Trends in Digital Literacy: a bibliometric review from 2005 to 2024

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ABSTRACT: This research intends to provide a scientometric analysis of the literature in digital literacy, published from 2005 to 2024. Data is extracted from the Scopus database for the period 2005 to 2024. Then, MS Excel was used to find annual performance growth, VOSviewer was used to generate the co-authorship map, and authors' keyword co-occurrence networks. A total of 9043 articles were generated, showing an upward trajectory with time. This accumulated 97047 citations from 2005 to 2024, in which 2024 is the highest number of publications. Furthermore, the article "The relation between 21st-century skills and digital skills: A systematic literature review" has the highest citation of 1029, published in 2017. The key contributors are Rusudan Makhachashvili, an author; Deakin University, Australia, as an institution; and the United States, as a country. Furthermore, "ACM International Conference Proceeding Series" is the source journal with 162 publications. The topmost keywords authors use are digital literacy, COVID-19, and digital divide. The study concludes the growing interest of various stakeholders in digital literacy. This study offers valuable insights into the current trends of the articles published in the domain of digital literacy by mapping the articles using the VOSviewer.

Keywords: Digital Literacy, Information Literacy, Digital Competence, COVID-19, Scientometrics, Annual Growth Rate, Doubling Time, VOSviewer, Biblioshiny

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INTRODUCTION

Digital literacy (DL) is an essential competence that allows one to access and contribute to contemporary society's advances and changes. Digital competence and digital literacy are perceived as fundamental skills for working, learning, communicating, and participating in contemporary society. It has also assumed an important role in educational policies to support the progress of educational staff and students, which assists learning. The digital evolution of society through the invention and innovation in information and communication technology creates a gap between known and unknown. With the development of these new technologies, there is also a need to understand how to use these technologies. The efficiency with which these digital technologies are used and taken advantage of is known as digital literacy. In the current scenario, the future economy is driven by digital technologies, which gives rise to the job in which a person should have proficiency in digital skills. Thus, it became essential for developed or developing countries to increase the digital literacy of individuals, institutions, and society (Hammoda & Foli, 2024).

Paul Gilster introduced the term “digital literacy” to the world in 1997 with his pioneering book on the subject. He mentioned that digital literacy consists of the abilities and knowledge to navigate, evaluate, and communicate information effectively in a technology-enabled world. He suggested that it becomes crucial for a person to educate themselves in this digital world. Digital literacy is a field that has evolved as a complementary skill necessary for participants actively involved in modern society (Ng, 2012). It not only encompasses the technical skills with digital devices, but also involves critical thinking, ethical use of information, and an awareness of how digital communications are changing (Eshet, 2004).

This study primarily aims to examine trends by assessing annual growth, relative growth rate, and doubling time of scholarly publications in the field of digital literacy. This study also aims to identify the prominent contributors to the publications in the aforementioned literature. Additionally, the thematic focus and intellectual structure within the field are also explored by using the authors’ produced keywords. This approach reveals the trends, emerging areas, influential contributors, and research development in the field of digital literacy.

OBJECTIVES OF STUDY

The objective of this study is to conduct a bibliometric analysis on the topic of Digital Literacy. In this, the overall growth, key contributors, influential publications, source of dissemination, and emerging themes of the topic are analysed using the Scopus database. This gives the specific objective which was analyzed in this study are as follows:

1. To examine the year-wise output of publications related to Digital Literacy.
2. To assess the Relative Growth Rate and Doubling Time of the scholarly literature in this domain.

3. To highlight the most influential publications in Digital Literacy research.
4. To identify the leading authors, institutions, and countries contributing to this field.
5. To determine the core journals and sources disseminating Digital Literacy research.

LITERATURE REVIEW

New technologies and the growth of Web tools has demanded individual to equip technological skills and knowledge to navigate technology-oriented workplaces (Reddy et al., 2020). Literacy is the profound enrichment and transformation of human thinking capabilities by mastery of simple and practical skills (Reddy et al., 2020), digital literacy is the ability to understand and use information in multiple formats from various sources when presented via computers (Paul Gilster, 1997). According to Eshet (2004) digital literacy includes a variety of difficult cognitive, physical, sociological, and emotional abilities required by users to function effectively in a digital world, in addition to the operation of digital equipment and software (Eshet, 2004).

Several studies have been conducted in the domain of DL, which analyze the development of articles. Park et al. (2021) extracted data from Web of Science and performed a scientometric analysis of DL and related fields, including ICT literacy, information literacy, and media literacy and suggested that digital literacy is a multidisciplinary field. Similarly, Wang & Si (2023) extracted 7523 documents from the Web of Science and analyses current trends, and influential contributors in this domain by highlighting the potential of bibliometric analysis as a tool for Journal Metrics. Another study by G. Wang & He (2022) examine digital literacy in higher education and identified that effective evaluation of digital literacy can help in the integration of digital technology, ontology research, educational practices, and continuous learning during a pandemic like Covid-19.

The above-reviewed literature showed that further investigation into digital literacy is needed. One challenge is that maintaining the current definition and frameworks is challenging due to the expeditious evolution of digital technologies. However, many studies are concentrating on the formal education of digital literacy, but there is a lack of research on informal and lifelong learning contexts. Bibliometric studies can shed light on global research trends and help identify underrepresented areas in digital literacy research. To bridge this gap, a thorough bibliometric analysis is conducted on the Digital Literacy publications from 2005 to 2024.

METHODOLOGY

This section provides a detailed research methodology by outlining the procedure and techniques applied to conduct this study.

1. Scope and Limitations of the study: This study conducts a comprehensive scientometric study on the publications of digital literacy which is extracted from the Scopus database during the period from 2005-2024. The year 2005 is taken as the starting point because the number of publications before this year was less than ten, making the dataset insignificant for meaningful trends. Adding that the dataset includes only journal articles, reviews, and conference papers, while non-scholarly and non-English documents were excluded. The study is limited to Scopus database and does not include literature from other databases, such as Web of Science or Google Scholar.

2. Data Collection: Scopus is a leading bibliographic database by Elsevier that provides peer-reviewed scholarly content. In this study, the search query used for the term "digital literacy" in the Title, Abstract, or Keywords fields. The search was limited to 2005-2024, excluding earlier years with fewer than 10 publications in a year. The search query yielded 9,043 publications, which include journal articles, reviews, and conference papers extracted on November 8, 2024. Non-scholarly and non-English documents were excluded.

3. Search Strategy

The search strategy was constructed using the keyword string (Figure 1):

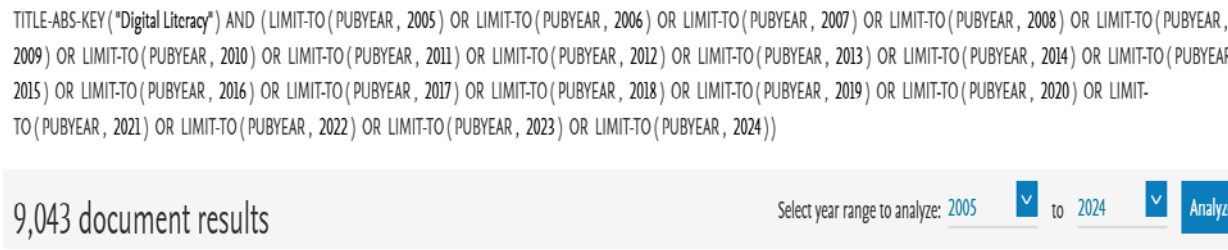

Figure 1: Search strategy

To enhance relevance, filters were applied for years (2005-2024), document type (article, review), and language (English). Duplicate records and incomplete metadata entries were removed to maintain data accuracy and consistency. The resultant documents on the topic of digital literacy were 9,043. This data was extracted on November 8, 2024.

