



## An Analysis of Research Publications on Reading Habits in the Digital Environment (RHDE): A Bibliometric Approach

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The purpose of the study is to perform a bibliometric analysis of the literature related to reading habits in the context of the digital environment. For the study, researchers extracted the bibliographic details of 474 records indexed in Scopus and WoS databases, which were further used by Biblioshiny and VOS viewer software to carry out thematic analysis and visualisation, respectively. The study found that research publications on reading habits in the digital environment (RHDE) have consistently increased since 2007. “Digital reading” was the most popular topic from 1998 to 2023, with China leading in publications, followed by the USA. Further, Chen C.M. was the most productive author, Zhejiang University (China) was the most significant institution in RHDE research, whereas Lecture Notes on Computer Science was the most productive source and out of eight themes that evolved from the strategic diagram, themes like digital reading, reading, and mobile reading need to be explored more in the future. The findings of the study provide important insights into the most influential authors, institutions, and countries involved in this field. It also suggests potential directions for future research, making it a valuable resource for researchers and organisations interested in this area.

**Keywords:** Reading Habits; Digital Environments; Comprehension; Digital Reading; Reading; Mobile Reading

### Introduction

Reading is a “fundamental skill” in learning<sup>1</sup> and a process by which a person “derives meaning and comprehension by decoding words from a text”<sup>2</sup>. It helps to improve critical thinking and develop new and different perspectives of an individual<sup>3</sup>. Engaging in reading consistently enhances an individual's ability to acquire information and knowledge, eventually. Chettri and Rout explained Reading Habits (RH) as the “activity of reading is regarded as a habit when it is repeatedly carried out”<sup>4</sup>. To simplify the concept of RH, Dukare described it as “behaviour that induces an individual to read books” for knowledge or entertainment or to spend time<sup>5</sup>. Further, RH may vary from person to person based on various factors, including preferences. Some people prefer to read from a printed form, whereas others read from a digital form. In printed form, people read from physical material such as books, newspapers, magazines, etc., whereas in digital form, people read from their electronic counterparts on digital devices. Recent technological advancements have fundamentally transformed the way we consume and interact with

written content. The proliferation of smartphones, tablets, and e-readers has made digital reading increasingly accessible and convenient. As a result, a growing number of individuals are opting for e-books and online articles over traditional print media<sup>6</sup>. This shift not only reflects changing preferences but also indicates a broader cultural move toward instant access to information and the ability to read anytime and anywhere. The shifting trend of using these digital devices has influenced the reading habits of readers in different ways. As a result, reading from these devices has become more common for educational, leisure, and work-related activities<sup>7</sup>.

In the present scenario, with the considerable development in technologies and the widespread use of digital devices, the research on RH can also be seen inclining towards digital rather than print<sup>2,8,9,10,11</sup>. Due to this transition from print to digital in the RH research domain, researchers worldwide have also shown interest and studied how digital devices impact the reading habits of different groups of people in digital environments. To understand this phenomenon, so far, several studies have been conducted on different

aspects of RH<sup>12,13,14,15,16</sup>, which have directly or indirectly contributed to the growth of the RH research domain. Further, as the number of publications on Reading Habits in the Digital Environment (RHDE) increases, the efforts and works made by different stakeholders and their contributions in this domain need to be identified, which may help to provide crucial information regarding the direction of future research. The present study is a bibliometric analysis of RHDE literature to determine the most influential and cited articles, authors, journals, trending topics and main research themes related to the RHDE domain.

The primary research Questions of this study are as follows:

### Research Questions (RQ)

1. What is the publishing trend in the RHDE domain from 1998 to 2023?
2. Who are the most productive authors, and which countries, institutions and sources have the highest publications in RHDE?
3. What are the main themes or sub-themes that can be found across the RHDE research domain?

### Review of literature

Technological advancement has significantly impacted the way we read. To understand this phenomenon, several researchers have focused on different aspects of reading in the digital environment and demonstrated intriguing findings. An insightful study conducted by Hahnel *et al.*<sup>17</sup> revealed that Information Communication Technology (ICT) - related skills are a prerequisite and relevant among students for digital reading. To delve deeper, Lim and Jung<sup>18</sup> did a “multi-level analysis using an international-scale dataset” (PISA 2009). The study found that navigation (“measured by the number of relevant pages visited”) positively predicted digital reading ability across schools and countries, while attitudes toward ICT significantly influenced digital reading. Fortunati and Vincent<sup>19</sup> investigated how digital technologies impact reading and writing in the educational environment. Where the result showed that “reading and writing competencies are changing with digital technologies”. In this context, Freund *et al.*<sup>20</sup> assessed how different textual environments impact reading. The results indicated that both the Plain Text and Interactive conditions positively impacted comprehension outcomes in academic reading, but their contributions were not merely additive. Similarly,

Delgado *et al.*<sup>21</sup> studied the effects of reading media on comprehension. The study revealed that paper-based reading leads to better comprehension outcomes compared to digital-based reading.

Baron *et al.*<sup>22</sup> conducted a global study among university students about their reading practices. The study revealed that “Cost and convenience are the primary drivers of digital reading in higher education”. On the other hand, Fajardo *et al.*<sup>23</sup> examined the link between digital reading and digital skills. They found that students faced challenges with essential digital skills, which they believed affected their performance on digital reading tasks.

