

## DIGITAL LITERACY RESEARCH IN SCOPUS: A BIBLIOMETRIC ANALYSIS BETWEEN 1997 AND 2021

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**Abstract.** Digital literacy has received much attention due to the proliferation of the use of technology in education and in workplace. People of all walks of life prefer to use electronic equipment to manage their daily routines and even social relationship. Thus, this paper attempts to put forth the key aspects of digital literacy within the research literature published between 1997 to 2021. This study pursued to (a) examine how digital literacy research has progressed, (b) determine what key areas are discussed in digital literacy, and (c) identify the major players in digital literacy research and their collaborations. Specifically, we analysed the progress of digital literacy research by examining (a) published studies, (b) source titles, (c) types of sources and documents, and (d) the languages in which the documents were written in, known as a bibliometric study. We also analysed the key areas of digital literacy research by looking into

common subject areas, keywords used most often, and title analysis. Finally, we sought to increase our understanding of the major players in digital literacy research and their collaborations by examining (a) which countries contributed most to digital literacy research, (b), the main institutions involved, and (c) authorship and citation analysis.

**Keywords:** digital literacy, digital competence, digital skills, information literacy, information science

## Introduction

Digital literacy was first coined by Paul Gilster in his 1997 book (Bawden, 2001, 2008) and since then, it has been discussed in many fields, contexts, and countries (Spante et al., 2018). It is widely mentioned in the research studies such as e-literacy (Lankshear et al., 2008), digital competence (Ferrari et al., 2012) and multimodal literacy (Boechler et al., 2014). According to Angeline et al. (2021), digital literacy was previously known as computer literacy, information and communication technology (ICT) literacy, and information literacy. However, due to the convergence of ‘parent’ fields of information sciences, media studies and information technologies as noted by Hagel (2015), and the rapid change of digital technology over the last decades, digital literacy has been associated with new literacies (Reddy et al., 2020). The ‘new literacies’ is a new concept in the literature where some consider it as a digital literacy comprising multiple dimensions and represent in new, multimodal social practice characterised by social networking activities and mobile technologies (Law et al., 2018). Thus, it is worthy to note that there are variants of digital literacy definitions, or at least substantive explanations that relate to digital literacy in the literature.

To reflect digital literacy to a wide range of cognitive and emotional skills using digital technologies, Eshet-Alkalai (2004) created a five-skill holistic conceptual model for digital literacy, in which it had been later expanded in 2009 to include add another skill. Eshet-Alkalai & Chajut (2009) framework has the following six skills: (1) photo-visual literacy (the ability to work effectively with digital environments, such as user interfaces, that employ graphical communication), (2) reproduction literacy (the ability to create authentic, meaningful written and artwork by reproducing and

manipulating pre-existing digital text, visuals, and audio pieces), (3) branching literacy (the ability to construct knowledge by a nonlinear navigation through knowledge domains, such as on the Internet and other hypermedia environments), (4) information literacy, the ability to consume information critically and sort out false and biased information, (5) socioemotional literacy (the ability to communicate effectively in online communication platforms such as discussion groups and chatrooms), (6) real-time thinking skill (the ability to process and evaluate large volumes of information in real time, such as in computer games and chatrooms).

As digital literacy has been widely discussed among the researchers of various disciplines and project purposes, it is the aim of this study to analyse the scientific literature published on digital literacy using bibliometric analysis. According to Pham et al. (2021), the term “bibliometrics” was introduced by Alan Pritchard in 1969. Instead of focusing on “substantive findings”, bibliometric analysis aims to synthesize the overall trends and pattern of the studied topic (Hallinger & Chatpinyakoop, 2019). This paper presents a bibliometric analysis of literature on digital literacy found in SCOPUS between 1997 and 2021, investigating into three main research questions: (a) how digital literacy research has progressed? (b) what key topic areas have been discussed in digital literacy research? and (c) who are the major players in digital literacy research and how have they collaborated?