4. Data analysis and Software tools: This study used scientometric analysis, which examines both performance indicators and science mapping aspects of Digital Literacy research (Aria et al., 2020).

MS Excel is accustomed to calculating year-wise publication growth, citation trends, relative growth rate (RGR), Doubling Time (DT), and identifying the most cited publications. However, VOSviewer version 1.6.20 was employed to create visualisation maps on co-authorship, institutional and country collaborations, and citation networks to detect the collaboration

between key contributors like Researchers, affiliations, countries, or sources (Van Eck & Waltman, 2023).

RESULTS

1. Year-wise Growth: This section presented the annual growth of the publications, which assists the researcher in understanding the importance of the topic. There is a total of 9043 documents published on the topic of DL from 2005 to 8 November 2024, publications before 2005 are not included as the number of publications is less than 10, which are indexed in the Scopus database. Table 1 represents the annual growth of the literature on the topic mentioned above, published from 2005 to 8 November 2024 in chronological order and observed an increasing trend. This increase in the number of literature suggests its importance and future relevance in the field of DL. This upward trajectory suggested that there is a high chance of getting more publications in the future.

Table 1: Annual Growth Rate

Sl. No.	Publication Year	Publication Count	Percentage	Citation Count	Citations per document
1.	2005	17	0.19	779	45.82
2.	2006	34	0.38	410	12.06
3.	2007	28	0.31	957	34.18
4.	2008	59	0.65	1382	23.42
5.	2009	92	1.02	2886	31.37
6.	2010	98	1.08	2319	23.66
7.	2011	115	1.27	2870	24.96
8.	2012	158	1.75	5169	32.72
9.	2013	201	2.22	3951	19.66
10.	2014	250	2.76	3957	15.83
11.	2015	245	2.71	4681	19.11
12.	2016	302	3.34	5700	18.87
13.	2017	337	3.73	6747	20.02
14.	2018	442	4.89	8221	18.60
15.	2019	619	6.85	8787	14.20
16.	2020	787	8.70	14347	18.23
17.	2021	917	10.14	9662	10.54
18.	2022	1139	12.60	7548	6.63
19.	2023	1502	16.61	5276	3.51
20.	2024	1701	18.81	1398	0.82
	Total	9043	100%	97047	10.73

Figures 2 and 3 highlight the dynamic evolution of the topic of DL, which is shaped by technological advancements, interdisciplinary applications, and the

global collaboration between researchers. Figure 2 illustrates the publication counts of the topic related to DL, whereas Figure 3 represents the citation count of the publications. The year 2020 received the highest number of citations, which is 14,347, as shown in Figure 3. This concludes that at the time of the epidemic of COVID-19, a higher number of works of DL were cited by the other authors in their study. This exponential growth of the publications revealed that research in the domain of DL becomes more pervasive and associative as time passes. Additionally, it highlights digital literacy as a promising research area for future study and exploration.

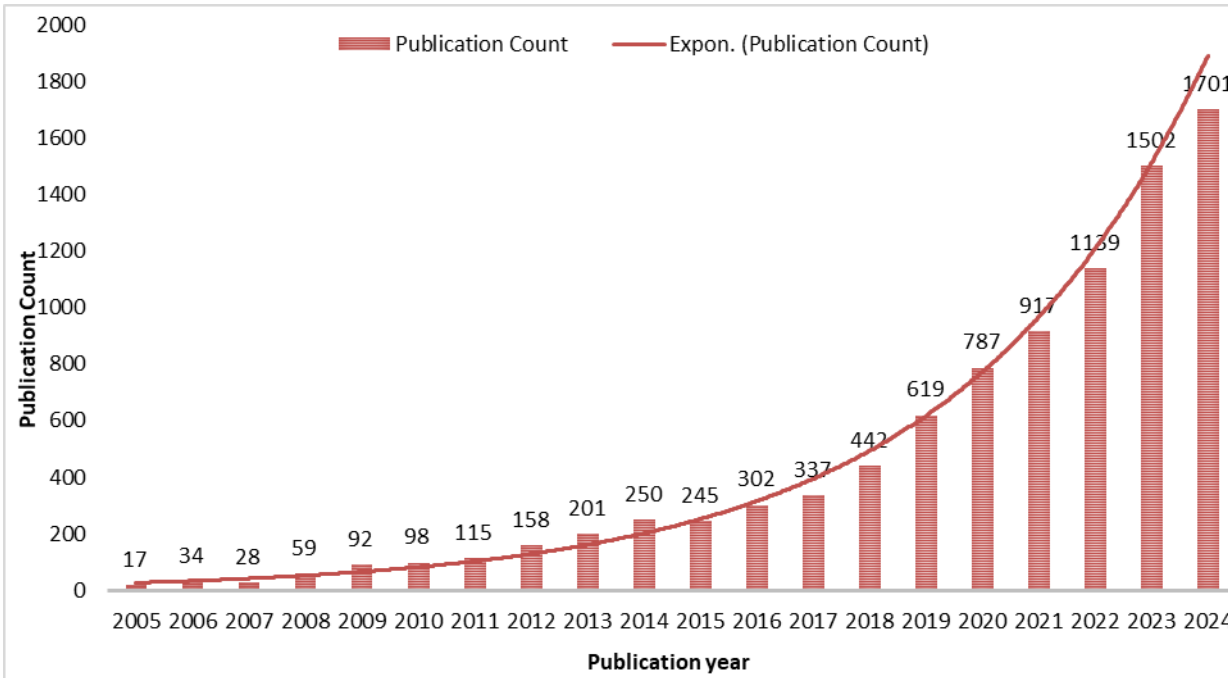

Figure 2: Growth of publications over time.

