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Research Progress on Digital Reading Behavior: A Bibliometric Study

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Abstract

Digital reading uses a screen as the primary medium for reading, distinguishing it from traditional paper-based reading. About 5.2 billion people worldwide use electronic devices to connect to the Internet, which has become the basis for the development of digital reading. Although there are currently bibliometric studies on digital reading and digital literacy, there is still a lack of information regarding digital reading behavior. This study employs VOSviewer software to conduct an in-depth bibliometric analysis using the Web of Science database, following the PRISMA guidelines for literature review studies. Drawing on 312 articles as research data, the study identified Chen as the leading researcher in digital reading behavior, as a result of publication volume, the number of references, and citation impact. China and the UNITED STATES are the most frequently cited countries on digital reading behavior. *The Electronic Library, Computers & Education,* and *Frontiers in Psychology* are the top three journals regarding productivity and references in works related to digital reading behavior. Extant research mainly focuses on four primary topics: digital reading literacy based on meta-cognitive strategies, the effect of information and communication technology on digital reading performance, digital reading intentions under the technology acceptance model, and digital reading strategy optimization with eye-tracking technology. This bibliometric analysis provides a nuanced understanding of the research landscape on digital reading behaviors, offering new insights within the existing literature through a comprehensive examination of researchers, publications, and critical themes.

Keywords: digital reading, reading behavior, reading habits, bibliometric

1. Introduction

The path of a reader often resembles a circuitous route through a metaphorical forest, comprising individual twists and turns, intricate interconnections, and moments of unexpected revelation (Holden, 2004). The term “reading” is defined as “students’ capacity to understand, use, evaluate, reflect on and engage with texts in order to achieve goals, develop knowledge and potential, and participate in society” (OECD, 2023, p. 42). The act of reading inherently entails a process of critical perception, interpretation, and rewriting of the material read (Freire, 1983). Reading can facilitate the construction of a knowledge base (Braunger & Jan Patricia Lewis, 2006), the development of speaking skills (Mart, 2012), and the enhancement of literacy skills (Genlott & Grönlund, 2013). Additionally, recreational reading has been demonstrated to mitigate the frustration associated with one’s fundamental psychological needs, thereby reducing psychological distress (Levine et al., 2020).

The message in Nicholas Negroponte’s, *Being Digital*, is that eventually, we will move toward an entirely digital society. (Negroponte, 1996). Contemporary technology profoundly impacts individuals’ perspectives of the world and their behaviors within it (Tully, 2003). The rapid progress in digital technologies is significantly changing the texts and tools people access. This change has enabled millions of individuals to reach texts that would otherwise be difficult to obtain due to financial or physical limitations (Biancarosa & Griffiths, 2012). The rise in popularity of digital technology and the advent of the new media era have led to significant changes in human reading activities. These changes have involved a transition from print media to electronic media and now to digital media, resulting in reading becoming primarily a digital activity.

In the current era, known as the digital society, a continuous influx of novel technology occurs while older ones are rapidly being substituted (Kurata et al., 2017). While digital reading has gained prominence as a method of reading, it is essential to note that the visual experience of reading on digital devices versus paper is distinct (Zhang et al., 2016). Digital reading is a distinct method that differs from the traditional practice of reading from paper, often taking the form

of screen reading. As media forms have evolved, various terms have emerged, including electronic reading, online reading, audio-visual reading, hypertext reading, screen reading, and intelligent reading. Other terms include virtual reading and ubiquitous reading. In conjunction with the advancement of computer and information technology and the advent of digital reading, an increasing number of users have transitioned to digital reading systems to meet their reading requirements. Concurrently, a multitude of digital reading systems have emerged (Chen et al., 2020). The resources available in the digital environment have also undergone a significant transformation, encompassing "websites, e-books, e-journals, e-newspapers, discussion boards, chat rooms, instant messaging, blogs, wikis, and other multimedia documents" (Haneefa K & P, 2020, p. 313). There is a growing need to examine the factors that support and impede digital reading, as well as the impact of electronic resources on digital reading behavior. Consequently, an increasing number of researchers have focused on how people use digital reading in their daily lives, the factors that influence reading habits, and the characteristics of texts that people prefer to read (Chen & Ke, 2015; Wu et al., 2019).

As outlined above, digital reading is ubiquitous, yet studying digital reading behavior remains a compelling area of research. Numerous researchers have conducted various studies on this subject. The field of digital reading behavior encompasses a multitude of research areas, including an investigation into the extant circumstances and attributes of digital reading behavior, an analysis of readers' intentions to engage with digital reading materials, an evaluation of readers' comprehension of digital content, and an assessment of the efficacy of digital reading platform navigation functions. A systematic literature review on digital reading behavior has already been conducted (Tang et al., 2023), as has a meta-analysis on mobile readers' behavior (Zhou et al., 2021). However, a discussion of digital reading behavior in bibliometric studies has yet to be undertaken.

A bibliometric analysis might offer valuable insights once a significant body of research on a specific subject has been accumulated. Bibliometric analysis is a method used to map out research specialties and analyze the interrelationships between different disciplines, fields, specialties, and individual articles (Zupic & Čater, 2015). On the other hand, a bibliometric analysis has become a robust scientific method, supported by the widespread availability and utility of bibliometric software and databases. This analysis eases acquiring and assessing large volumes of scientific data in relatively new areas, especially in affluent areas such as artificial intelligence and big data. Bibliometric studies are essential as they allow researchers "to (1) gain a one-stop overview, (2) identify knowledge gaps, (3) derive novel ideas for investigation, and (4) position their intended contributions to the field" (Donthu et al., 2021, p. 285). Therefore, conducting a bibliometric analysis in this study on digital reading behavior is highly significant.

The present study employs bibliometric methods to examine research on digital reading behavior. The main goals of this bibliometric study are to (1) identify and visualize the researchers involved in this field, their countries of origin, and any international collaborations they have, (2) identify and visualize the range of academic journals that publish research on digital reading behavior, and (3) assess the current state of research on digital reading behavior and identify potential areas for future investigations.

2. Literature Review

Communication and information technology have created innovative platforms for reading. The list comprises desktop and laptop computers, e-readers like *Kindle* and *Nook*, tablet computers like the iPad, and portable devices like the *iPod Touch* and mobile phones (Baron, 2013). Reading text from the screen is also called "digital reading" or "reading electronic text" (Clinton, 2019). Bi (2010) define that "digital reading is a process of acquiring or disseminating knowledge digitally, regardless of the tools, places or methods"(p. 246). Moreover, Leu et al. (2004) described identifying a problem, locating information, evaluating the information, synthesizing information, and communicating information for online reading. This definition was considered an explicit multifaceted definition because it addressed both conceptual and componential elements of reading digitally (Singer & Alexander, 2016). Therefore, reading digitally tends to be cognitively different from the process of reading on paper in terms of "brain activation, the contextual environment, cognitive focus, comprehension, and reading speed" (Cull, 2011, Section 10, para. 4).