Thus far there have been three bibliometric articles on digital literacy; Alagu & Thanuskodi (2019) analysed the Web of Science (WoS) database related to digital literacy during the period of 1992-2011, while Caldevilla-Domínguez et al. (2021) analysed the Scopus database but related to digital literacy at the university level during the period of 2013-2020. The latest bibliometric article was written by Baber et al. (2022) that used WoS database to evaluate publications from 2017 to 2021 related to digital literacy with a particular emphasis on Covid-19. Based on these, the authors decided to proceed with this bibliometric analysis, but the database used is Scopus and the period of publications is from 1997 to 2021 to get a wider spectrum of the digital literacy research.

## 1. Method

Scopus database was selected as it is the “largest single abstract and indexing database ever built” (Ami et al., 2019; Burnham, 2006), and it is the largest searchable citation and abstract source of searching literature (Aghaei Chadegani et al., 2013). Further, according to Wahid et al. (2020), Scopus is one of the largest abstract and citation databases of peer-reviewed literature, and able to provide a comprehensive overview of the world’s research output. Using Scopus, we were able to obtain analytical results from the collected documents such as author name, year, access type, subject area, document type, source title, keywords, affiliation, country, source type and language.

The search term ‘digital literacy’ contained in the title of the article was used to search for relevant articles published in any language related to research in digital literacy as following: TITLE (“digital literacy”) and only till year 2021. We focused on the title of the articles because title is the most important element of any scientific article and the main indication of article’s subject (Jamali & Nikzad, 2011). Further, with the advance of Internet search engines, article titles have become one of the primary sources of drawing readers’ attention to the articles (Ichiyama, 2021). From our search conducted in February 2022, Scopus initially returned 1,161 document results, and after a minor refinement on the document types, we removed 5 erratum documents and finally, 1,156 document results were included in our study. All the data gathered from the Scopus database then exported into comma-separated values (.csv) and research information system (.ris) formatted files. We used Microsoft Excel, and Harzing’s Publish or Perish for data analysis and VOSviewer software for data visualisation.

## 2. Results

This section presents the results obtained from the bibliometric analysis related to the following research questions: (1) how digital literacy research has progressed, (2) what key topic areas have been discussed in digital literacy research, and (3) what characteristics of scientific collaborations in digital literacy research among authors of different countries are.

To address the first research question, how digital literacy research has progressed, we analysed the following data: (a) number of publications by year, (b) source title, (c) source and document type, and (d) document language.

**Publications by year.** Table 1 shows the statistics on annual publications of digital literacy research from the year 1997 to 2021 and shows a trend of increasing numbers of publication.

From 1997 until 2007, there were less than 20 documents as recorded in the Scopus database. Surprisingly, starting 2008, the number of documents published had increased tremendously from 22 to 209 in 2021. This increase reflects the growing interest in digital literacy especially in the last five years from 2017 until 2021 which recorded 62.63% of the total number of documents published.

Table 1. Number of Digital Literacy Publications by Year

Year	Number of documents	Percentage (%)	Cumulative percentage (%)
1997	1	0.09	0.09
2000	1	0.09	0.18
2001	2	0.17	0.35
2002	1	0.09	0.44
2003	1	0.09	0.52
2004	3	0.26	0.78
2005	8	0.69	1.47
2006	6	0.52	1.99
2007	11	0.95	2.94
2008	22	1.90	4.85
2009	30	2.60	7.44
2010	31	2.68	10.12
2011	28	2.42	12.55
2012	44	3.81	16.35

2013	59	5.10	21.46
2014	54	4.67	26.13
2015	61	5.28	31.40
2016	69	5.97	37.37
2017	89	7.70	45.07
2018	97	8.39	53.46
2019	148	12.80	66.27
2020	181	15.66	81.92
2021	209	18.08	100.00
<b>Total</b>	<b>1156</b>	<b>100.00</b>	

**Source types.** Table 2 shows that journals were the most common source (707, 61.16%), followed by conference proceedings (241, 20.85%) and books (133, 11.51%). The remaining sources, book series and trade journals recorded less than 10% of total number of publications.

Table 2. Document sources

Source type	Number of publications	Percentage (%)
Journal	707	61.16
Conference Proceeding	241	20.85
Book	133	11.51
Book Series	72	6.23
Trade Journal	3	0.26
<b>Total</b>	<b>1156</b>	<b>100.00</b>

**Document types.** This study also pursued to determine the document types. We did not limit the scope of a specific type for a better view of the topic published by scholars worldwide. Table 3 shows that more than half of the total number of documents were articles of original research (653, 56.49%), followed by conference papers (294, 25.43%), and book chapters (127, 10.99%). The remaining types amounted only 7.09% of the total number of documents.