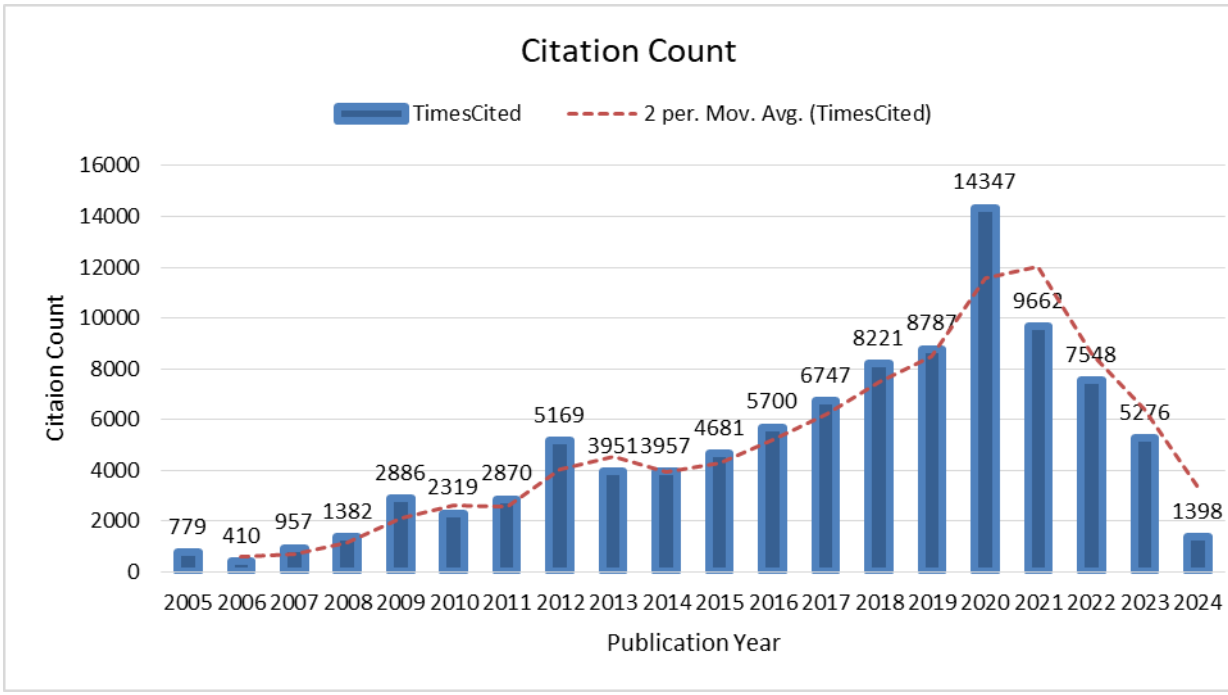

Figure 3: Growth of citations over time.

2. Relative growth rate and doubling time: The relative growth rate is increased in the number of publications per unit of time (Hunt, 1990). Mathematically, it can be represented as

$$R(1-2) = \frac{W1 - W2}{T2 - T1}$$

Where, R (1 - 2) = Mean relative growth rate over the specified period
W1 = Ln W1: (Natural log of starting number of publications)
W2 = Ln W2: (Natural log of final number of publications)
T2-T1 = the unit time difference between the initial time and final time.

This presented the growth of the articles relative to the previous year's publications. This helps researchers, scholars, and funding agencies to understand the future growth of the literature on the specific topic. Figure 4 illustrates the article's relative growth rate (blue lines) and doubling time (red lines). As shown in Figure 4, the Relative Growth Rate (blue line) exhibited a sharp rise during the early years (2005-2007), indicating a sudden increase in scholarly interest in Digital Literacy. The highest RGR was recorded in 2017 (1.75).

On the other hand, Figure 4 illustrates a small decline and stabilisation in the RGR from 2015 to 2024, suggesting that the field has transitioned from an

emerging field to a more established research domain. Additionally, the average RGR for that entire period was 1.32.

Doubling time is another important indicator that helps to measure how long it takes for the number of publications to double. It is inversely proportion to the RGR and is mathematically calculated as:

$$\text{Doubling Time (Dt)} = \frac{0.693}{R}$$

where R/or RGR is the Relative Growth Rate of the publications.

Figure 4 illustrates the Dt trend shown by the red line. Notably, the year 2005 exhibits the highest Dt value of 1.71, indicating that publication growth was sluggish because it was still in its initial phase. However, the Dt values show a gradual decline with minor fluctuations that indicate increased and sustained research productivity, particularly between 2010 and 2023. Additionally, the average doubling time for aforementioned period was 0.57, highlighting that the field has been expanding steadily.

Overall, the negative relationship between RGR and Dt shows that although the amount of research on digital literacy has increased dramatically, the rate of growth has stabilised recently, showing the maturity and academic consolidation of the area.

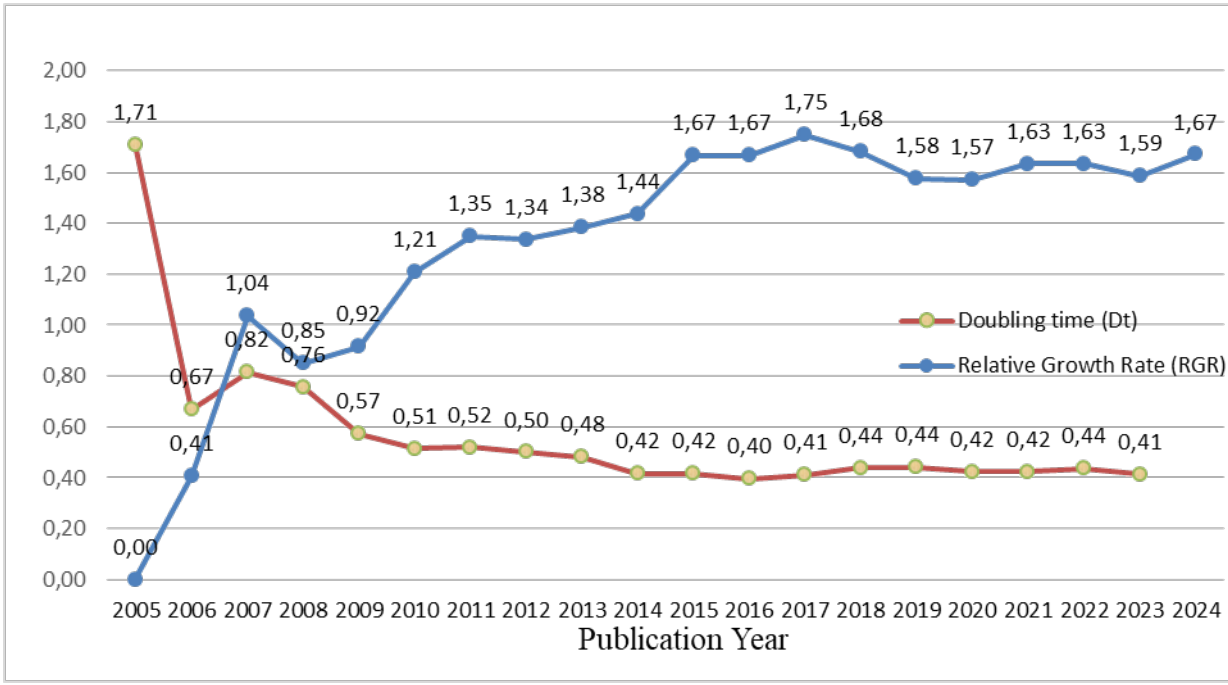

Figure 4: Relative growth rate and doubling time of articles published

3. Most influential articles: Information on the most influential articles helps identify the high-demand scientific topics in a specific field. Here, influential articles are those that are influenced the work of others, i.e., the metric to decide an influential article is the citations given to that article. Accordingly, Table 2 represents the top 10 influential articles in the literature on digital literacy. However, the most influential article is "The relation between 21st century skills and digital skills: A systematic literature review" with 1029 citations. The aforementioned article is authored by Ester Van Laar, which is published by Computers in Human Behaviour in 2017. Furthermore, the article titled "The "all of us" research program" authored by Joshua C. Denny with 966 citations and "The dark side of information: Overload, anxiety and other paradoxes and pathologies" authored by David Bawden has 792 citations on second and third position respectively. Notably, these top 10 influential articles contributed a total of 6480 citations, which inferred that so many works were influenced by these articles in this or other fields of the study.