Indeed, an increasing number of researchers have paid attention to the substantial difference between reading online or in print (Mokhtari et al., 2009). The extant literature on the comparative efficacy of paper and digital reading could be more conclusive. Some studies have indicated superior reading comprehension on screens relative to paper (Aydemir et al., 2013), but others have not seen any substantial disparities between the two forms of media (Margolin et al., 2013; Porion et al., 2016). Conversely, researchers have also indicated a possible benefit of reading on paper (Dahan Golan et al., 2018; Singer & Alexander, 2017). Recent research increasingly acknowledges the e-book as a novel technological complement to traditional printed materials, which is met with acceptance, particularly among regular print readers, rather than as an either/or proposition (Schwabe et al., 2023). It is important to know that e-books and print books serve diverse purposes and are not intended to replace one another.

Digital reading involves utilizing the capabilities of digital technology to offer a unique experience distinct from

traditional print reading. It aims to transform reading as a social experience, facilitating interactions, collaborations, and discussions. Additionally, digital reading offers novel avenues for engaging with digital multi-modal texts (Lim & Toh, 2020). Furthermore, the process of converting reading materials into digital format has improved the ease of accessing texts (Bădulescu, 2016; Rich, 2009). Additionally, the incorporation of full-text indexing and search functions in reader devices or search software is a valuable tool (Brown, 2001). Nevertheless, the advent of e-platforms, user-friendly reading devices, and technological trends has shifted the perception of digital reading. It is now regarded as a process encompassing not only information acquisition but also digital literacy development (Sung & Chiu, 2022).

Due to the expansion and progress of digital reading, a growing number of researchers have focused on studying digital reading behavior. Digital reading is markedly distinct from print reading. Due to the growing prevalence of digital texts, reading modes and habits have transformed. In a study by Liu (2005), the author demonstrates that screen-based reading is typified by an increased investment of time "in browsing and scanning, keyword spotting, one-time reading, non-linear reading, and reading more selectively, while less time is spent on in-depth reading, and concentrated reading" (p. 705) over the past ten years. Mangen (2008) asserted that these activities are indicative of a preference for shallow forms of reading, such as scanning and skimming. Hillesund (2010) also identified that readers utilize the Internet and computers for overview purposes, employing browsing and skimming techniques, which can be characterized as discontinuous and fragmented reading.

Other studies concentrate on the content, the discrepancies in digital reading behavior, and its consequences. A survey conducted online in Japan found that "approximately 70% of total reading time was spent on digital media" and that preferences favored print media (Kurata et al., 2017, p. 884). There is a difference between how people actually read and what they claim to like in print and digital media. Gender differences also exist in the effectiveness of digital reading behavior. Male students exhibit a far greater impact of electronic resources on their reading habits compared to female students (Haneefa K & P, 2020).. However, female students not only had a slightly higher level of liking for reading than males (He et al., 2023; Mog & Gayan, 2024), but also preferred print reading and multiformat use (Hu et al., 2023; Liu & Huang, 2008).

Based on the above differences between digital and print media, readers use different cognitive strategies when reading print and digital media (Jian, 2022). To further study this issue, scholars have conducted many studies on behavioral strategies for digital reading and have explored the factors that influence digital reading. However, many studies have reached similar conclusions regarding degree and direction. Based on Technology Acceptance Model (TAM), Unified Theory of Acceptance and Use of Technology Model (UTAUT), and Unified Theory of Acceptance and Use of Technology Model 2 (UTAUT 2), the findings indicate that factors such as effort expectancy, social influence, perceived risk, and habit substantially influence behavioral intention. Furthermore, both behavioral intention and habit significantly affect digital reading behavior (Chang et al., 2023; Lin, 2019; Martins et al., 2018; Zhou et al., 2021).

To summarize, the previous research mainly focused on the difference between traditional and digital reading and digital reading content. Recent research on digital reading behavior focuses on the definition of digital reading, reading ability, reading literacies, or digital reading platforms. Few scholars discussed the factors influencing young children's reading behavior and willingness and the differences in digital reading behavior between countries. These problems should be given more attention in future research.

In particular, the following research questions are proposed:

RQ1: Who are the key researchers and what are they core journals in the field of digital reading behavior?

RQ2: What are the keywords in the current literature of digital reading behavior?

RQ3: What are the research gaps and future research directions in digital reading behavior research?

3. Materials and Methods

The databases chosen for this research were selected based on a comprehensive and widely used research database that provides access to a vast array of scientific and scholarly literature across various disciplines. Web of Science was selected due to its extensive coverage across a wide range of scientific fields (Falagas et al., 2008). Web of Science covers the oldest publications while emphasizing the quality of its content coverage rather than quantity (Kulkarni, 2009). Web of Science offers a distinct edge over Scopus in terms of coverage, as it includes a comprehensive database dating back to 1945, whereas Scopus only goes back to 1966. Additionally, Web of Science is updated on a weekly basis and is well known for its scientific coverage in "life sciences, clinical medicine, biotechnology, agriculture, environmental sciences, physics, chemistry, earth sciences, mathematics, engineering, technology, and computer science" (Burnham, 2006, Section 1).

This research obtained comprehensive data using a two-step approach. The process began by carefully selecting and inputting pertinent keywords into the scientific publication database's search engine. Subsequently, a content analysis

was performed to verify the obtained documents, guaranteeing that only those genuinely pertinent to the current investigation were included (based on specific criteria).

In line with the above, the present bibliometric study was conducted using a series of keywords, including “screen reading,” “mobile reading,” “computer reading,” “electronic reading,” “e-reading,” and “online reading.” This approach was taken to indicate that “digital reading“ represents a set of concepts or definitions rather than a single noun. In this study, a systematic search was conducted using the following keywords: (“digital reading” OR “screen reading” OR “mobile reading“ OR “computer reading“ OR “electronic reading“ OR “e-reading” OR “online reading”) and (behavior or habits). The keywords mentioned above may be found in the title, abstract, or keyword fields, as well as in author keywords included in the Web of Science database. The keywords “digital reading” and “behavior” were selected for this bibliometric study due to its emphasis on studying digital reading behavior as a novel approach to reading in the context of scientific and technological advancement, as detailed in the title “Digital Reading Behavior” above.

