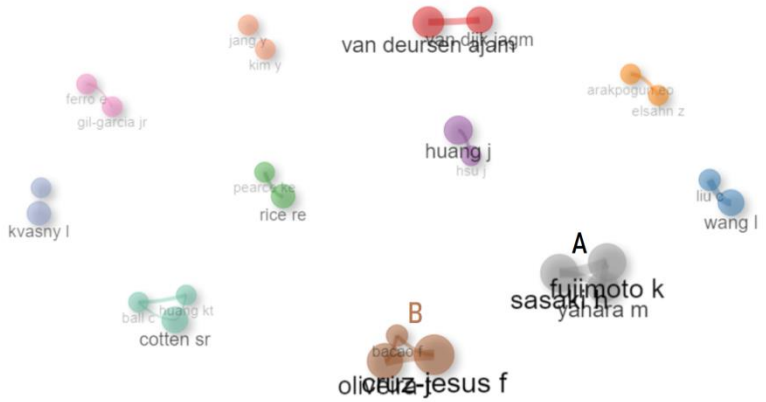
Figure 7. Global cooperation between nations



Authors collaboration network.

. he analysis of author collaboration provides insights into the achievements and current landscape of research cooperation in the field of the digital divide. Curved lines represent collaborative relationships between authors, while color gradients indicate clusters of collaboration. The size of each circle corresponds to the number of publications, and the thickness of the lines reflects the intensity of collaboration.Cluster A, which includes authors Sasaki H, Fujimoto K, and Yahara M, stands out as a significant focal point within this research domain, as depicted in Figure 8's collaborative network. This cluster highlights the substantial contributions and collaborative efforts of Sasaki H, Fujimoto K, and Yahara M in advancing digital divide research.

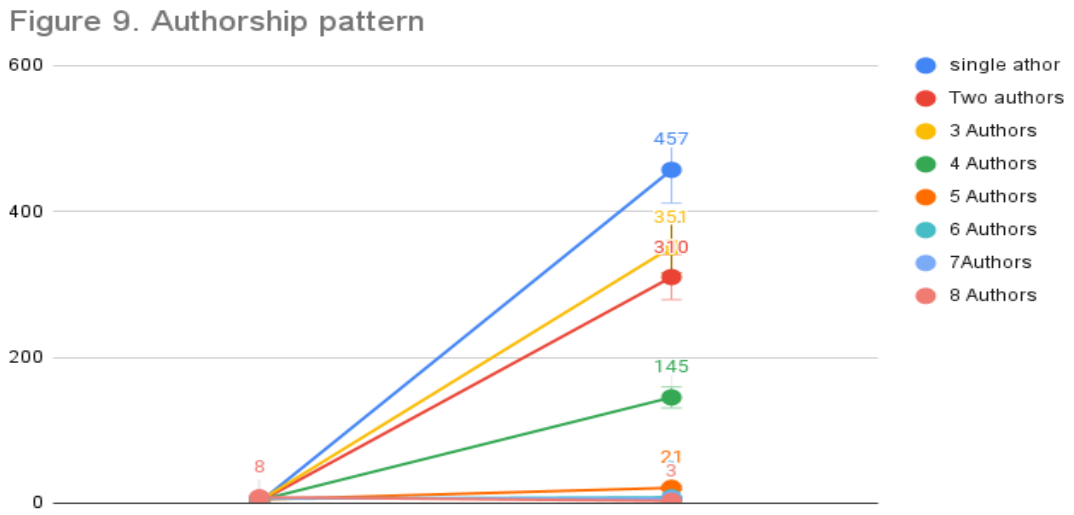
Figure 8 .Authors collaboration network.