Table 3. Document types

Document type	Number of documents	Percentage (%)
Article	653	56.49
Conference Paper	294	25.43
Book Chapter	127	10.99
Review	39	3.37
Book	17	1.47
Editorial	13	1.12
Note	8	0.69
Data Paper	2	0.17
Conference Review	1	0.09
Letter	1	0.09
Short Survey	1	0.09
<b>Total</b>	<b>1156</b>	<b>100.00</b>

**Source titles.** A journal called *Journal of Adolescent and Adult Literacy* contributed the highest number of publications on digital literacy (n=29) but is closely followed by the *ACM International Conference Proceeding Series* (n=28) and *Journal of Physics Conference Series* (n=25). Table 4 shows the top 20 sources on digital literacy.

Table 4. Source titles

Source Title	Num ber of docu ments	Per cent age (%)
Journal Of Adolescent and Adult Literacy	29	4.43
ACM International Conference Proceeding Series	28	4.28
Journal Of Physics Conference Series	25	3.82
Communications In Computer and Information Science	22	3.36
Library Philosophy and Practice	20	3.06
Education And Information Technologies	15	2.29

Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence And Lecture Notes In Bioinformatics	15	2.29
Ceur Workshop Proceedings	12	1.83
Computers And Education	12	1.83
Media And Communication	11	1.68
Proceedings Of the European Conference on E Learning Ecel	11	1.68
Media International Australia	10	1.53
International Journal of Emerging Technologies in Learning	9	1.38
Nordic Journal of Digital Literacy	9	1.38
Ascilite 2018 Conference Proceedings 35th International Conference of Innovation Practice and Research in The Use Of Educational Technologies In Tertiary Education Open Oceans Learning Without Borders	8	1.22
Computers And Composition	8	1.22
Research In Learning Technology	8	1.22
Iop Conference Series Earth and Environmental Science	7	1.07
Language And Education	7	1.07
E Learning and Digital Media	6	0.92

**Languages used in documents.** A document must have an English language abstract and title to be indexed in the Scopus database, although the content may be written in other languages. However, some documents probably having published in more than one language. In this study, we included all languages used in the documents as we decided that we only analysed the metadata and bibliographic information, not specifically on language. Table 5 reveals that English was most common and accounted for 94.49% of all the documents, Spanish was second with 3.26% while Portuguese was third with 1.20%. The remaining documents were published in French, Russian, German, Bosnian, Dutch and Persian where each accounted for only a small percentage, less than 1%.

Table 5. Languages in documents



Language	Number of documents	Percentage (%)
English	1091	93.49
Spanish	38	3.26
Portuguese	14	1.20
French	10	0.86
Russian	9	0.77
German	2	0.17
Bosnian	1	0.09
Dutch	1	0.09
Persian	1	0.09
<b>Total</b>	<b>1167</b>	<b>100.00</b>

To address the second research question, what key topic areas have been discussed in digital literacy research, we analysed the documents in terms of (a) main subject areas, (b) frequency of keywords and (c) document titles.

**Subject areas.** This study classified the documents based on their subject areas, as presented in Table 6. The data showed that research on digital literacy has appeared in a variety of subject areas. 42.99% or 831 of the total documents were classified as social sciences, followed by computer sciences (n=439, 22.71%), arts and humanities (n=177, 22.71%) and engineering (n=126, 9.16%). The remaining subject areas such as psychology, business, management and accounting, mathematics, and medicines, each accounted less than 3% of total documents. There are documents that have been classified in more than one subject area.