This study aims to collate literature on digital reading behavior from the online WoS database and present a comprehensive overview of the field through visual representations. VOSviewer is employed as a visualization tool to facilitate exploration of the field’s influential sources, “research themes, cited references and their intersections with other references, cited sources and their links to other sources, and most frequently cited authors” (Du & Chen, 2022, Abstract section). Consequently, this study will develop a bibliometric study of the field, combining the PRISMA guidelines and VOSviewer visualizations.

Through the research in Web of Science, the earliest article was in 1970. In the digital age, numerous articles from January 1988 to June 2024 are available. The analysis was restricted to articles, conference papers, book chapters, and books. Excluded from consideration were documents presented in the format of editorial material, book reviews, notes, meeting abstracts, revisions, news items, reprints, and other types of non-traditional academic writing. The selected articles were not included in the subsequent content analysis, which was conducted in order to eliminate any articles that were irrelevant regarding digital reading behavior.

Figure 1 shows the steps of analysis carried out to find the relevant articles. PRISMA guidelines were followed in the process of conducting the literature review for this study (Moher et al., 2015). At the outset of the process, 403 articles were identified in the Web of Science database. After applying inclusive criteria during the screening phase, a total of 361 documents were successfully retrieved. Later, 312 additional articles were obtained following the application of content analysis during the eligibility stage. Ultimately, bibliometric analysis was conducted on the 312 articles in the final stage. The present study employed the VOSviewer 1.6.20 software for bibliometric analysis, establishing a comprehensive analysis foundation.

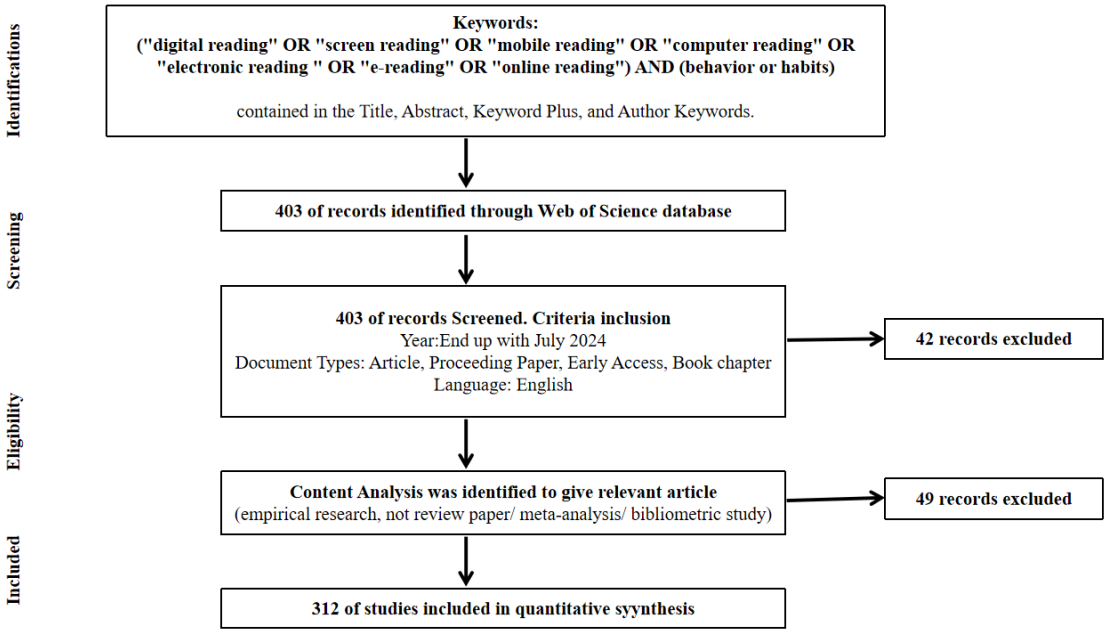

Figure 1. Research protocol

4. Result

4.1 Overview

Research on digital reading and digital reading behavior has evolved alongside the advancement of technology. The volume of research in this field has increased profoundly with the advent of the digital age at the beginning of the 21st century. Figure 2 depicts a favorable trajectory in this research field. As emerging digital technologies continue to evolve, scholars' research on digital reading behavior exhibits a discernible periodicity. This finding suggests that research on digital reading behavior has been a significant area of academic interest over the past decade and has retained its popularity.

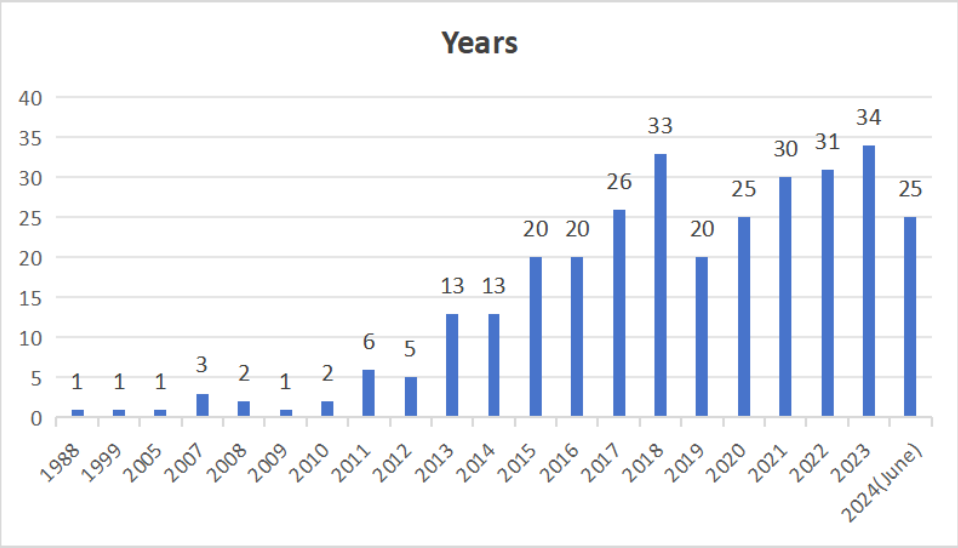

Figure 2. Scientific publication per year

Figure 3 illustrates the distribution of scientific publications about studies on digital reading behavior. As Figure 3 illustrates, most articles (71.5%) represent the predominant form of publication, while the Proceedings Paper accounts for a significant proportion (24.4%). This finding may be attributed to the long-standing focus on digital reading and its associated behaviors, which have been the subject of extensive academic discourse in journals, conferences, and monographs that have devoted greater attention to this research area.