Table 2: Most Cited Articles

Rank	Articles	Authors	Sourced Journals	Citations	Publication Year
1	"The relation between 21st-century skills and digital skills: A systematic literature review"	Van Laar, Ester et al.	Computers in Human Behavior	1029	2017
2	"The "all of us" research program"	Denny, Joshua C. et al.	New England Journal of Medicine	966	2019
3	"The dark side of information: Overload, anxiety and other paradoxes and pathologies"	Bawden, David et al.	Journal of Information Science	792	2009
4	"Children and adolescents and digital media"	Chassiakos, Yolanda Reid et al.	Pediatrics	719	2016
5	"Can we teach digital natives digital literacy?"	Ng, Wan.	Computers and Education	590	2012

6	"The participation divide: Content creation and sharing in the digital age"	Hargittai, Eszter & Walejko, Gina.	Information Communication and Society	547	2008
7	"eHealth literacy: Extending the digital divide to the realm of health information"	Neter, Efrat & Brainin, Esther.	Journal of Medical Internet Research	512	2012
8	"Barriers and solutions to online learning in medical education - An integrative review"	O'Doherty, Diane et al.	BMC Medical Education	506	2018
9	"From digital literacy to digital competence: the teacher digital competency (TDC) framework"	Falloon, Garry.	Educational Technology Research and Development	420	2020
10	"Mitigating the psychological impact of covid-19 on healthcare workers: A digital learning package"	Blake, Holly et al.	International Journal of Environmental Research and Public Health	399	2020

4. Key contributors

The key facilitators responsible for creating impactful knowledge in this domain are discussed. Exploring the key contributors in the domain of DL assists the researcher and various stakeholders, in collaboration with funding agencies, in identifying expertise for a high return on investment.

A. Researcher:

Researchers are the one who takes part in the creation of knowledge. A detailed analysis of the researchers assists young researchers in learning and exploring the domain of digital literacy with the help of an impactful researcher.

Furthermore, Table 3 represents the list of the top 10 researchers in the domain of digital literacy in terms of publications (NP), Average publication per year (APY), Citations Score (CS), Collaboration Link Strength (CLS), and average citations per document (ACD), where the top 5 are highlighted.

Considering the number of publications, Rusudan Makhachashvili was the most productive author with 23 publications in digital literacy. She is the Head of the Department of Romance Langauge and Typology, chaired at Kyiv Boris Hrinchenko University, Kyiv, Ukraine. However, I. Semenist is in the second position with 20 publications, and Lukasz Tomczyk is in the third position with 15 publications.

Table 3: Top 10 researchers in the domain of digital literacy

Rank	Author	Organization	Country	APY	NP	CS	CLS	ACD
1	"Rusudan Makhachashvili"	"Borys Grinchenko Kyiv Metropolitan University"	Ukraine	2021.96	23	50	20	2.17
2	"Ivan Semenist"	"Borys Grinchenko Kyiv Metropolitan University"	Ukraine	2021.95	20	45	20	2.25
3	Łukasz Tomczyk	Jagiellonian University	Poland	2020.81	15	214	3	14.27
4	Ola Erstad	Univeristy of Osla	Norway	2014	13	235	2	18.08
5	Heidi Julien	University at Buffalo	United States	2018.92	13	130	16	10.00
6	Ana Perez-Escoda	Universidad Antonio Nebrija	Spain	2019.46	13	392	0	30.15
7	Ekaterina Tour	Monash University	Australia	2019.31	13	211	2	16.23
8	Jackie Marsh	University of Sheffield	United Kingdom	2015.17	12	353	3	29.42
9	Sarah McGrew	Univeristy of Maryland	United States	2020.17	12	773	20	64.42
10	Carita Kiili	University of Tampere	Finland	2018	11	305	10	27.73

APY= Average Publications per Year NP= Number of Publications CS= Citations Score CLS= Collaboration Link Strength ACD= Average Citations per Document

Regarding the collaboration intensity, the dataset analysed using VOSviewer to illustrate co-authorship pattern of the researchers. Based on the analysis the 9,043 publications authored by 23,229 authors. Among them, the software identified the top 1,000 authors with the strongest collaboration links. From this, a connected network of 44 prominent authors was generated, visualized in Figures 5 and 6.

Figure 5 (Network Visualization) displays authors as nodes, where the dimensions of each node represent the number of publications (NP), and the lines indicate collaborative relationships (CLS). The network is divided into three major clusters shown in red, green, and blue. In this visualization, Sungwon Yoon (NUS Medical School, Singapore) stands out in this with four publications and links to 45 other researchers, making him the most collaborative author in the network. However, Lian Leng Low and Haikel A. Lim, associated with the National University of Singapore, followed him with 41 and 40 collaborative links, respectively.

Figure 6 (Overlay Visualization) focuses on citation influence (CS) and the Average Publication Year (APY). The color gradient represents the recency

of publications – yellow represents more recent authors. In this visualization, Lian Leng Low appears prominently in yellow with an average publication year of 2022.60, indicating recent and active contributions to digital literacy research.

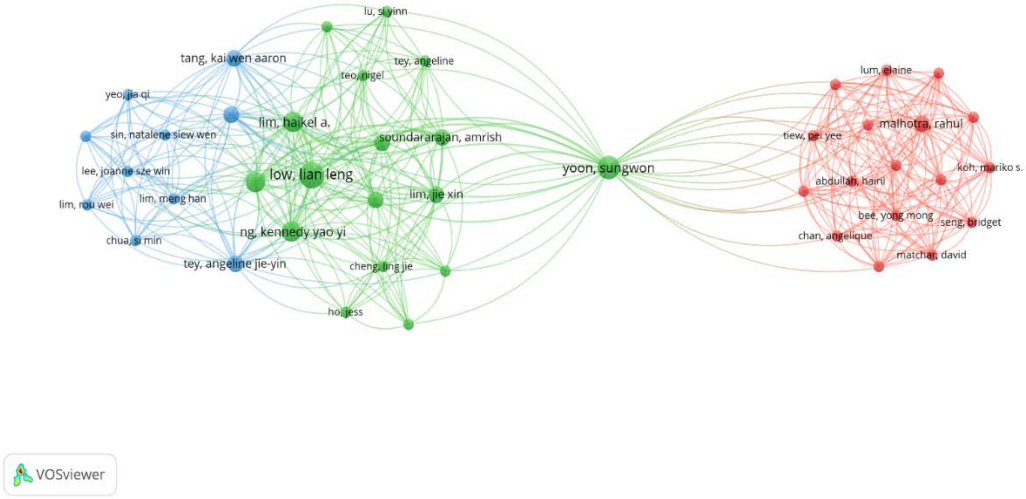

Figure 5: Network Visualization of Researchers based on NP and CLS
NP=Number of Publications CLS= Collaboration Link Strengths