Table 6. Subject areas of digital literacy research

Subject Area	Number of documents	Percentage (%)
Social Sciences	831	42.99
Computer Science	439	22.71
Arts and Humanities	177	9.16

Engineering	126	6.52
Psychology	51	2.64
Business, Management and Accounting	50	2.59
Mathematics	45	2.33
Medicine	39	2.02
Decision Sciences	36	1.86
Physics and Astronomy	29	1.50
Environmental Science	21	1.09
Economics, Econometrics and Finance	18	0.93
Health Professions	18	0.93
Energy	12	0.62
Earth and Planetary Sciences	10	0.52
Nursing	7	0.36
Pharmacology, Toxicology and Pharmaceutics	6	0.31
Agricultural and Biological Sciences	5	0.26
Multidisciplinary	5	0.26
Chemical Engineering	2	0.10
Chemistry	2	0.10
Materials Science	2	0.10
Biochemistry, Genetics and Molecular Biology	1	0.05
Dentistry	1	0.05
Total	1933	100.00

**Keyword analysis.** Figure 1 presents a network visualisation of the author keywords that each had a minimum of 10 occurrences. This study used VOSviewer, a software tool for constructing and visualising bibliometric networks to map authors' keywords. For example, keywords with the same colour were commonly listed together. So, in this study, digital literacy, higher education, digital divide, online learning, social media, Covid-19 and fake news are seen clustered together in the same red colour, suggesting that

these keywords were closely related and usually occurred together (Sweileh et al., 2017)

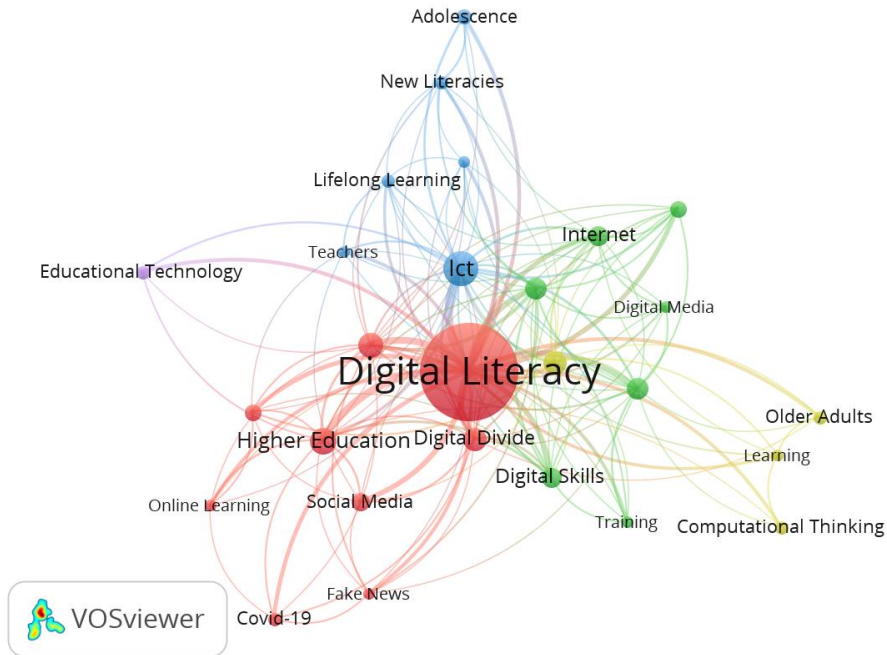


Figure 1. Network visualisation map of author keywords with at least 10 occurrences

Table 7 summarises the most frequently used keywords in digital literacy studies. Some keywords had been refined and combined such as digital literacy and digital literacies to become as digital literacy, information, and commination technologies (ICT) and information technologies (IT) to become as ICT only. As a result, digital literacy was expected to be the most frequently used in the documents with 77.08% of total documents and this includes both digital literacy and digital literacies. subsequent keywords are e-learning (15.45%), students (12.37%), and ICT (11.94%). Keywords such as education, teaching, higher education, and the remaining ones scored on less than 10% of total documents, but they are still important mainly around the digital literacy concept.



Table 7. Keywords in Digital Literacy Research and Their Frequency

Keyword	Number of documents	Percentage (%)
Digital Literacy	891	77.08
E-learning	179	15.48
Students	143	12.37
ICT	138	11.94
Education	98	8.48
Teaching	77	6.66
Higher Education	60	5.19
Digital Technologies	59	5.10
Literacy	55	4.76
Engineering Education	54	4.67
Surveys	49	4.24
Information Literacy	47	4.07
Digital Divide	46	3.98
Curricula	45	3.89
Human	39	3.37
Internet	36	3.11
Social Media	33	2.85
Media Literacy	32	2.77
Educational Technology	31	2.68
Digital Devices	29	2.51