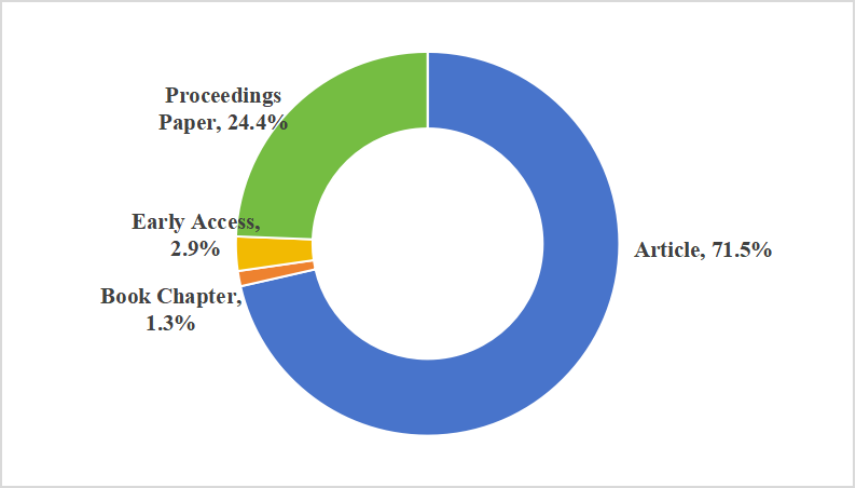

Figure 3. Publication type

4.2 Data Analysis of Author

4.2.1 Highly Productive Researcher

Table 1 presents a list of researchers who play a pivotal role in the field of digital reading behavior research. Chen is consistently the most productive researcher, boasting the largest number of publications and the greatest number of citations in comparison to other authors. Regarding the average frequency of citations, three researchers stand out as

having published only a single paper on the topic under examination in this study, who are Artelt, Doerfler, and Pfost.

Table 1. Author of at least 3 publications

No.	Author	Documents	Citations
1	Chen C.M.	9	125
2	Mizrachi D.	5	112
3	Liu Q.H.	4	59
4	Mangen A.	4	90
5	Soroya S.H.	4	24
6	Zhang L.Y.	4	62
7	Altamura L.	3	5
8	Cheng H.	3	4
9	Gil L.	3	36
10	Goldhammer F.	3	67
11	Hahnel C.	3	67
12	Kiili C.	3	31
13	Kroehne U.	3	67
14	Li M.C.	3	68
15	Liu J.	3	9
16	Liu Z.M.	3	74
17	Naumann J.	3	109
18	Salmeron L.	3	5
19	Schwabe A.	3	27
20	Siegenthaler E.	3	114
21	Wurtz P.	3	114
22	Yin C.J.	3	0
23	Zhao F.Z.	3	0

4.2.2 Author's Countries of Origin and Their Collaboration

A minimum of 56 countries affiliated with the study have published publications on the analyzed topic. Figure 4 demonstrates that China and the UNITED STATES have the highest scientific publication output on this issue compared to other countries, with each country publishing over 60 articles. An examination of scientific literature indicated that China and the UNITED STATES are the leading countries referenced in studies on digital reading behavior (Figure 5). The number of citations for articles affiliated with the UNITED STATES is 725, while those affiliated with China are 484. Thus, 36.95% of the 3,272 article citations on this topic refer to these two countries (Table 2).

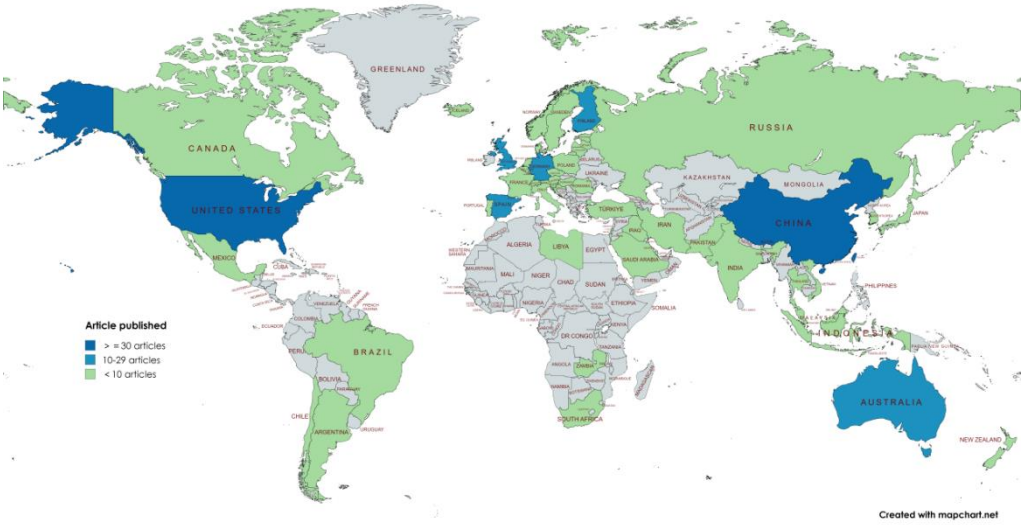

Figure 4. Global distribution of contributing authors

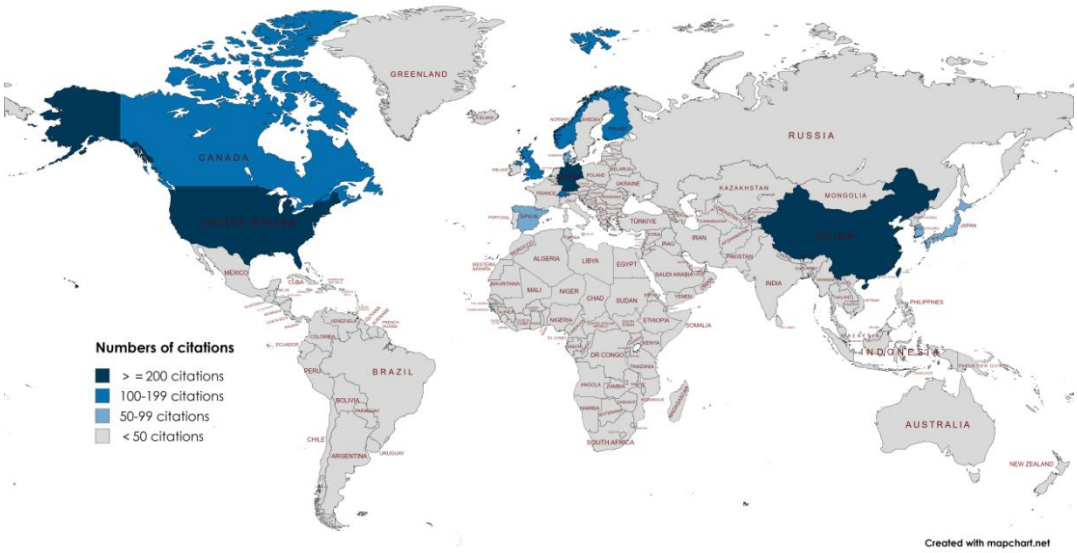

Figure 5. Global distribution of publication citations

Table 2. Document and citation distribution based on author's country affiliation