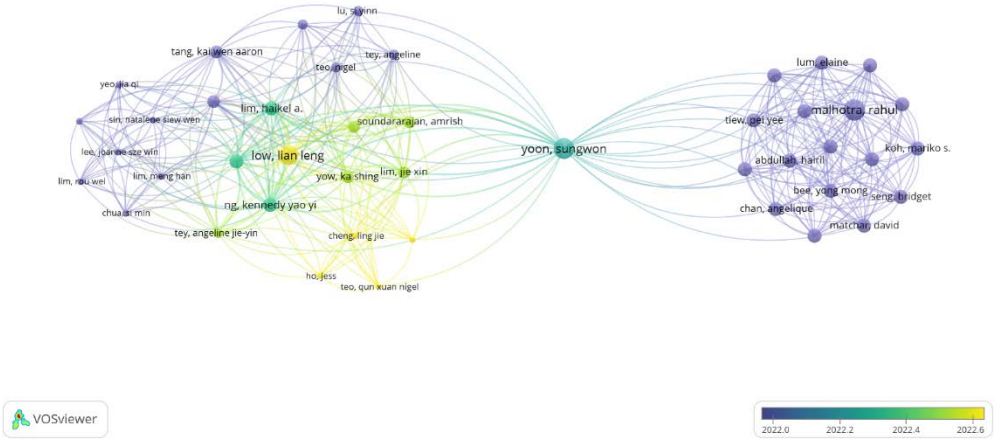

Figure 6: Overlay Visualization of Researchers based on CS and APY

CS= Citations Score APY= Average Publications per Year

B. Organization:

Organizations/ or institutions are where the researcher researches the topic of his/her interest. It provides details of the institute's productivity, interest, and funds allocation for exploring digital literacy knowledge. Analysis of the institutions at which the author conducted their research helps fellow researchers in the same field support potential academicians, allocate funds, and develop policies for advancing the topic.

Considering this, Table 4 presents the top 10 most relevant affiliations that produce publications in the domain of DL, highlighting the top 5 in terms of the number of publications (NP), collaboration link strength (CLS), citations score (CS), and average citations per document (ACD). Among these organization/or institutions, Deakin University (Australia) ranks first, with 14 publications and the highest citation score of 418. It also records an average of 29.86 citations per document, indicating strong scholarly influence in Digital Literacy research. Following this, “Universidad Complutense de Madrid” and “Universidad Internacional de La Rioja” (Spain) contributed 12 and 11 publications, respectively.

Table 4: Top 10 organizations in the domain of Digital Literacy

Rank	Organization	Country	APY	NP	CLS	CS	ACD
1	Deakin University	Australia	2015.79	14	1	418	29.86
2	Univerisdad Complutense de Madrid	Spain	2022.08	12	2	40	3.33
3	Universidad Internacional De La Rioja	Spain	2021.09	11	5	64	5.82
4	University of Oslo	Norway	2018.6	10	0	121	12.10
5	State University of Management	Russia	2020.7	10	1	27	2.70
6	Universidad De Granada	Spain	2019.89	9	0	56	6.22
7	Universidad De Sevilla	Spain	2019.67	9	2	108	12.00
8	University of Washington	United States	2016.89	9	1	178	19.78
9	Arizona State University	United States	2018	7	2	38	5.43
10	Queensland University of Technology	Australia	2019.71	7	3	68	9.71

APY= Average Publications per Year NP= Number of Publications CLS= Collaboration Link Strength CS= Citations Score ACD= Average Citations per Document

For co-authorship analysis between the institutions, a minimum threshold of one publication and zero citations per organisation was applied in VOSviewer. The software set a threshold of 1,000 from the 16,622 organisations, resulting in 44 organizations with the strongest collaboration links among the authors, as illustrated in Figures 7 and 8.

Figure 7 illustrates the Network Visualisation, which illustrates nodes as institutions. The size of the nodes represents the publication output of the organisation (NP), and the lines connecting them indicate collaboration (CLS). This indicates that the “Population Health and Integrated Care Division” of Singapore General Hospital has 51 collaboration links, resulting in four publications, making it the institution with the most collaborations in the domain of Digital Literacy. Following that, the Faculty of Health Sciences at the University of Beira Interior (Portugal) has 32 collaborations, resulting in 2 publications, and the “Department of Internal Medicine” at the “National University Health System” (Singapore) has 28 collaborations, also yielding 2 publications.

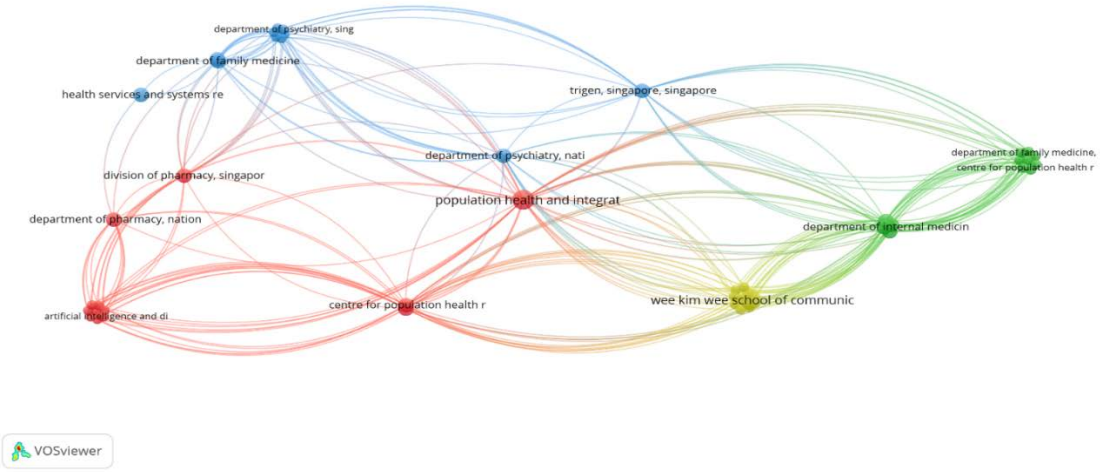

Figure 7: Network Visualisation of Organisations based on NP and CLS

NP= Number of Publications CLS= Collaboration Link Strength

Figure 8 shows an Overlay Visualisation which illustrates the evolution of the organisation over time based on average publication year. Organisations with yellow shades represent more recent contributions. The Artificial Intelligence and Digital Innovation Research Group, situated in Singapore, shows the most recent activity in Digital Literacy research with an average publication year of 2024. Furthermore, organisations such as the Department of Bioengineering, located at the University of California, and the National University of Singapore have shown a consistent engagement over time. Notably, some organisations produce fewer publications even after the high levels of collaboration.

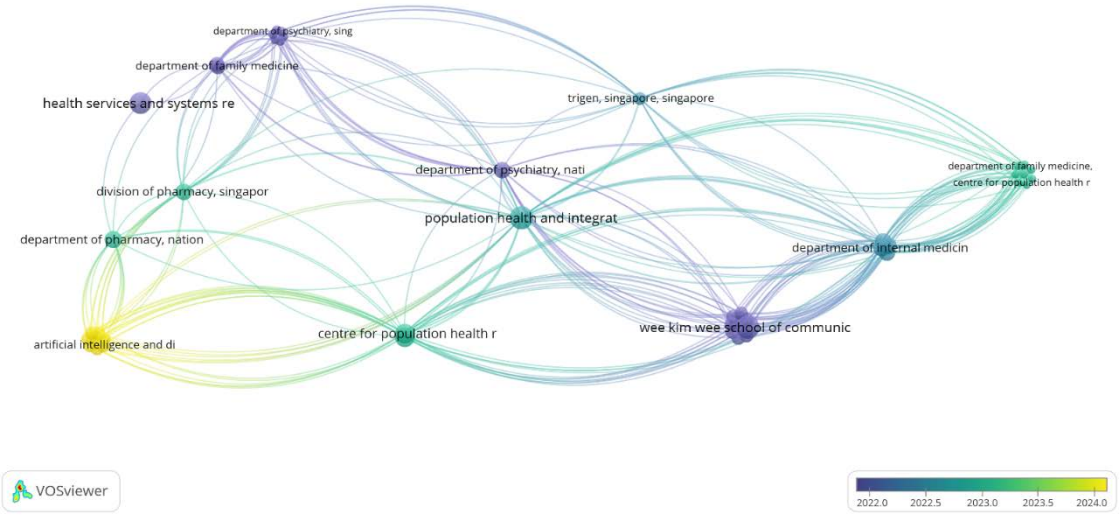

Figure 8: Overlay Visualization of Organizations based on CS and APY
CS= Citations Score APY= Average Publications per Year