**Title analysis.** Figure 2 shows the visualisation of a term co-occurrence network based on title fields with a minimum of 10 occurrences of a term. We used a binary counting method that indicates the number of documents in which a term occurs at least once, the number of times a noun phrase occurred in the title of publication played no role (van Eck & Waltman, 2014). Figure 2 reveals that the word “digital literacy” was the main term acting as the central node of the whole network (Verk, Golob, & Podnar, 2019) in digital literacy research. The size of the nodes indicates the weight of the occurrence of the terms, while the thickness of joining lines indicates the strength of the relationship among the terms. Related words, as indicated by the same colour,

frequently occurred together. From the titles of the publications in our study, VOSviewer generated five different colours representing five clusters with 26 terms.

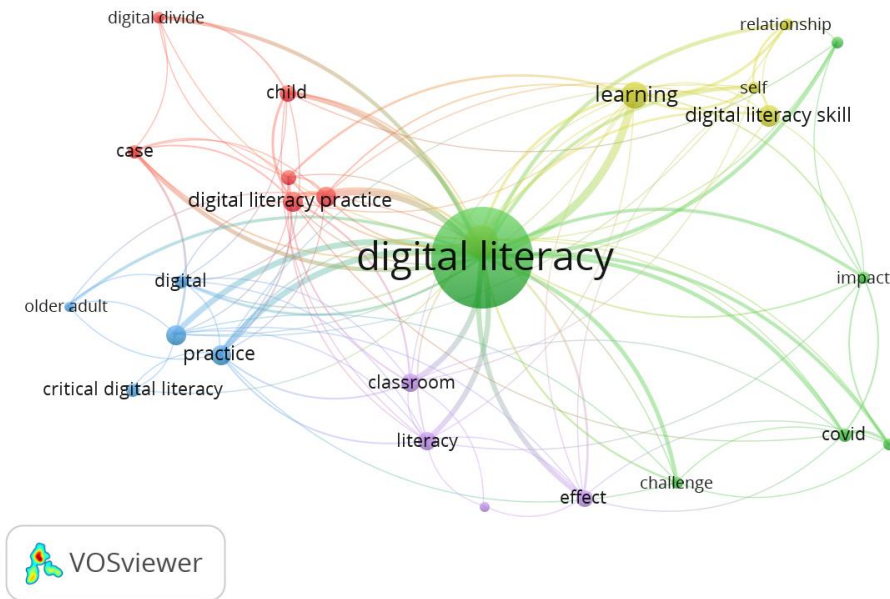


Figure 2. VOSviewer network visualisation of a term co-occurrence based on title fields (binary counting) what characteristics of scientific collaborations in digital literacy research among authors of different countries are.

To address the third research question, what characteristics of scientific collaborations in digital literacy research among authors of different countries are, we examined the following data: (a) the countries that most frequently contributed, (b) the main institutions involved in digital literacy research, (c) authorship analysis, and (d) citation analysis.

**Countries contributing most to digital literacy research.** Table 8 indicates the top 25 countries from where most digital literacy research originated. The United States was clearly far on the leading position (n=261, 22.58%),

followed by the United Kingdom (n=104, 9.00%), Australia (n=99, 8.56%), and Indonesia (n=98, 8.48%). After that was Spain but down with a significant gap (n=58, 5.02%). The remaining distribution of authors' national affiliations represented with less than 5% and was spread across the globe – Canada, Russian Federation, India, Brazil, South Korea, Turkey, China, Malaysia, Mexico, Portugal, Thailand, Germany, Hong Kong, Norway, Denmark, Israel, New Zealand, South Africa, Italy, and Austria. It can be said that digital literacy play an important role in a wide range of geographic areas.