Apart from that, some studies have also focused on the reading format and gender variable of RHDE. In this direction of research, Reich *et al.*<sup>24</sup> compared tablet-based eBooks to print books in young children’s learning. They found that well-designed eBooks can be as effective or even more effective than print books. Thayer *et al.*<sup>25</sup> investigated the use of e-readers among graduate students in their academics and revealed that “e-readers in academia depend on varied reading practices of students”. Furthermore, in the context of gender reading, Liu and Huang<sup>26</sup> examined gender differences in the online reading environment and found that females prefer paper as a reading medium, while males are more satisfied with online reading. Ronconi *et al.*<sup>27</sup> investigated the effects of “reading medium on adolescent readers” and revealed that reading medium affected comprehension of the main idea. Compared to girls, boys were faster and had “higher calibration” when reading on “screen compared to paper”.

### Methodology

To achieve the study's objectives, the researchers have adopted the four-step strategy (Figure 1) to carry out bibliometric analysis. For this, the study has followed the procedures of previous studies<sup>28,29,30</sup>.

#### Step 1: Selection of bibliometric database

Scopus and Web of Science (WoS) are two popular databases that index thousands of peer-reviewed journals from various disciplines. Due to the comprehensive coverage of these databases, “scholars' communities, students, and professionals” use them frequently to search their academic literature. Therefore, the study selected Scopus and WoS databases to extract the bibliographic dataset on the reading habit.



Fig. 1 — Workflow of the study

**Step 2: Formulation of the search strategy and preparation of the dataset**

Search strategy plays a significant role in retrieving suitable datasets from a database. So, to achieve this objective, the study used equivalent and alternate keywords with the “OR” Boolean operator to retrieve the dataset from Scopus and Web of Science databases. A total of 947 records (in “. bib” text format) from Scopus and 234 records (in “.txt” format) from WoS were retrieved on 6 October 2023. Subsequently, the filtration process was carried out with the help of R studio, where the retrieved data from both databases were combined to remove the duplicate and erroneous records. After removing 206 duplicate and 9 erroneous records, a total of 966

Table 1 — Search terms used in Scopus and WoS database

Searching terms	
	"Digital Reading" OR
	"Digital Reading Habits" OR
	"Digital Reading Behavior" OR
searching fields	"Digital Reading Culture" OR
(Title, Abstract,	"Digital Reading Pattern" OR
Keywords)	"Digital Reading Trend" OR
	"Digital Reading Practice" OR
	"Mobile Reading"

records were extracted in Comma-Separated Values (CSV) format for further analysis.

**Step 3: Screening of the retrieved literature and preparation of the final dataset**

To attain the final dataset for further analysis, the researchers selected two variables (title and abstract

of the article) for screening. After meticulously reviewing the titles and abstracts of 966 pieces of literature, researchers excluded 492 irrelevant publications for the study and selected the remaining 474 publications with a retention rate of 49.07 % (474 out of 966) as a final sample for further analysis.

#### Step 4: Bibliometric and Thematic analysis

The study used two techniques (performance analysis and science mapping) for the bibliometric analysis to explore and analyse large volumes of scientific literature. Further, to see the thematic evolution, the study implemented thematic analysis using Bibliometrix software to identify the main themes and sub-themes of the RHDE research domain. Later on, for visualisation, VOS viewer software was used to create a cluster network via keyword co-occurrence analysis based on the main theme of all four quadrants. (Figure 6).

#### Result and analysis

To see the trend and pattern related to Reading Habits in the Digital Environment (RHDE), the study analysed the articles published during the period 1998 to 2023. Table 2 shows the descriptive statistics of 474 articles published in the RHDE domain. A total of 1007 authors worldwide contributed 474 papers, which were published in 290 sources (including books, journals, etc.) and used 1293 author-specific keywords. Further dataset revealed that in the RHDE research domain, the average proportion of citations per publication was 10.11, whereas the average author per document was 2.12, co-authors per document was 2.85, and the collaborative index was 6.751.

Figure 2 depicts the annual growth rate of publications in RHDE and their citations. It was noticed from the figure that even though the research in the RHDE domain was started in the year 1998, however actual rise and consistency in the RHDE research publication can be seen from 2007. Further, the trend of citations reveals that the oldest published articles are getting more citations than the new ones.

Figure 3 displays the trending topics of the RHDE research domain based on the top research keywords that occurred frequently from 1998 to 2023. In the figure, the circle shape shows the number of occurrences of keywords, whereas the horizontal line shows the research period. Throughout the time frame, a total of 42 topics were trending for a specific period, including digital document readers, field study, information systems, library services, e-book

resources, personal digital assistant, blind people, diary study, automatic text highlighting, browsing interface, accessibility, acrobat, design, icdl, mobile communication systems, mobility, digital documents, user interfaces, annotation, e-reader, ebooks, active reading, e-book, electronic books, literature, academic libraries, e-books, digital, literacy, hypertext, mobile reading, social reading, reading comprehension, comprehension, digital reading, reading, reading habits, higher education, Pisa, text comprehension, Pisa reading, analog reading. Out of all topics, digital reading occurred the highest number of times (180), whereas digital document readers, field study, information systems, library services, e-book resources, and personal digital assistants had the lowest occurrence among all topics.