C. Countries: This section provides the geographical distribution of the publications in the field of digital literacy. It provides insights into the global research participation and collaboration. In other words, this analysis identifies the most productive and influential countries contributing to the advancement of DL. Table 5 lists the topmost 10 most productive countries, whereas Figures 9 and 10 show how they work together and how their work has changed over time in the field of DL research using VOSviewer. For network visualisation, a minimum threshold of five publications and zero citations per country was taken. Based on this standard, 102 countries met the inclusion level, of which 101 formed a connected collaboration network.

The network visualisation shown in Figure 9 illustrates how countries collaborate with each other. Here, the node size represents publication output, and connecting lines indicate their collaboration and the strength of the collaborations. The overlay visualisation, as shown in Figure 10, highlights temporal progression i.e., how things have changed over time. The lighter-coloured nodes correspond to more recent activity, highlighting how Asian and emerging economies have become more relevant in recent years.

The results show that the United States is the leading nation in this domain, acquiring the highest publications (NP=1,763), citations (CS=27,254), and collaboration links (CLS=603). This shows that the nation has a robust

research infrastructure, funding support, and active collaborations with other countries. The United Kingdom and Australia come in second and third positions, respectively. Both have plenty of international collaborations and a high citation impact, indicating that their academic ecosystems are well-developed and their skills are very focused on digital skills and information and communication technology.

Additionally, Spain (NP = 600, CS = 7,345) has made a significant contribution, indicating its developing role in Digital Literacy research among European countries in the last few years. Likewise, Asian countries like Indonesia (NP = 532) and China (NP = 407) have shown a sharp rise in publication volume in recent years, reflecting emerging scholarly interest. However, these countries still have relatively lower average citations per document (ACD = 4.73 and 5.93, respectively). This shows that even though productivity is growing, the impact and visibility of research are still growing.

Notably, Fiji is the country with no links with any other countries. However, it have 10 publications. This suggests that Fiji's research efforts in digital literacy are primarily independent. Such independent contributions show the global importance of DL.

In terms of influence, after the United States, countries such as Spain, Australia, China, Germany, Canada, and Indonesia also exhibit substantial citation impact, reflecting both regional leadership and thematic diversity in DL research. Overall, the trend indicates that developed countries (e.g., USA, UK, Australia, Spain, Canada) continue to lead in both productivity and impact, while developing nations (e.g., Indonesia, China, India, Russia) are rapidly expanding their research footprint, marking the globalization of digital literacy discourse.

Table 5: Top 10 countries in the domain of digital literacy

Rank	Country	APY	NP	CLS	CS	ACD
1	United States	2019.05	1763	603	27254	15.46
2	United Kingdom	2019.08	781	576	15272	19.55
3	Australia	2019.04	609	314	9384	15.41
4	Spain	2019.68	600	286	7345	12.24
5	Indonesia	2022.16	532	118	2515	4.73
6	China	2022.57	407	185	2414	5.93
7	Canada	2019.35	364	205	4764	13.09
8	India	2021.57	355	184	2487	7.01
9	Russia	2021.39	292	89	1114	3.82
10	Germany	2020.96	281	292	3121	11.11

APY= Average Publications per Year NP= Number of Publications CLS= Collaboration Link Strength CS= Citations Score ACD= Average Citations per Document

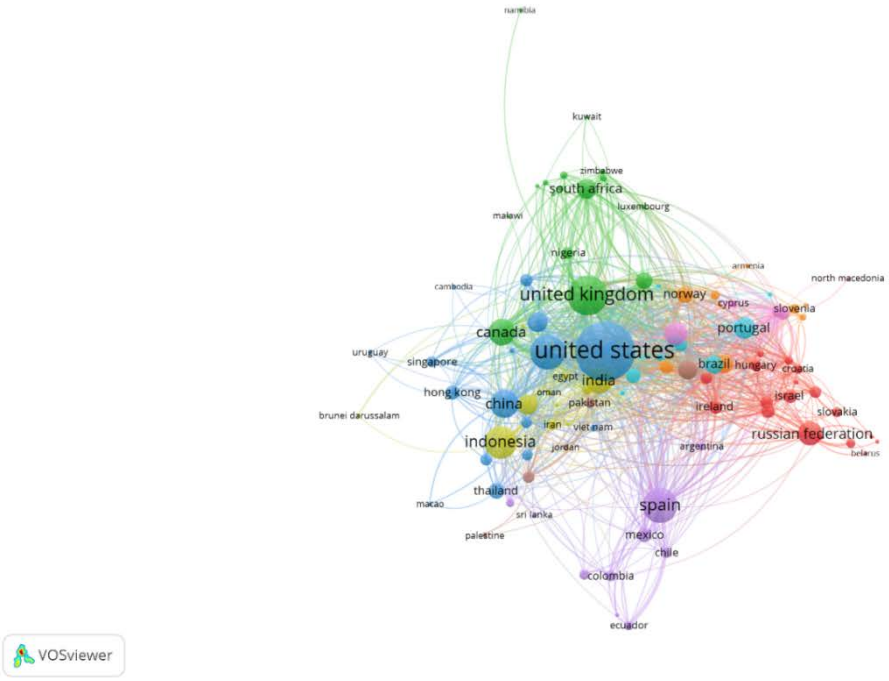

Figure 9: Network Visualization of Countries based on NP and CLS
NP= Number of Publications CLS= Collaboration Link Strength