Table 8. Geographics Origins of Digital Literacy Research

Country	Number of documents	Percentage (%)
United States	261	22.58
United Kingdom	104	9.00
Australia	99	8.56
Indonesia	98	8.48
Spain	58	5.02
Canada	56	4.84
Russian Federation	37	3.20
India	27	2.34
Brazil	26	2.25
South Korea	23	1.99
Turkey	23	1.99
China	22	1.90
Malaysia	21	1.82
Mexico	21	1.82
Portugal	19	1.64
Thailand	19	1.64
Germany	17	1.47
Hong Kong	15	1.30
Norway	15	1.30
Denmark	14	1.21
Israel	14	1.21
New Zealand	14	1.21
South Africa	14	1.21
Italy	13	1.12
Austria	12	1.04

**Main institutions.** Table 9 shows institutions that contributed 6 or more digital literacy research documents. Out of 1,156 documents, both Monash University and Universitas Pendidikan Indonesia shared the highest number of documents (n=15, 1.30%), followed by Deakin Universiti (n=13, 1.12%)



and Universitetet i Oslo (n=9, 0.78%). The remaining institutions contributed between 6 to 8 documents which are from many parts of the globe.

Table 9. Institutions Contributing 6 or More Digital Literacy Research Documents

<b>Institution</b>	<b>Number of documents</b>	<b>Percentage (%)</b>
Monash University	15	1.30
Universitas Pendidikan Indonesia	15	1.30
Deakin University	13	1.12
Universitetet i Oslo	9	0.78
The University of British Columbia	8	0.69
Swinburne University of Technology	8	0.69
Universitas Negeri Semarang	8	0.69
Bina Nusantara University	8	0.69
University of Illinois Urbana-Champaign	7	0.61
City University of Hong Kong	7	0.61
Lancaster University	7	0.61
University of Alberta	7	0.61
The University of Queensland	7	0.61
Universitas Sebelas Maret	7	0.61
The University of Auckland	6	0.52
Tecnologico de Monterrey	6	0.52
Universidade de São Paulo	6	0.52
Queensland University of Technology	6	0.52
The Open University	6	0.52
Macquarie University	6	0.52
Open University of Israel	6	0.52
University of Technology Sydney	6	0.52
University of California, Berkeley	6	0.52
University of Melbourne	6	0.52
University at Buffalo, The State University of New York	6	0.52

Sheffield Hallam University	6	0.52
York University	6	0.52
South-West University Neofit Rilski	6	0.52

**Authorship analysis.** Table 10 shows the number of authors per document. From 1,156 documents considered in this study, 344 (29.76%) documents were single authored while the remaining had more than one author; 339 (29.33%) documents had two authors and 339 (20.76%) had three authors. There were five documents in which the author’s information is not available or cannot be verified, and 1 document with 20 authors.

Table 10.Number of Authors per document

Author Count	Number of documents	Percentage (%)
0	5	0.43
1	344	29.76
2	339	29.33
3	240	20.76
4	122	10.55
5	58	5.02
6	26	2.25
7	12	1.04
8	3	0.26
9	2	0.17
10	2	0.17
12	1	0.09
14	1	0.09
20	1	0.09
<b>Total</b>	<b>1156</b>	<b>100.00</b>

Table 11 shows the most productive authors who contributed to research on digital literacy. On average, an author produces 2.63 articles for the given time frame from 1997 until 2021. The first four authors had published six articles, namely, Ibrar Bhatt from Queen's University Belfast, Christoph A.

Hafner from City University of Hong Kong, Rodney H. Jones from University of Reading and Robert Meurant from Seojeong College University. Overall, the authors came from institutions around the world.

Table 11. Most productive authors in digital literacy research

<b>Author</b>	<b>Number of documents</b>	<b>Percentage (%)</b>
Bhatt, I.	6	0.52
Hafner, C.A.	6	0.52
Jones, R.H.	6	0.52
Meurant, R.C.	6	0.52
Castek, J.	5	0.43
Erstad, O.	5	0.43
Gardner, L.	5	0.43
Milenkova, V.	5	0.43
Prinsloo, M.	5	0.43
Tomczyk, Ł.	5	0.43
Buckingham, D.	4	0.35
Burnett, C.	4	0.35
Chaudhary, K.	4	0.35
Detlor, B.	4	0.35
Frydenberg, M.	4	0.35
Julien, H.	4	0.35
Majgaard, G.	4	0.35
Ng, W.	4	0.35
Pandya, J.Z.	4	0.35
Pérez-Escoda, A.	4	0.35

VOSviewer software was used to present a network visualisation (see Figure 3) of the mapping of co-authorship among different authors. This mapping used the fractional counting method and was based on data of those authors who had at least four documents on digital literacy. The colour, circle size, font size, and thickness of connecting line indicate the strength of the relationship among the authors. For example, the diagram suggests that

Chaudary P. and Sharma B. who are from the same country, Fiji have collaborated closely. From the analysis, it seems that most authors prefer to work with authors with the same origin, such as Rizal R. and Setiawan W. who are both from Indonesia.