Authorship pattern

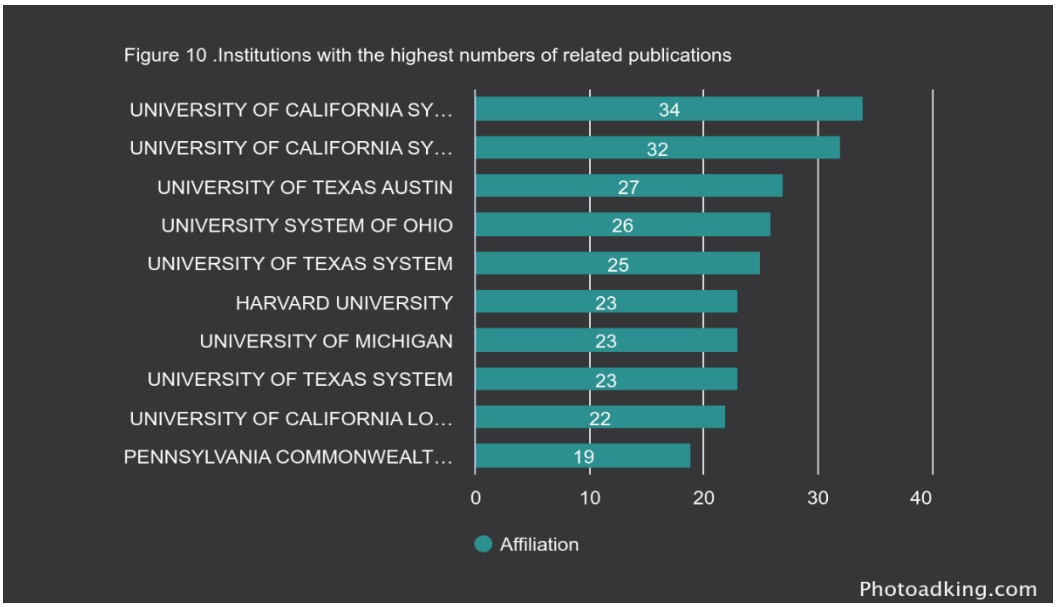
The authorship pattern analysis reveals insights into the distribution of collaborative efforts within research on the digital divide. Figure 9 The data illustrates that the majority of publications are authored by 1 or 2 individuals, comprising 457 and 310 instances, respectively. This suggests a prevalent trend of single or dual authorship, where researchers may take on individual or paired roles in conducting and publishing their work. Additionally, there is a notable presence of publications with 3 or 4 authors, indicating moderate levels of collaboration among small groups of researchers. This suggests that while some studies are conducted by smaller teams, there is still a significant degree of collaboration involved in producing research on the digital

divide. However, publications with 5 or more authors are relatively less frequent, representing a smaller proportion of the overall authorship pattern. This indicates that larger collaborative efforts involving five or more individuals are less common in this research domain.



Institutions that have made significant contributions in advancing research on the digital divide.

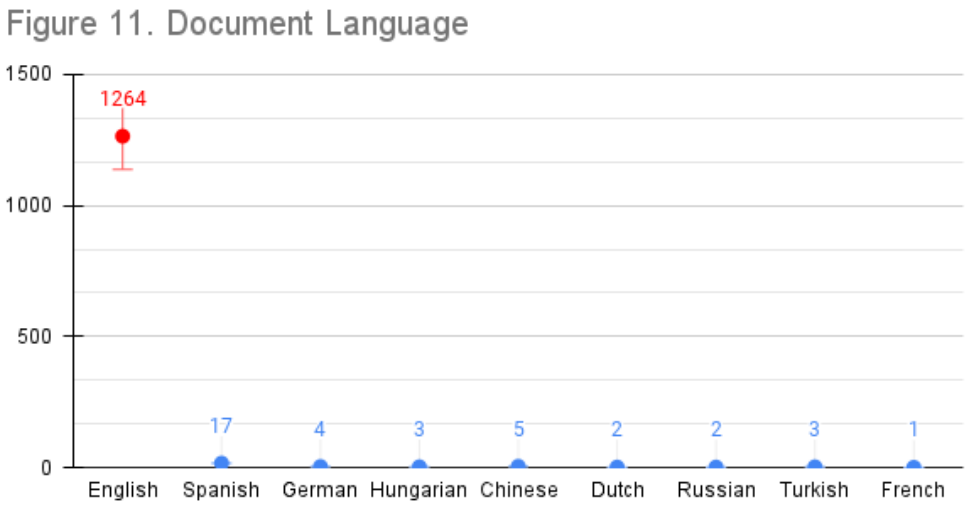
Figure 10 Institutions that have made significant contributions through a substantial number of publications and citations play a pivotal role in advancing research on the digital divide. According to Figure 10, the University of California System emerges as a prominent leader with a total of 66 articles, highlighting its extensive engagement and commitment to this field of study. Similarly, the University of Texas Austin and the University System of Ohio have demonstrated strong research output with 27 and 26 articles respectively, indicating their dedicated efforts in addressing digital disparities.Prestigious institutions such as Harvard University, the University of Michigan, and the University of California Los Angeles have also made substantial contributions, each with 23 to 34 articles. This underscores their influence in shaping scholarly discourse on the digital divide. The significant number of publications from these institutions reflects their leadership in generating knowledge, fostering collaborations, and driving innovations aimed at reducing digital inequalities.Moreover, the substantial research contributions from these institutions not only enhance academic understanding but also inform policy decisions and interventions to promote digital inclusion and equitable access to technology. Higher publication counts often signify an institution's reputation as a leader in its field, garnering respect and recognition from peers in academia and beyond. The ability to collaborate effectively, secure funding, and disseminate research findings can all be influenced by an institution's established prestige (Farooq and Durst, 2023).