Country	Documents	Citations
China	71	484
USA	64	725
Taiwan	31	353
Germany	20	468
England	20	188
Spain	17	86
Australia	12	46
Finland	11	131
Japan	9	59
Malaysia	9	27
Norway	8	126
Canada	7	172
India	7	18
Turkey	7	37
Italy	6	64
Netherlands	6	27
South korea	6	90
Austria	5	49
Denmark	5	50
France	5	30

The following section will examine the phenomenon of multinational collaboration between authors and their affiliated countries. Figure 6 indicates that out of the 56 nations the writers are associated with, 41 individuals possess networks of co-authors originating from those nations. Seventeen additional nations, including Argentina, have been identified as lacking any form of global cooperation in undertaking analyses on this subject. When comparing Table 2 and Figure 6, it is evident that Chile, Poland, Portugal, India, and Zambia have independently published publications on this topic. However, they have not established any collaborative networks with other nations.

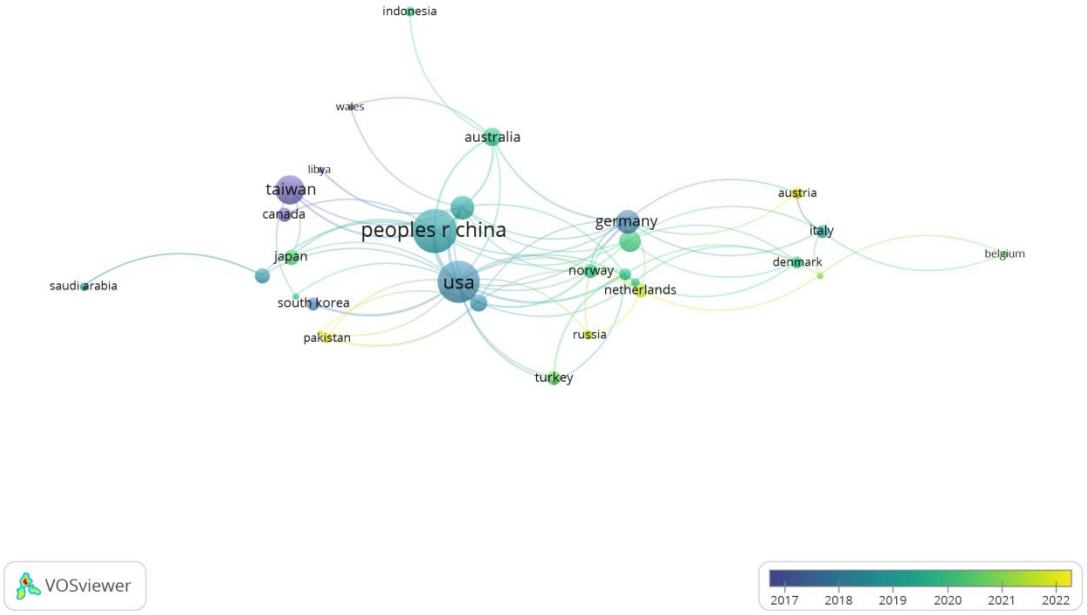

Figure 6. Co-authorship network by countries

Figure 6 depicts that China and the UNITED STATES are the main contributors to research this topic, as shown in the national co-authorship network. This result is apparent from the substantial number of network connections with other nations and the significant size of the circle, which indicates a more considerable amount of papers published from those countries on the country's co-authorship network. Furthermore, we can clearly see direct collaborations between China and the UNITED STATES. When the 34 related countries classified based on the frequency rate of co-authorship, it is possible to identify six distinct clusters (Table 3).

Table 3. Co-authorship clusters by countries

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Austria	Canada	Finland	Maylaysia	Australia	France
Denmark	Japan	Netherlands	South Korea	England	Turkey
Genrmany	China	Norway	USA		
Italy	Taiwan				
Spain					

4.3 Data Analysis of Journal

4.3.1 Journal of Choice

As presented in Table 4, the *Electronic Library, Computers and Education, Frontiers in Psychology,* and the *Library Hi Tech* are the four most highly cited journals publishing studies on the subject matter of the present study. Interestingly, judging from the average number of citations in periodicals, some journals like *Information Communication and Society, International Journal of Information Management, The Journal of the Association for Persons with Severe Handicaps*, and *Displays* have published only one relevant paper. However, the single articles have a considerable number of citations, with each having more than 50 citations. This result indicates that journals studying digital reading behavior are scattered in academic journals.

Table 4. Journals with a minimum of three relevant publications (number of articles and citations)

Journal	Total Article	Cite
Electronic Library	10	89
Computers & Education	9	299
Frontiers in Psychology	7	104
Library Hi Tech	7	97
Journal of Computer Assisted Learning	5	65
Interactive Learning Environments	5	53
Desidoc Journal of Library & Information Technology	5	17
Journal of Research in Reading	4	57
Reading and Writing	4	37
Learning and Individual Differences	3	126
Computers in Human Behavior	3	104
Journal of Academic Librarianship	3	88
Computer Assisted Language Learning	3	81
Journal of Documentation	3	74
Library & Information Science Research	3	51
Information Research: an International Electronic Journal	3	8

4.3.2 Data Analysis of Cited Journal and Citation

The journal *Computers and Education* is highly cited by other journals, as evidenced by the larger dots in the plot compared to others (Figure 7). This publication exhibits a significant amount of interconnectedness with six other journals, similar to the *Electronic Library* and *Library Hi Tech*. Based on Figure 7, the data for the one-year timeframe suggests that *Computers and Education* have received a significant number of citations. This finding is evident from the presence of yellow connecting lines, which represent the year 2020.