Table 3 depicts the top ten most productive authors based on the publications in the RHDE research domain (from 1998 to 2023). Based on the articles, Chen C M from National Chengchi University (Taiwan) published the highest number of articles, followed by Hu J from Zhejiang University (China) with ten articles, and Naumann J from Goethe

Table 2 — Descriptive statistics

Description	Results
Time span	1998:2023
Sources (Journals, Books, etc)	290
Documents	474
Annual Growth Rate %	17.87
Document Average Age	6.86
Average citations per doc	10.11
References	6754
Keywords Plus (ID)	1319
Author's Keywords (DE)	1293
Authors	1007
Authors of single-authored docs	82
Documents per author	0.47
Author per document	2.12
Co-Authors per doc	2.85
Collaboration Index	6.751

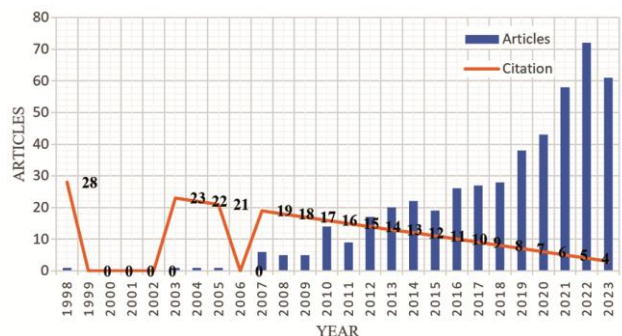


Fig. 2 — Annual growth and citation of publication

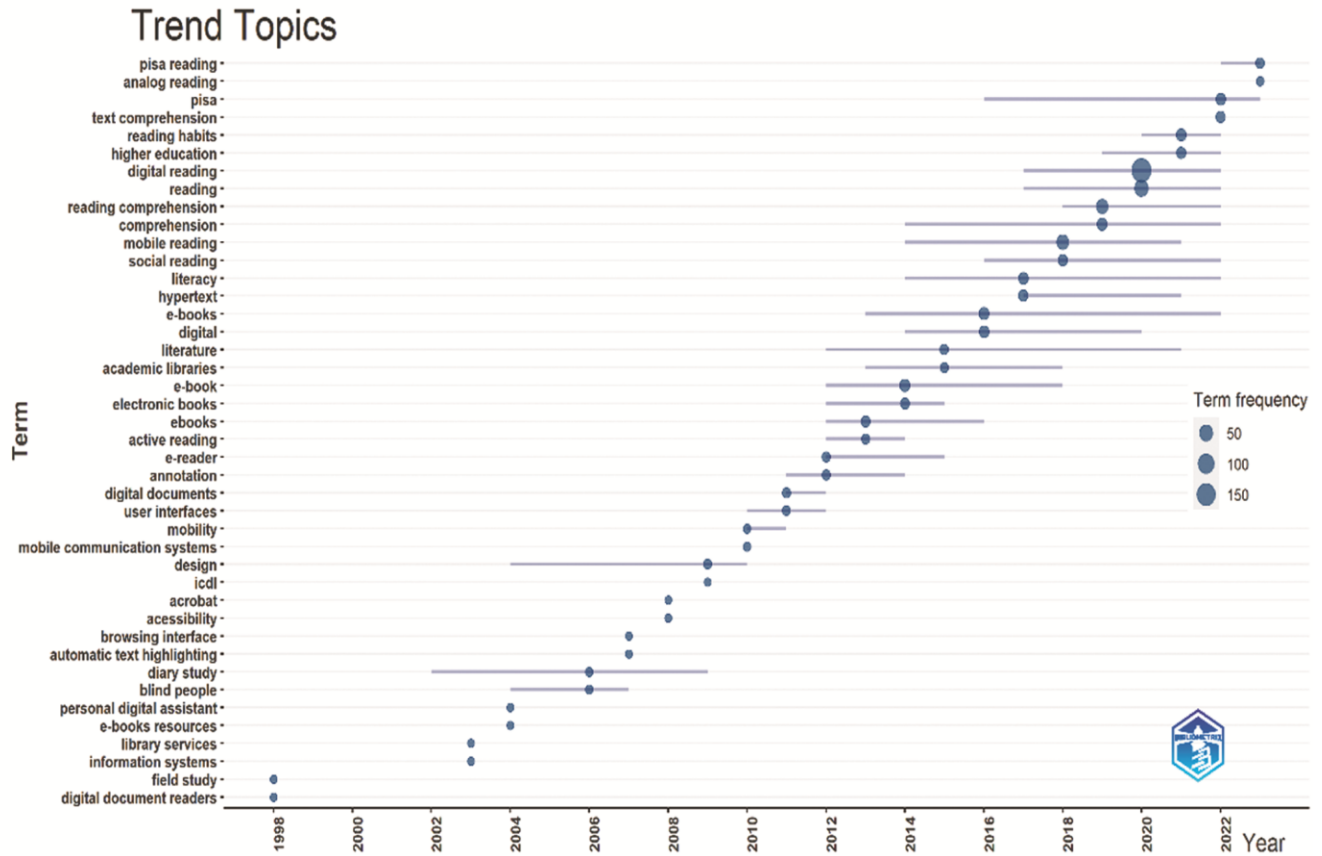


Fig. 3 — Trending topics

Table 3 — Top 10 prolific authors based on publication

Author	Articles	h_index	TC	Affiliation
Chen C M	13	7	254	National Chengchi University (Taiwan)
Hu J	10	4	58	Zhejiang University (China)
Naumann J	8	8	227	Goethe University (Germany)
Buchanan G	7	5	52	University of Melbourne (Australia)
Salmerón L	6	4	294	University of Valencia (Spain)
Schwabe A	6	3	15	University of Vienna (Austria)
Alexander P	5	4	330	University of Maryland (USA)
Pearson J	5	3	46	Swansea University (UK)
Mason L	5	2	26	University of Padova, Padova (Italy)
Goldhammer F	4	4	91	German Institute for International Educational Research (DIPF), Frankfurt am Main (Germany)

Note: TC = Total citation

University (Germany) with eight articles. However, in terms of citation, Alexander P. from the University of Maryland (USA) received the highest citation (TC=330).

Table 4 shows the top 10 most productive journals in the research domain of RHDE from 1998 to 2023. It was observed from the table that Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics) published 18 publications with 74 total citation count, followed by Computers & Education (NP=11, TC=341) and Conference on Human Factors in Computing Systems - Proceedings (NP=10, TC=256). Further, the list of disciplines in the table depicts that the majority of journals that published RHDE research belong to the Computer Science discipline, followed by Library & Information Science, Psychology, and Education.

Figure 4 represents the top 10 most productive institutions that published articles in the RHDE research domain. The figure reveals that Zhejiang University from China (n=13) has published a higher number of articles, followed by the National

Chengchi University from Taiwan (n=12), and Western Mindanao State University from the Philippines (n=10). This indicates that the top three countries which published the RHDE domain articles are from Asia.

Figure 5 represents the 10 most productive countries in the RHDE research domain. Based on the number of publications, China has the highest publication (n=166) followed by the USA (n=133) and Germany (39). The figure clearly shows that the top two countries lead significantly in the number of publications, creating a marked gap with those ranked from third place onward.