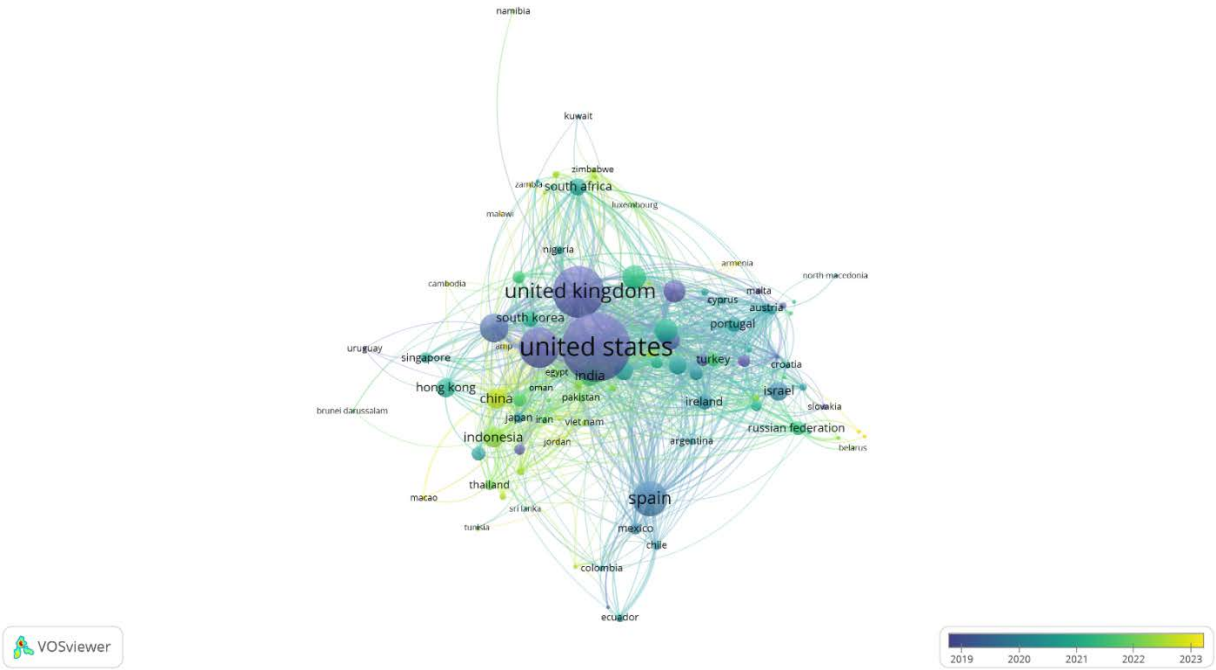

Figure 10: Overlay Visualization of Countries based on CS and APY

CS= Citations Score APY= Average Publications per Year

5. Top sources: Sources (journals, conference proceedings, and series) are the driving force in disseminating scientific knowledge and shaping scholarly communication in the domain of DL. The number of publications, which a scholarly publications, for sources is an effective method to identify and explore the pioneers in the field of digital literacy (Khodabandelu & Park, 2021). Table 6 lists the top 10 sources in terms of number of publications (NP), Citation Score (CS), Collaboration Link Strength (CLS), average publications per year (APY), and Average Citations per Document (ACD), with the top 5 highlighted.

The ACM International Conference Proceedings Series is the most productive source 162 publications, indicating its popularity among researchers for presenting conference-based outputs on digital literacy and technology integration. However, it has a relatively low citation influence (ACD = 2.60). In contrast, the Journal of Medical Internet Research records the highest Citation Score (2079) and highest ACD (30.57), making it the most influential source in terms of research impact rather than publication volume. Education and Information Technologies ranks highly in terms of both productivity (NP = 81),

influence (CS = 1851), and demonstrates the strongest collaboration network (CLS = 266), highlighting its pivotal role in DL scholarship.

Table 6: Top 10 sources of scholarly publications in the domain of digital literacy

Rank	Source Title	APY	NP	CL	CS	ACD
1	ACM International Conference Proceeding Series	2019.7	162	49	421	2.60
2	Lecture Notes in Computer Science	2019.5	122	26	361	2.96
3	Communications in Computer and Information Science	2018.88	114	42	255	2.24
4	Education and Information Technologies	2021.53	81	266	1851	22.85
5	Lecture Notes in Network and Systems	2022.52	75	13	56	0.75
6	Journal of Medical Internet Research	2021.22	68	6	2079	30.57
7	Sustainability (Switzerland)	2022.23	66	56	1086	16.45
8	Journal of Adolescent and Adult Literacy	2016.8	59	113	1052	17.83
9	Ceur Workshop Proceedings	2018.54	54	2	100	1.85
10	Computers and Composition	2016.04	51	37	625	12.25

APY= Average Publications per Year NP= Number of Publications CS= Citations Score ACD= Average Citations per Document

For network visualization, VOSviewer applied direct citation analysis with a minimum threshold of five documents per source. From 3662 sources, 338 satisfied the criterion, and 305 established an integrated collaborative network (Figures 11 and 12). Figure 11 displays source productivity and collaboration patterns, where node size represents the publication output and link thickness indicates the magnitude of collaboration. Figure 12 (Overlay Visualization) illustrates publication recency and impact trends, where lighter colors indicate more recent contributions, facilitating the identification of emerging journals in DL research.

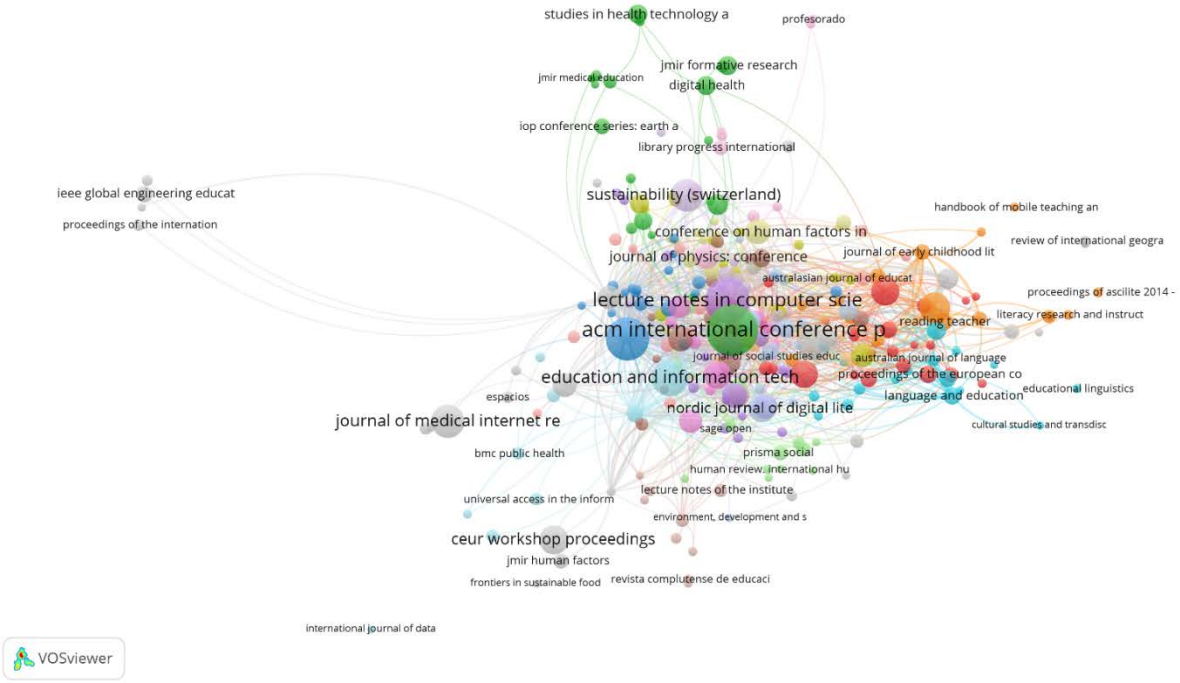

Figure 11: Network Visualization of sources based on NP and CLS
NP= Number of Publications CLS= Collaboration Link Strength