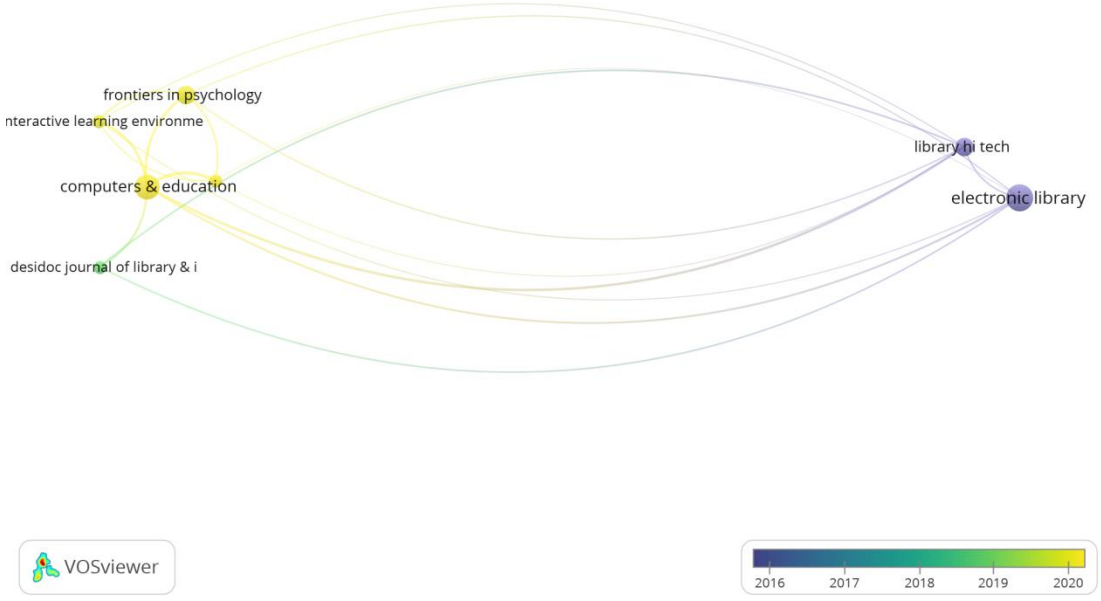

Figure 7. Network of citations in journal

4.4 State of the Art

4.4.1 Data Analysis of Cited Paper and Citation

A review of the literature reveals the ten most-cited papers, with each document receiving more than 60 citations (Table 5). It is evident that the paper authored by Pfost et al. (2013) is the most cited paper, having been cited 98 times. This paper primarily examines the influence of reading activities on enhancing reading literacy, particularly assessing diverse reading behaviors within the context of traditional print media and emerging digital reading formats on the Internet. This study was one of the first to compare digital reading with reading on paper. Quan-Haase et al. (2016) wrote the second most cited paper, which was cited 90 times. This empirical research is based on the impact of the development

of digital skills and communication technologies on older people's daily activities and practices. The paper reported that older adults use digital technology to replicate and adapt established habits.

Table 5. Top 10 cited papers

No.	Document title	Authors	Year	Cited by	Reference
1	Students' extracurricular reading behavior and the development of vocabulary and reading comprehension	Pfost, M; Dörfler, T; Artelt, C	2013	98	(Pfost et al., 2013)
2	Interviews with digital seniors: ICT use in the context of everyday life	Quan-Haase, A; Martin, K; Schreurs, K	2016	90	(Quan-Haase et al., 2016)
3	Undergraduates' Academic Reading Format Preferences and Behaviors	Mizrachi, D	2015	89	(Mizrachi, 2015)
4	Literacy before and after inclusion in general education settings: A case study	Ryndak, DL; Morrison, AP; Sommerstein, L	1999	84	(Ryndak et al., 1999)
5	Arrivederci CIAO.com, Buongiorno Bing.com'-Electronic word-of-mouth (eWOM), antecedences and	Khammash, M; Griffiths, GH	2011	70	(Khammash & Griffiths, 2011)
6	Gender differences in the online reading environment	Liu, ZM; Huang, XB	2008	68	(Liu & Huang, 2008)
7	Are Approaches to Learning in Kindergarten Associated with Academic and Social Competence Similarly?	Razza, RA; Martin, A; Brooks-Gunn, J	2015	64	(Razza et al., 2015)
8	Comparing reading processes on e-ink displays and print	Siegenthaler, E; Wurtz, P; Bergamin, P; Groner,	2011	63	(Siegenthaler et al., 2011)
9	Assessing children's reading comprehension on paper and screen: A mode-effect study	Stole, H; Mangen, A; Schwippert, K	2020	62	(Stole et al., 2020)
10	The relationship of Kolb learning styles, online learning behaviors and learning outcomes	Lu, H; Jia, L; Gong, SH; Clark, B	2007	59	(Lu et al., 2007)

Figure 8 illustrates the document citation network related to the subject matter of this study. Given the extensive research period on digital reading behavior in Web of Science, which began in 1988, there are nine sequences of interrelated papers comprising a total of 36 papers (Table 6). Sequence 1, which refers to the work by Hu and Yu (2021), has been recognized as one of the most often referenced publications. This research discusses how positive attitudes on social media can promote digital reading achievement. In cluster 2, the central paper is by Liu and Zhang (2014). This study examined the interactive effects of information cascades, Internet word of mouth, and recommender systems on online user behavior.

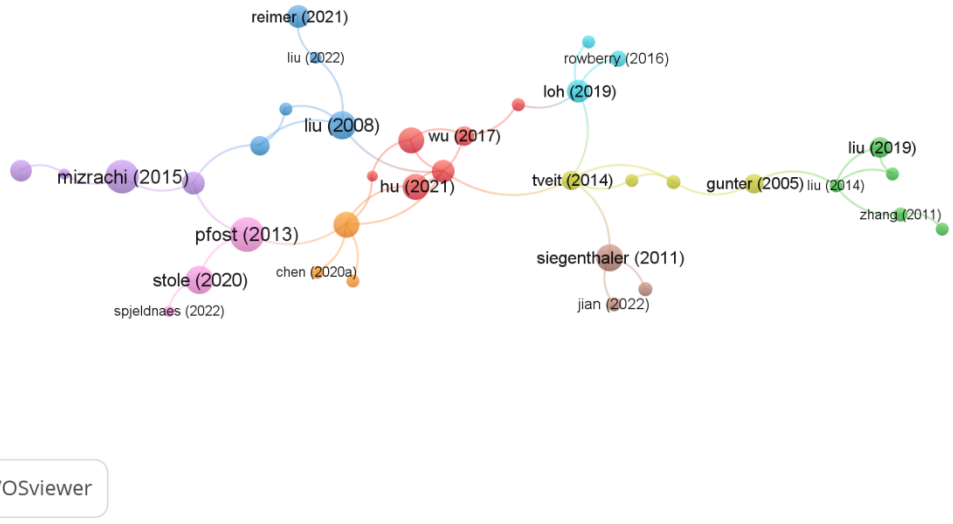

Figure 8. Document citation network

Table 6. Citation cluster with a minimum of 3 publications

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
(Hahnel et al., 2016)	(Q. Liu & Zhang, 2014)	(Kurata et al., 2017)	(Clowes, 2019)	(Farinosi et al., 2016)
(Hahnel et al., 2017)	(Q. Liu et al., 2019)	(Z. Liu & Huang, 2008)	(Grzeschik et al., 2011)	(Halamish & Elbaz, 2020)
(Hu & Yu, 2021)	(Q. Liu et al., 2020)	(Z. Liu, 2022)	(Gunter, 2005)	(Kuhn et al., 2024)
(Jang et al., 2021)	(L. Zhang & Ma, 2011)	(Reimer et al., 2021)	(Tveit & Mangen, 2014)	(Mizrachi, 2015)
(Lim & Jung, 2019)	(M. Zhang et al., 2017)	(Soroya & Ameen, 2020)		
(Wu & Peng, 2017)				
Cluster 6	Cluster 7	Cluster 8	Cluster 9	
(Loh & Sun, 2019)	(Chen et al., 2020)	(Jian, 2022)	(Pfost et al., 2013)	
(Rowberry, 2016)	(He et al., 2023)	(Siegenthaler et al., 2011)	(Spjeldnæs & Karlsen, 2024)	
(Schwabe et al., 2022)	(Naumann, 2015)	(Siegenthaler et al., 2012)	(Stole et al., 2020)	