**Thematic analysis**

Figure 6 depicts the Strategic diagram of RHDE research for conducting thematic analysis. To generate a strategic diagram, the study used Biblioshiny software, where researchers set the

Table 4 — Most Productive Sources

Source	Disciplines	NP	TC
Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)- Book series	Computer Science	18	74
Computers & Education	Computer Science	11	341
Conference On Human Factors in Computing Systems - Proceedings	Computer Science	10	256
Acm International Conference Proceeding Series	Computer Science	10	13
Frontiers In Psychology	Psychology	8	90
Reading And Writing	An interdisciplinary journal	8	46
Communications In Computer and Information Science- Book series	Computer Science	7	17
Electronic Library	Library & Information Science	6	48
Investigacion Bibliotecologica	Library & Information Science	6	5
Interactive Learning Environments	Education	5	78

Note: NP=No.of publication; TC=Total citation

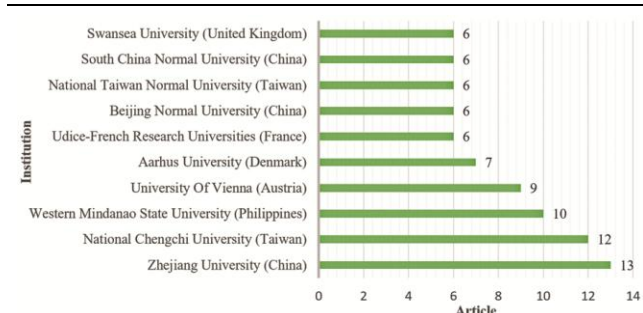


Fig. 4 — Most productive institutions

author's keywords with a minimum five-time occurrence and keywords with the highest frequency were considered as the themes for all four quadrants. In the figure, centrality and density are the measures that show whether themes in each quadrant are significant and relevant to the RHDE research domain or not. The first quadrant deals with “**Motor themes**”, considered “well-developed and interconnected themes” with “high centrality” and “density values” that significantly impact the RHDE research domain. The second quadrant deals with “**niche themes**,” which are also “well-developed, interconnected, and high-density themes”, but these themes “have lower centrality values and have less impact on the overall advancement” than “motor themes.” Whereas “**emerging or declining themes**” come under the third quadrant, where themes with low centrality and density value are neither well established nor interconnected. “**Basic themes**” in the fourth quadrant are highly relevant due to their high centrality but have low-density value, which sets the base for “future exploration and development” in the RHDE research domain.

Eight themes have evolved from the strategic diagram (Figure 6), which comes under different quadrants. These themes are digital reading, mobile reading, reading, comprehension, readability, cultural omnivorous, active reading, and interactive learning environments. Further, the strategy diagram depicts that out of eight themes, only four themes, comprehension of motor themes and digital reading, mobile reading, and reading of basic themes, have been found to be “prominent and influential.” In “**motor themes**,” the comprehension theme is relevant and plays a crucial role in developing the RHDE research domain. In contrast, themes like digital reading, mobile reading, and reading fall under “**basic themes**” hence they are highly relevant, however, need to be explored further, as these themes serve as a basis for future exploration in the RHDE research domain.