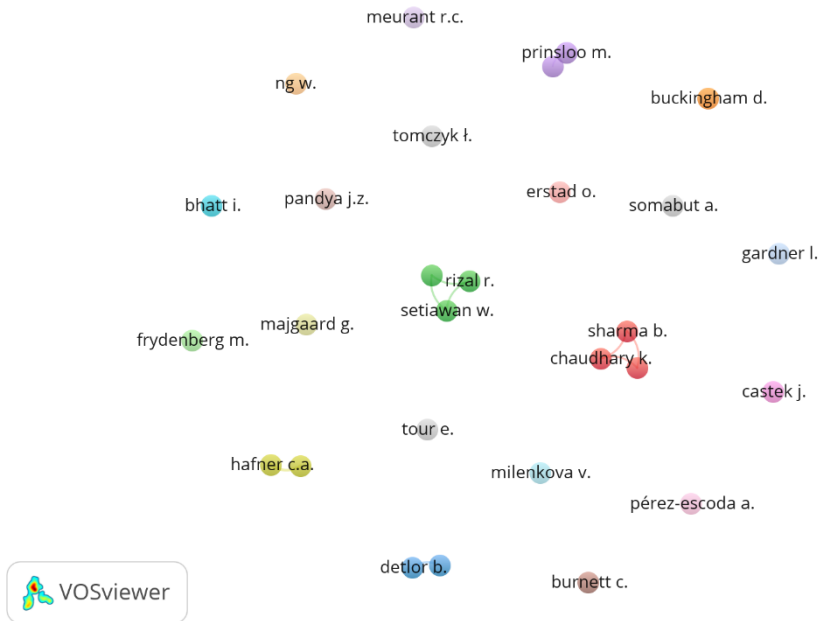


Figure 3. Network visualisation map of digital literacy research co-authors

Figure 4 further shows the network visualisation map of the authors based on the countries they are affiliated with. Only countries with at least five documents and at least five citations were considered in this analysis. Based on the fractional counting method, it was clear that authors from the United States have played a prominent role in collaborating with authors from other countries in digital literacy research, such as with South Korea, United Kingdom, and Canada. Countries that share similar origin and culture, namely Spain, Brazil and Portugal were seen to work together in the research effort.

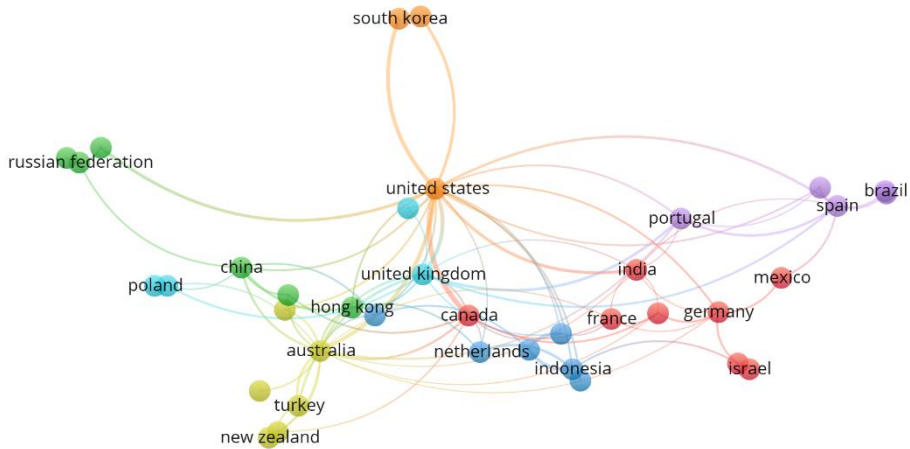


Figure 4. Network visualisation map of the authors based on the countries

**Citation Analysis.** Table 12 reports the citation metric of the papers obtained from the Scopus database. There were 9,990 citations reported in 25 years (1997-2021) for 1,156 documents, with an average of 399 citations per year.