4.4.2 Analysis of Keyword Co-occurrence

Table 7 and Figure 9 indicate the keyword analysis of the article collection. Figure 9 illustrates the co-occurrence keywords network obtained by using the Voswiever software. Similar colors indicate similar research top clusters. The keywords selected by the authors are the focus of the analysis in this section. Table 7 presents the 20 most frequently occurring keywords used by authors in their papers. It is important to note that some words with general characteristics, such as “digital reading,” “reading,” “e-reading,” “reading behavior,” “reading habits,” “online reading,” and “mobile reading” have been overlooked in this analysis. The article collection most commonly identifies “digital literacy,” “reading comprehension,” “eye movements,” “reading motivation,” “reading strategies,” “user studies,” “college students,” and “social media”. This section addresses most topics identified in the extant literature on digital reading behavior (Figure 9).Therefore, it can be inferred that research on digital reading habits primarily focus on the following subjects: the response by different users to digital reading behavior, reading strategies for digital reading, a comparison of reading effects between paper and digital reading, and eye tracking and effectiveness improvement research for digital reading.

Table 7. Keyword occurrences

No.	*Keyword*	*Occurrences*
1	*digital reading*	*42*
2	*reading*	*31*
3	*e-reading*	*24*
4	*e-books*	*24*
5	*reading habits*	*21*
6	*online reading*	*20*
7	*mobile reading*	*15*
8	*digital literacy*	*10*
9	*print reading*	*10*
10	*reading comprehension*	*10*
11	*eye movements*	*8*
12	*reading behavior*	*8*
13	*eye tracking*	*7*
14	*internet*	*7*
15	*literacy*	*7*
16	*reading motivation*	*7*
17	*reading strategies*	*7*
18	*user studies*	*7*
19	*college students*	*6*
20	*social media*	*6*

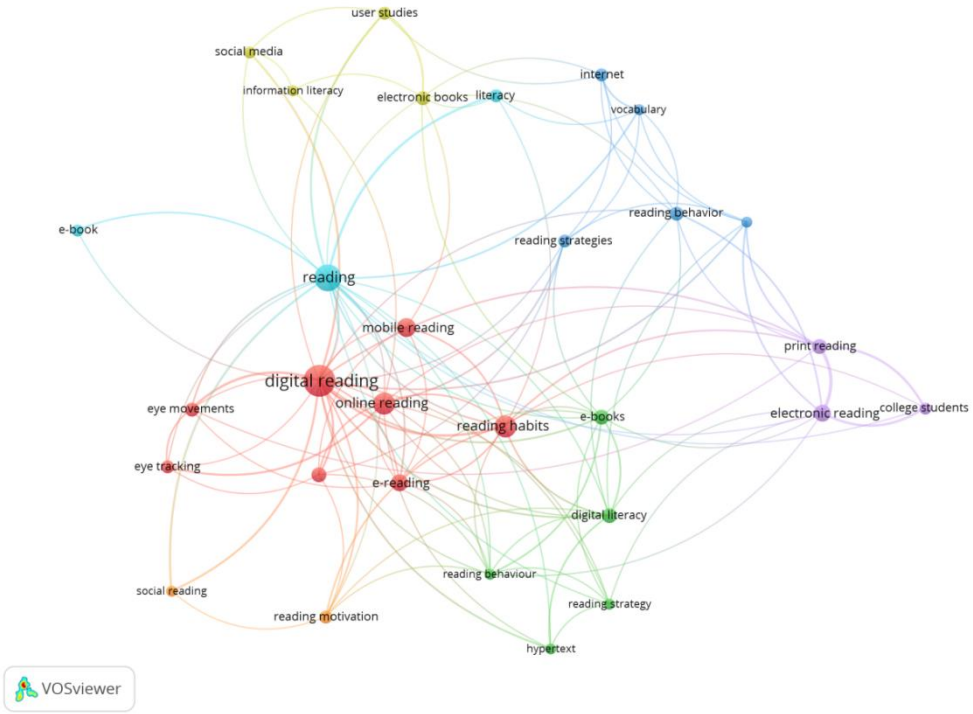

Figure 9. Co-occurrence keywords network

4.4.3 Bibliometric Coupling Analysis

A bibliographic coupling analysis of the clusters was conducted to ascertain the number of clusters of research on digital reading behavior based on using similar references. Figure 10 depicts the outcomes of bibliographic coupling and network analysis conducted with the VOSviewer software. Colors that are the same suggest that variables belong to the same cluster. There are five clusters of research references, which are presented in more detail in Table 9.