Moreover, to see the connection between extracted themes and their subthemes, the study used VOS viewer software and created the “cluster network” for each theme using “keyword co-occurrence analysis”. For this, researchers have collected all articles associated with each theme.

**Digital reading**

Digital reading is one of the themes under the basic quadrant. Figure 7 depicts the relationship of the

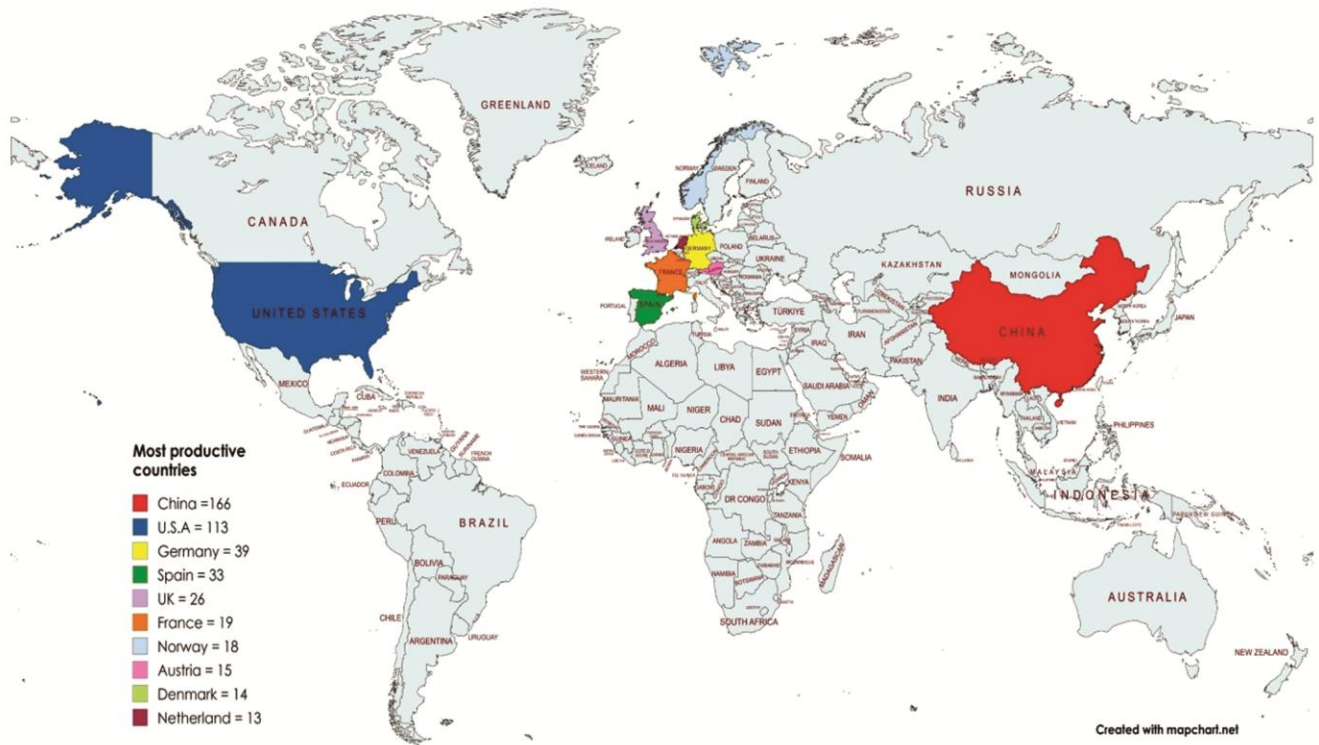