Language distribution of documents in research on the digital divide

The language distribution of documents in research on the digital divide reflects the global reach and diversity of scholarship in this field. Figure 11 English emerges as the predominant language, with 1,264 documents, highlighting its status as the lingua franca of academic communication and

research dissemination. This extensive use of English indicates the widespread international collaboration and accessibility of English-language research on the digital divide. Additionally, Spanish, German, Hungarian, Chinese, Dutch, Russian, Turkish, and French languages contribute to the literature, albeit in smaller proportions. These languages represent the linguistic diversity of researchers worldwide, with scholars from various linguistic backgrounds engaging in the study of digital inequalities and inclusion. While English dominates the literature, the presence of documents in other languages underscores the importance of multilingual perspectives and the need for inclusive communication in addressing the digital divide. Overall, this language distribution reflects the global interest and collaborative efforts in advancing knowledge and understanding of digital disparities across linguistic boundaries.



Overview of scientific productivity of Digital divide

Table 4 Over the span of 2000 to 2023, the scientific productivity surrounding the digital divide has been robust, with 1295 documents generated from 620 sources. This productivity exhibits an impressive annual growth rate of 9.34%, reflecting the increasing attention to this topic. The average age of documents is 10 years, indicating ongoing relevance. Each document garners an average of 28.88 citations, pointing to its impact and influence. With 3077 authors contributing, including 399 single-authored documents, collaboration is evident, with an average of 2.71 co-authors per document. International co-authorships constitute 16.14%, highlighting global engagement in addressing the digital divide.

Description	Results
Timespan	2000:2023
Sources (Journals, Books, etc)	620
Documents	1295
Annual Growth Rate %	9.34
Document Average Age	10
Average citations per doc	28.88
References	36409
Author's Keywords (DE)	2278
Authors	3077
Authors of single-authored docs	399
Single-authored docs	456
Co-Authors per Doc	2.71
International co-authorships %	16.14

Table 4

Most Cited Countries

. Table 5 illustrates the significant contributions made by various countries in research on the digital divide, as evidenced by their scientific output. The United States leads with 16,759 articles, averaging 35.4 citations per article, highlighting its extensive research activity and influence. Following closely, the United Kingdom has contributed 3,943 articles, each receiving an average of 39 citations.Notably, the Netherlands, despite having fewer

articles (3,848), stands out with a remarkably high average citation rate of 109.9, underscoring the quality and impact of its research in this field. Other prominent contributors include China, Germany, and Norway, reflecting a global commitment to comprehensively explore and address the complexities of the digital divide through rigorous scientific investigation.

Country	TC	Average Article Citations
USA	16759	35.4
UNITED KINGDOM	3943	39
NETHERLANDS	3848	109.9
CHINA	1860	16.2
SPAIN	1290	24.8
CANADA	1098	34.3
GERMANY	1085	54.2
AUSTRALIA	844	21.6
NORWAY	503	55.9
ITALY	491	28.9

Table 5

Discussion

The exploration of research trends in the digital divide through bibliometric mapping provides valuable insights into the evolution of scholarly discourse, key contributors, thematic priorities, collaboration networks, and institutional engagement. This discussion synthesizes the findings presented in the study and contextualizes them within the broader landscape of digital inequalities research.

Document Types and Yearly Growth of Literature:

The analysis of document types reveals a diverse array of scholarly contributions, primarily comprising articles, book reviews, and editorial materials. This diversity underscores the multidisciplinary nature of digital divide research, drawing insights from fields such as communication, sociology, information science, and public health. Moreover, the steady increase in scholarly output over the years reflects a growing interest and investment in understanding and addressing digital disparities. Although there were variations in yearly publication numbers, the overall trend shows a consistent increase, particularly with notable peaks in recent years (2020, 2021, and 2023). These surges are likely influenced by heightened societal awareness and increased policy focus on digital disparities, which were amplified by global events such as the COVID-19 pandemic. This crisis exacerbated existing inequalities in digital access and skills, contributing to the observed spikes in research activity during these years.

Characteristics of Journals with High Publication and Citation Counts:

The analysis of journals with the highest numbers of related publications and citations highlights key outlets shaping scholarly discourse on the digital divide. Journals such as "New Media & Society" and "Journal of Medical Internet Research" emerge as influential platforms, publishing research that spans theoretical, empirical, and methodological approaches to understanding digital inequalities. The high citation counts and impact factors of these journals signify their role as hubs for disseminating seminal research and shaping academic conversations. Additionally, the diversity of journals in the top 10 list reflects the interdisciplinary nature of digital divide research, spanning disciplines such as telecommunications, health informatics, and education.

Productive and Impactful Authors:

The identification of productive and impactful authors sheds light on key contributors driving research in the digital divide domain. Authors such as James J, Oliveira T, and Van Dijk JAGM demonstrate significant productivity and influence, contributing to a diverse body of literature that spans conceptual, empirical, and policy-oriented inquiries. Their geographic diversity underscores the global nature of digital inequalities and the need for contextually informed research to address local challenges. Moreover, collaborative networks among authors, as depicted in the authorship pattern analysis and collaboration networks, highlight the importance of knowledge exchange and interdisciplinary collaboration in advancing understanding and solutions to the digital divide.