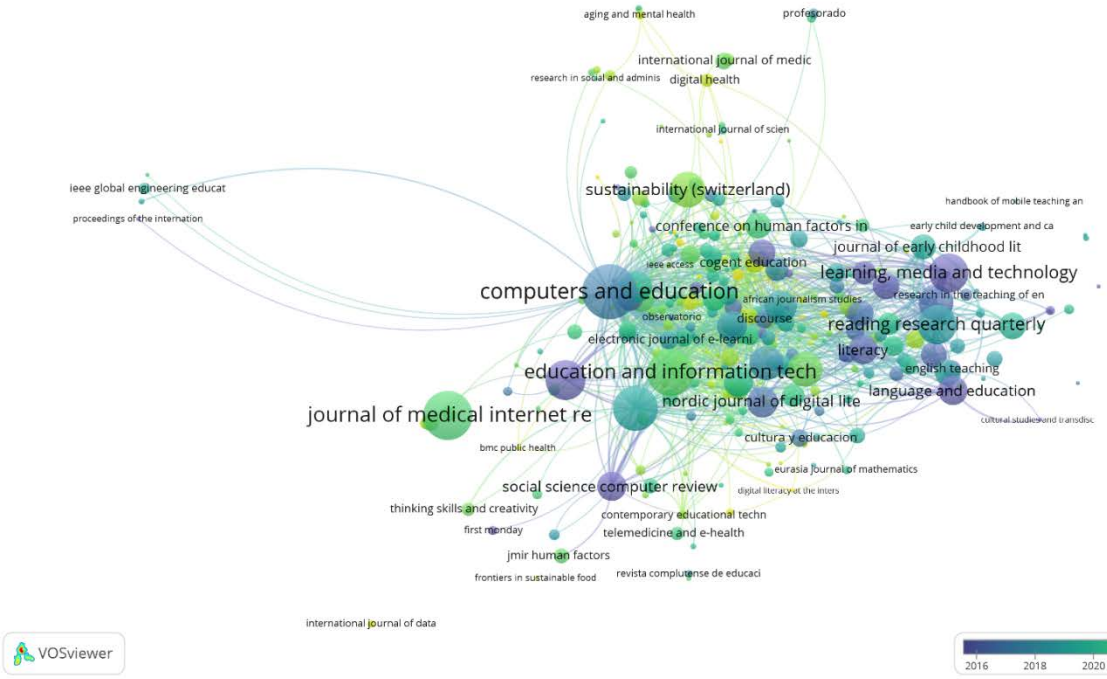

Figure 12: Overlay Visualization of sources based on CS and APY
CS= Citations Score APY= Average Publications per Year

DISCUSSION

This paper presents a scientometric analysis of the digital literacy topic, visualizing its trends and developments. From a total of 9043 publications, approx. 6% (=6480/97047) are citations generated by the top 0.1% (10/9043) of the publications. This paper highlights the growing nature of digital literacy publications, with a mean relative growth rate of 1.32 and a mean Doubling time of 0.57. Previous studies like Baber et al. (2022), Purnomo et al. (2020), etc., also showed a steadily upward trajectory of publications, which confirms the growth of the articles in the future.

Furthermore, the article of Van Laar et al. (2017), which is a review paper, is the most cited article, with 0.01% of the total citations produced by the articles from 2005 to 2024, and was published in 2017. Rusudan Makhachashvili of Ukraine is identified as the most productive author with 23 publications, while Sarah McGrew of the United States is the researcher with the highest citation score (i.e., 773). Furthermore, the United States is the country that is still dominant in producing a large volume of articles and citations in the DL domain. However, Baber et al. (2022) found in their study

that Spain was in second position; however, in the last few years, the United Kingdom and Australia surpassed Spain.

Concerning the number of publications of sources, "ACM International Conference proceeding Series", "Lecture Notes in Computer Science", and "Communications in Computer and Information Science" were identified as the top producing sources in the domain of digital literacy. However, "Journal of Medical Internet Research", and "Education and Information Technologies" were identified as the most influential articles in terms of citation score.

Concerning the keywords co-occurrence analysis, the hot research topics concerning the interest of the digital literacy community were mainly distributed among 'Covid-19', 'digital divide,' higher education,' 'information literacy,' 'social media,' and 'digital competence.' However, in another study by Park et al. (2021), keywords were distributed among 'media literacy,' 'information literacy,' digital literacy,' 'media education,' and 'ICT.' It shows that with time, the topic related to digital literacies is moving from broad to specific areas.

This quantitative analysis of digital literacy literature is an exploratory attempt to depict the fundamental characteristics. The study's findings offer significant insights for many stakeholders to attain a thorough understanding of digital literacy research. These maps and tables can be utilized to assist new researchers, universities, and editorial boards in discovering and highlighting interesting digital literacy trends for further investigation and development.

Some limitations to the current investigation should also be noted. Firstly, the investigation focused on the peer-reviewed literature from the Scopus database. Second, this paper focused on articles retrieved using the search term 'digital literacy' from the title, abstract, and keywords without examining the core contents. Third, regarding the software used in this study, the analyses may vary depending on the application of different parameter values. As a result, this work can be expanded in the future by conducting an in-depth content analysis in conjunction with a scientometric analysis of articles from other databases, providing further insights and building on the findings presented here.

CONCLUSION

This paper uses the scientometric methods to map the scientific landscape of Digital Literacy (DL) research from 2005 to November 8, 2024. In our first objective, a yearwise look at the data shows that scholarly output has been steadily rising (a total of 9,043 publications), with a big jump starting in 2018 and a peak in citations in 2020. Out of the 9,043 publications, around 6% citations are from the top 10 publications, which is the 0.1% (10/9,043) of the publications. This shows how the pandemic has changed things like online learning, seeking health information, and using digital offerings. The second aim is to calculate the RGR and Dt of the scholarly publications. The observed relationship between those metrics illustrated the field's maturity and scholarly consolidation. This demonstrates that, although the volume of research on digital literacy has increased dramatically, the growth rate has stabilized in

recent years. Previous studies like Baber et al. (2022), Purnomo et al. (2020), etc., also showed a steadily upward trajectory of publications, confirming the expected growth of articles which can be seen here.

The third objective shows the influential articles i.e., those that got the most citations. The most cited works are about the teacher/learner digital competence, eHealth/digital health literacy, information overload and online risks, and online education during pandemic-era. These are the areas where the field has had the most theoretical and practical impact.

Likewise, the fourth objective is about the analysis of key contributors, indicating that the field is anchored by a consolidated core of authors and highly networked affiliations. Co-authorship remains extensive among developed nations, where the United States, the United Kingdom, and Australia are the primary leaders in production and influence. However, the situation is changing with time. Spain has become an important European center, and Indonesia and China are growing quickly, but their effects are still being felt more in lower-ranked journals due to lower average citations per document. In addition, information is spread through channels such as conferences, including the ACM International Conference Proceedings Series, which lead to many publications, while journals, such as the "Journal of Medical Internet Research" and "Education and Information Technologies", are important for citation impact and connectivity.

To conclude, results show that the field has grown quickly and is now stabilizing. And maximum influence is shown in education and health-related places, and the number of contributors is growing in different parts of the world. These show researchers and policymakers where to publish (high-impact journals), who to work with (high-CLS authors/institutions), and what themes are becoming more popular (digital competence, health literacy, misinformation/online risk, AI-adjacent topics). Subsequent research ought to enhance citation-based metrics with the altmetrics, utilize longitudinal topic modelling to identify thematic transitions post-2020, and investigate equity-focused outcomes (e.g., digital inclusioin, skills deficiencies) across various regions to convert academic progress into societal influence.

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