Fig. 5 — Most productive countries

**Thematic analysis**

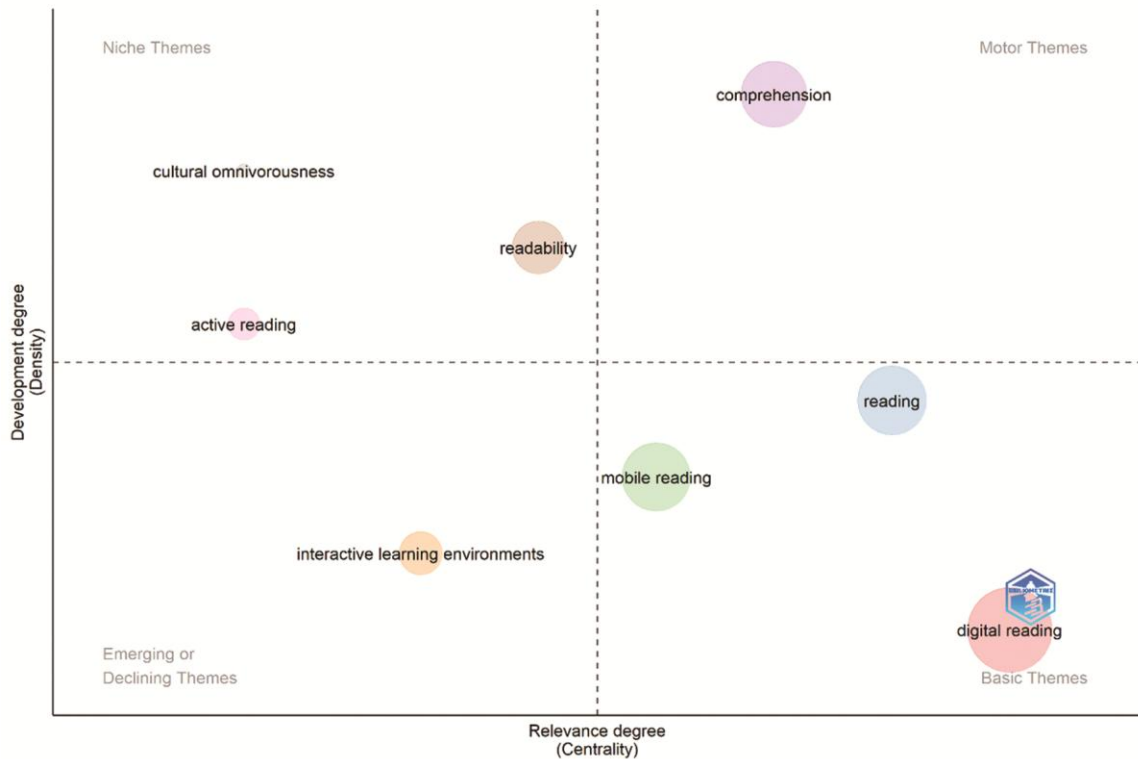


Fig. 6 — Strategic diagram of RHDE research (1992 to 2023)

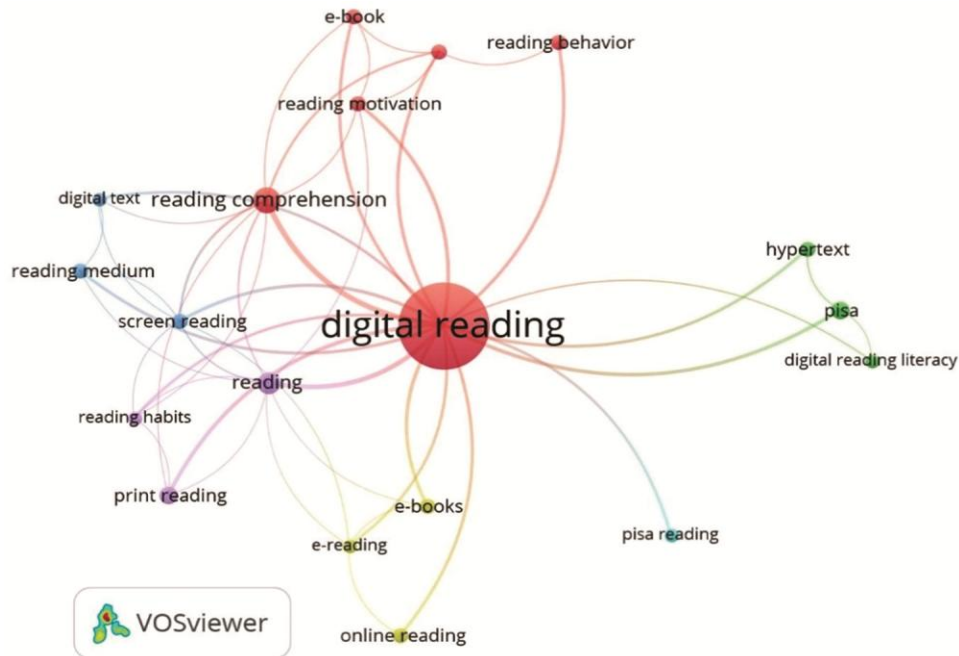


Fig. 7 — Keywords network of “digital reading” theme and focused areas of research

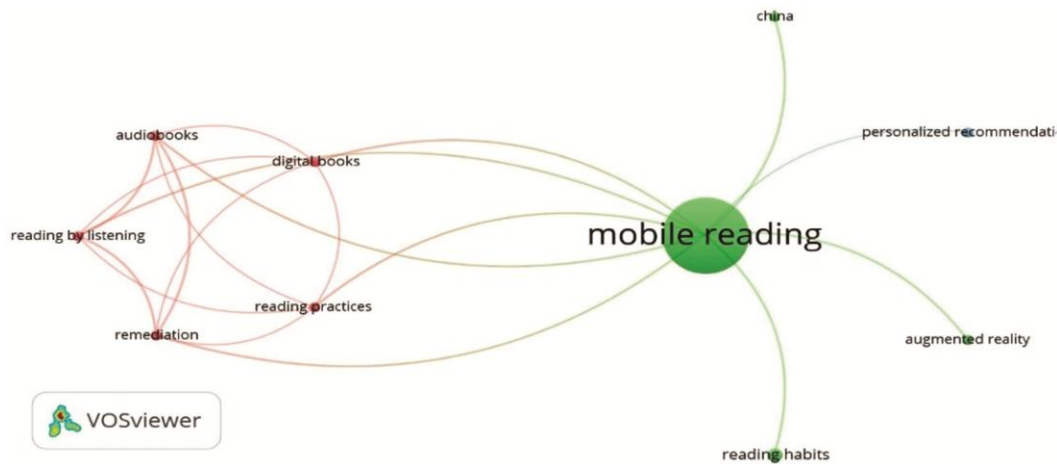


Fig. 8 — Keywords network of “mobile reading” theme and focused areas of research