Thematic Trends and Subject Areas of Research:

Thematic mapping reveals evolving research priorities within the digital divide landscape, with themes ranging from technology adoption and usage patterns to social disparities and health outcomes. The thematic clusters identified reflect the multifaceted nature of digital inequalities, encompassing technological, socioeconomic, and demographic dimensions. Moreover, the subject area analysis underscores the interdisciplinary nature of digital divide research, with contributions from fields such as information science, communication, sociology, and public health. This interdisciplinary approach is essential for developing holistic interventions and policy responses that address the complex drivers of digital disparities and promote inclusive digital ecosystems.

Global Collaboration and Institutional Engagement:

The analysis of global collaboration networks and institutional engagement highlights the interconnectedness of digital divide research across geographic and organizational boundaries. Collaborative efforts among countries, as evidenced by collaboration networks and global cooperation maps, underscore the shared commitment to addressing digital inequalities on a global scale. Institutions such as the University of California System and Harvard University, renowned for their high publication and citation counts, play crucial roles in shaping research agendas, promoting collaboration, and advocating evidence-based policies to address the digital divide. Additionally, the linguistic diversity observed in scholarly documents underscores the importance of multilingualism in facilitating inclusive knowledge exchange and dissemination.Using bibliometric mapping, this study offers a comprehensive view of the evolving landscape of digital divide research. By analyzing quantitative data on publication trends, citation patterns, author affiliations, thematic focuses, and collaborative networks, the research provides valuable insights for researchers, policymakers, and practitioners. These insights can inform strategies to advance knowledge, guide interventions, and foster digital inclusion in an increasingly interconnected global context.

Limitations

While the study offers valuable insights into research trends concerning the digital divide, it is important to acknowledge several limitations.. Firstly, the reliance on a single data source, the Web of Science database, may introduce bias and restrict the scope of analysis. Other databases or sources of literature, such as Scopus or Google Scholar, could offer additional perspectives and enhance the comprehensiveness of the study notwithstanding these limitations, the study makes a significant contribution to enhancing our understanding of research trends in the digital divide... By acknowledging these constraints, future research endeavors can strive to address these limitations and offer a more nuanced and comprehensive analysis of this important field.

Conclusion

The research on trends in the digital divide offers valuable insights into the changing terrain of scholarly investigation in this crucial field. By employing bibliometric mapping and analyzing diverse parameters—including document types, annual growth rates, journal attributes, authors' output, citation trends, thematic mapping, and collaboration patterns—the study provides a thorough comprehension of the trajectory of digital divide research..The findings indicate a substantial increase in scholarly output over the years, with a notable surge in interest and engagement observed in recent years, particularly in 2021 and 2023. This trend underscores the growing recognition of the digital divide as a pressing societal issue that warrants scholarly attention and intervention.Key themes and areas of focus identified in the study include internet access, adoption, usage, disparities across demographic groups, technological determinants, and social implications. Seminal articles and influential authors contribute significantly to shaping scholarly discourse and advancing knowledge in the field.Moreover, collaboration among countries and authors plays a crucial role in fostering interdisciplinary research efforts and leveraging diverse perspectives to address digital inequalities effectively. Institutions that produce substantial research outputs also play a key role in advancing knowledge and devising solutions to narrow the digital divide. The study also underscores the linguistic variety in research publications, where English is predominant but other languages also contribute, illustrating the global scope of digital divide research.

Implications of the Study

Policymakers and practitioners can leverage the insights from this study to develop targeted interventions and policies aimed at reducing digital disparities and promoting digital inclusion across various sectors such as education, healthcare, and social services.Scholars can use the findings to identify research gaps, emerging trends, and areas for further investigation within the digital divide domain. Collaborative research efforts can help address complex challenges and generate innovative solutions.The study underscores the importance of international collaboration in addressing the digital divide. By fostering partnerships among countries and institutions, researchers can enhance the effectiveness of interventions and leverage resources more efficiently.

Education and Awareness: Educators and stakeholders can use the study findings to raise awareness about the digital divide's implications and encourage initiatives aimed at improving digital literacy and access to technology, particularly among underserved populations.The study lays the groundwork for future research directions, including longitudinal studies, comparative analyses across regions, and interdisciplinary investigations to deepen our understanding of the digital divide and its multifaceted dimensions.

This study contributes to the ongoing discourse on the digital divide by providing a comprehensive overview of research trends, key contributors, and thematic priorities. By addressing digital inequalities, societies can strive towards greater equity, inclusivity, and access to opportunities in the digital age.

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