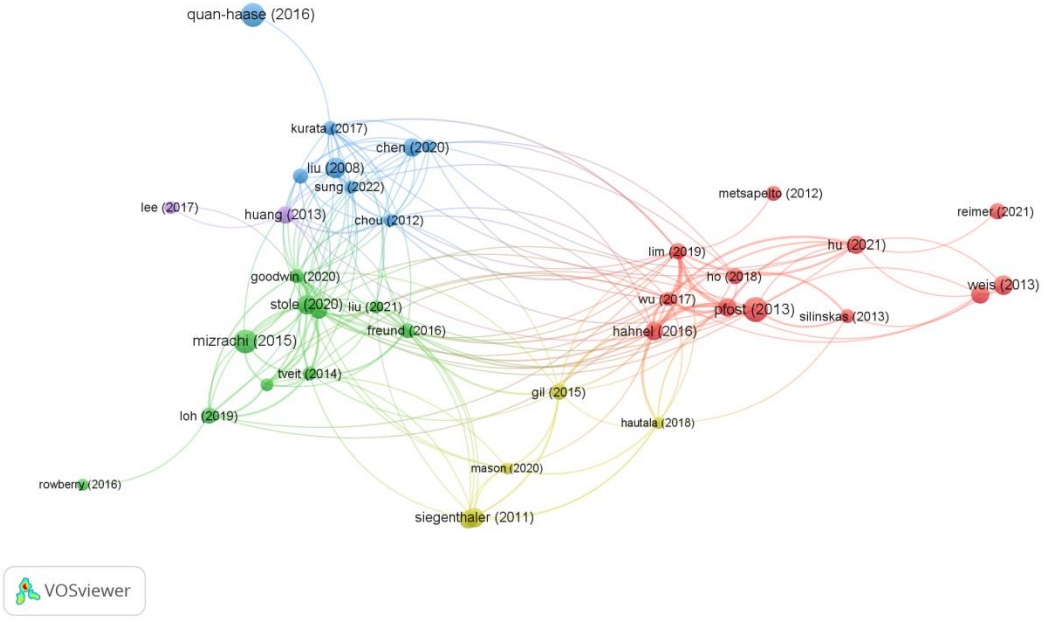

Figure 10. Bibliographic coupling and network analysis

A more detailed examination of the scientific articles associated with each group allowed for the identification of the meanings inherent in each cluster. The initial cluster, based on empirical evidence such as Programme for International Student Assessment (PISA) data, examines the impact of various factors, including family, school education, and social media, on the development of reading literacy among young people. The second cluster of studies concerns the differences between paper and digital readers regarding content learning, reading comprehension, receptivity, and

processing of reading information. The third cluster of studies discusses the relevance of reading tools, reading environment, language used, and reader demographics to digital reading strategies. Subsequently, in the four clusters, researchers employed tools such as eye-tracking and CompLEC to measure the behavior and performance of readers when reading digitally.

Table 9. Bibliographic coupling paper cluster

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Hahnel(2016)	Freund(2016)	Chen(2020)	Gil(2015)	Huang(2013)
Ho(2018)	Goodwin(2020)	Chou(2012)	Hautala(2018)	Lee(2017)
Hu(2021)	Halamish(2020)	Farinosi(2016)	Mason(2020)	
Lim(2019)	Liu(2021)	Jan(2016)	Siegenthaler(2011)	
Metsapelto(2012)	Loh(2019)	Kurata(20217)	Siegenthaler(2012)	
Naumann(2015)	Mizrachi(2015)	Liu(2008)		
Pfost(2013)	Rowberry(2016)	Quan-haase(2016)		
Razza(2015)	Stole(2020)	Sung(2022)		
Reimer(2021)	Trakhman(2018)			
Silinskas(2013)	Tveit(2014)			
Weis(2013)				
Wu(2017)				

5. Discussion

Over the past few decades, scholars have directed a significant amount of attention examining digital reading behavior. The research has fluctuated slightly over a five-year cycle but has maintained a certain level of research interest (Figure 2). Publications in the field of information and library science were the most preferred choice for publishing research on digital reading behavior. This finding is quite reasonable since digital reading is an interdisciplinary area of study situated at the nexus of information science and library science.

China and the UNITED STATES have become prominent countries in terms of scientific article published and citation counts related to digital reading behavior. China has implemented a series of “Reading for All” programs to guide the development of reading activities across the country (Liu, 2012), and the UNITED STATES has implemented the No Child Left Behind Act (NCLB) since 2001 (Goertz, 2005). Both countries are leaders in the development and research of digital reading. At the same time, both countries have made significant breakthroughs in the research and development of digital reading technology and equipment. The *Amazon Kindle* is a bestseller worldwide, and in China, companies such as *Hanwang* are also focused on developing digital reading devices. Both countries are at the forefront of research and development in digital reading.

Based on the context-related keywords in Table 7, comparative analysis in empirical research is most the most prevalent method used in publications on digital reading behavior. In other words, statistical methods are frequently employed to construct (and adjust) quantitative comparisons (Iranifard & Latifnejad Roudsari, 2022). This shift may be attributed to two underlying factors. First, comparative analysis is an old research mode widely used within many, if not all, fields of scientific inquiry; “the bulk of contemporary human and social sciences abound with examples of comparative approaches” (Azarian, 2011, p. 114). Second, since digital reading appeared, the comparison between paper reading and digital reading has not stopped. Researchers have studied different groups of people (the elderly or students), media carriers (electronic screens or ink screens), languages (English or non-English), and content (academic content or entertainment content) when comparing these different aspects of reading medium.

Based on this research, four research streams were identified as dominating publications on digital reading behavior namely (1) validation studies focusing on digital reading motivation, (2) exploratory studies focusing on digital reading behavior performance, (3) the role and position of media and technology in the digital reading process, and (4) the guidance of digital reading learning strategies to enhance learners’ digital reading literacy. A substantial body of research has focused on the relationship between digital reading behavior and motivation. In contrast to the established practice of reading from paper for millennia, digital reading has transformed the reading process, enabling the consumption of texts on computer screens, tablets, mobile phones, and other digital devices. On the other hand, shifts in the medium of reading have also influenced how reading is conducted, with the advent of hyperlinks and the accessibility of content at any time and in any location also affecting how people read.

A review of the research construct-related keywords (Table 7) revealed that researchers are consistently engaged in

studying reading content and tools, illustrating that it is also essential to focus on digital reading users. Many studies focus on specific target groups and have found certain differences in the perceptions and United Statesge effects of digital reading among different groups.

6. Conclusion

This bibliometric study provides a comprehensive analysis of three key aspects: researcher impact, journal influence, and the current state of research in digital reading behavior. Chen emerged as the most highly cited researcher in this field while Artelt, Doerfler, and Pfost held significant influence through their highly cited works. This finding highlights their substantial contribution to the discourse on digital reading behavior.

Regarding the author's nationality, China and the UNITED STATES have the highest number of researchers in this field. Five clusters of countries are actively participating in joint research on this particular topic: China, the UNITED STATES, Germany, and Norway are the primary countries in each global collaborative research cluster among the created clusters.

The majority of studies on digital reading behavior have been conducted in the fields of social science, educational technology, information science, and library science. *Electronic Library*, *Computers & Education*, and *Frontiers in Psychology* are the top three journals in terms of productivity and citations regarding digital reading behavior.

Looking ahead, promising opportunities exist for exploring areas beyond the current scope, particularly concerning individual reader differences, especially among adolescents and children. Future research could delve into topics such as reading motivation and habits in adolescents, the impact of social media on digital reading, and the acceptance intentions and behaviors of students toward digital reading. These areas offer rich potential for advancing our understanding of digital reading behavior and its broader implications.

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Authors contributions

Professor Dr. Hamedi Mohd Adnan and Dr. Muhammad Naeem Javed were responsible for study design. The manuscript was drafted by Ph.D. student Yang Yang, and revised by Professor Dr. Hamedi Mohd Adnan and Dr. Muhammad Naeem Javed. All authors have read and approved the final manuscript.

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The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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