digital reading theme with 19 various items of 6 clusters related to the RHDE research domain. Altogether, 203 articles out of 474 deal with digital reading in the study. These articles have focused on several aspects pertaining to RHDE, such as reading behavior, reading motivation, reading strategies, reading comprehension, digital reading literacy, hypertext, pisa, digital text, reading medium, screen reading, e-book, e-reading, online reading, print reading, and reading habits.

### Mobile reading

Mobile reading of the basic themes is connected with various nodes of 3 clusters, such as audio books,

digital books, reading by listening, reading practices, remediation, augmented reality, reading habits, and personalised recommendations (Figure 8). As this theme is not very developed, its reflection can be seen in the total number of articles published under it. Altogether, 37 articles have been published under the mobile reading theme so far.

Figure 9 presents a visualisation of the reading theme, which features the highest number of clusters (8) and links (116) compared to other basic themes. Under the RHDE research domain, the reading theme has more publications due to the widespread use of the “reading” keyword. So far, several studies have

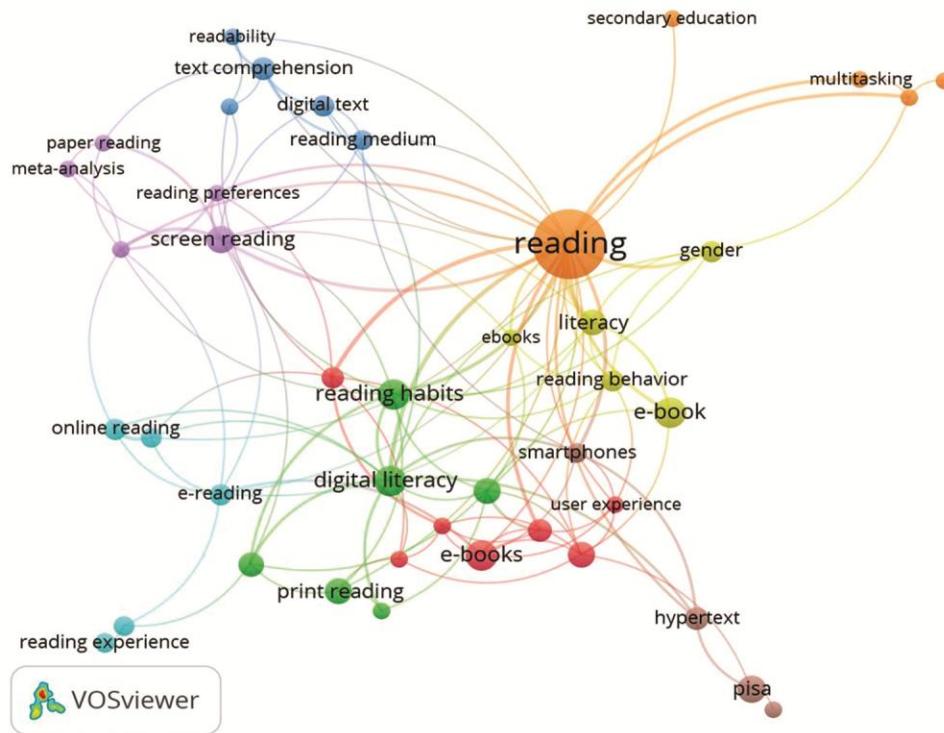


Fig. 9 — Keywords network of “reading” theme and focused areas of research

been carried out under this theme, which focused on different facets of reading such as gender, e-book, literacy, reading behavior, digital literacy, reading habits, smart phones, print reading, e-reading, screen reading, reading preferences, reading medium, digital text, text comprehension, readability, multitasking and secondary education.

### Comprehension

Comprehension is the only theme that comes under “motor themes”, which is relevant and has a crucial role in developing the RHDE research domain (Figure 6). The theme contains 19 items from 4 clusters, which have focused on various aspects related to the comprehension theme, such as digital, engagement, motivation, new literacies, reading strategies, and vocabulary, Primary education, readability, reading speed, secondary education, and text comprehension, calibration, digital reading, digital text, reading comprehension, screen reading, digital literacy, and reading (Figure 10).

### Discussion

The study is a bibliometric analysis of 474 research articles published and indexed in the WoS and Scopus databases under the RHDE research domain between

1998-2023. The result of the study reveals significant information related to **RQ1**: publishing trends, **RQ2**: most productive authors, countries, and institutions, and **RQ3**: main themes or sub-themes of the RDHE research domain.

(**RQ1**) In recent times, several studies have been conducted on reading habits. However, when we talk about research in the RHDE domain, its inception can be seen from 1998 onwards in our study (refer to Table 1). Since then, the research in this domain has shown an upward publication trajectory, which was similar to the finding of a previous study<sup>31</sup>. However, in citations, the results were opposite to each other's findings, where the number of studies was not directly proportional to their citations. Further, among all the trending topics (based on author keywords occurrence), the study revealed that “digital reading” was one of the trending topics among researchers, which can be identified in a similar study<sup>32</sup>.

(**RQ2**) From 1998 to 2023, numerous researchers contributed to the RHDE research domain by publishing a significant number of publications. Among the top five authors found from our study (Table 3), four authors, Chen C, Hu J, Naumann J and Salmerón L, were in line with the result of the previous study<sup>32</sup>. The dataset related to the top ten

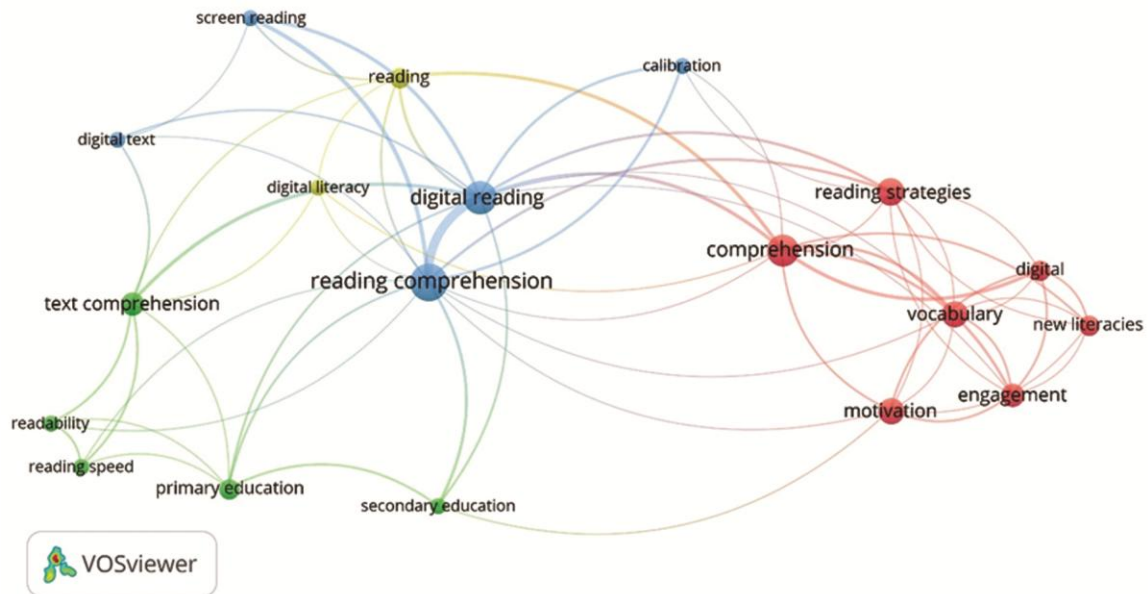


Fig. 10 — Keywords network of “comprehension” theme and focused areas of research

most productive countries in the RHDE research domain (Figure 5) revealed that except for China, the rest of the countries in the list were from Western countries belonging to Europe and America. Furthermore, as China emerged as a leading productive country in RHDE research publications, its reflection could also be seen in the most productive institutions, where Zhejiang University (China) emerged as the most productive institution with 14 publications, followed by National Chengchi University (Taiwan), with 12 publications and Western Mindanao state university (Philippines) with 10 publications. Whereas in the most productive sources, similar to the findings of a recent study conducted by Borgohain *et al.*<sup>33</sup>, Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Bioinformatics)-Book series of computer science discipline was the most productive source with NP=18 (Table 4). Apart from that, there were sources such as *Frontiers in Psychology*, *Reading and Writing* in the list, which were in line with previous studies and considered a significant publication source<sup>32,34</sup>.

**(RQ3)** The study visualised the four main themes (comprehension, digital reading, reading and mobile reading) from the two quadrants dealing with motor and basic themes. In our study, Comprehension falls under the motor theme of the RHDE research domain, which means it is one of the top-developed themes of this research domain. This result aligns with a similar study that conducted a Scientometric analysis based on co-word occurrence in the area of Universal

Reading Motivation, where Comprehension was found to be one of the top-researched themes<sup>35</sup>. Additionally, the study also found that digital reading was one of the basic themes that needed to be developed in the future. This finding is consistent with another related domain where “digital reading” was also identified as a basic theme<sup>36</sup>.

## Conclusion

It can be concluded from the study that research on RHDE is gaining popularity among researchers, and it is growing yearly with an annual growth rate of 17.87% (Table 2). Among 42 topics from 1998 to 2023, the “digital reading” topic was trending due to its highest number of occurrences in different research works. Regarding publications, China emerged as the top contributor, followed by the United States. Furthermore, the most productive author was Chen C M from the National Chengchi University of Taiwan, and Zhejiang University of China was noted as the most significant institution in RHDE research. Whereas in the most productive sources, Lecture Notes on Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Bioinformatics)-Book series of the computer science discipline stood out most productive. Moreover, the strategic diagram highlighted several key areas for future exploration, including digital reading, reading, and mobile reading. These themes present exciting opportunities for deeper investigation and development, reflecting the evolving landscape of reading in our increasingly digital world.

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