Table 12. Digital Literacy Citation Metrics

Metric	Data
Total Papers	1156
Total Citations	9990
Number of years	25
Citations per year	399.6
Citations per paper	8.64
Citations per author	6254.54
Papers per author	642.73
Authors per paper	2.47

h_index	43
g_index	73

Table 13 summarize the 20 documents on digital literacy that are most often cited, based on the number of times each was cited. The top two documents were the review studies by Bawden (2001) in the early days of digital literacy since Gilster (1997) and Ng (2012) which highlighted on digital literacy of digital natives. Other documents most cited were those that addressed the issues of web-oriented digital literacy, media literacy, information literacy, privacy, e-learning, and self-efficacy.

Table 13. Most Influential Documents with a Minimum of 100 Citations per Document

<b>Author (Year)</b>	<b>Title</b>	<b>Source</b>	<b>T C</b>	<b>CY P</b>	<b>CPA</b>
Bawden (2001)	Information and digital literacies: A review of concepts	<i>Journal of Documentation</i>	44 3	22.1 5	443. 00
Ng (2012)	Can we teach digital natives digital literacy?	<i>Computers and Education</i>	30 0	33.3 3	300. 00
Hargittai (2005)	Survey measures of web-oriented digital literacy	<i>Social Science Computer Review</i>	22 9	14.3 1	229. 00
Koltay (2011)	The media and the literacies: Media literacy, information literacy, digital literacy	<i>Media, Culture and Society</i>	22 0	22.0 0	220. 00
Jones & Hafner (2012)	Understanding Digital Literacies:	<i>Understanding Digital Literacies:</i>	16 5	18.3 3	82.5 0

	A practical introduction	<i>A Practical Introduction</i>			
Park (2013)	Digital Literacy and Privacy Behavior Online	<i>Communication Research</i>	15 4	19.2 5	154. 00
Mohammad yari & Singh (2015)	Understanding the effect of e-learning on individual performance: The role of digital literacy	<i>Computers and Education</i>	14 2	23.6 7	71.0 0
Gui & Argentin (2011)	Digital skills of internet natives: Different forms of digital literacy in a random sample of northern Italian high school students	<i>New Media and Society</i>	13 0	13.0 0	65.0 0
Hargittai (2009)	An update on survey measures of web-oriented digital literacy	<i>Social Science Computer Review</i>	12 8	10.6 7	128. 00
Meyers, Erickson, & Small (2013)	Digital literacy and informal learning environments: An introduction	<i>Learning, Media and Technology</i>	12 4	15.5 0	41.3 3
Eshet-Alkali, & Amichai-Hamburger (2004)	Experiments in digital literacy	<i>Cyberpsychology and Behavior</i>	12 2	7.18	61.0 0

Greene, Yu, & Copeland (2014)	Measuring critical components of digital literacy and their relationships with learning	<i>Computers and Education</i>	11 6	16.5 7	38.6 7
Prior, Mazanov, Meacheam, Heaslip, & Hanson (2016)	Attitude, digital literacy and self efficacy: Flow-on effects for online learning behavior	<i>Internet and Higher Education</i>	11 5	23.0 0	23.0 0
Littlejohn, Beetham, & McGill (2012)	Learning at the digital frontier: A review of digital literacies in theory and practice	<i>Journal of Computer Assisted Learning</i>	11 0	12.2 2	36.6 7
Lea, & Jones (2011)	Digital literacies in higher education: Exploring textual and technological practice	<i>Studies in Higher Education</i>	10 4	10.4 0	52.0 0
Hafner (2014)	Embedding Digital Literacies in English Language Teaching: Students' Digital Video Projects as Multimodal Ensembles	<i>TESOL Quarterly</i>	10 2	14.5 7	102. 00
Jaeger, Bertot, Thompson, Katz, &	The Intersection of Public Policy and Public Access: Digital Divides, Digital Literacy,	<i>Public Library Quarterly</i>	10 2	11.3 3	20.4 0



Decoster (2012)	Digital Inclusion, and Public Libraries				
Spante, Hashemi, Lundin, & Algers (2018)	Digital competence and digital literacy in higher education research: Systematic review of concept use	<i>Cogent Education</i>	95	31.67	23.75
Pangrazio (2016)	Reconceptualising critical digital literacy	<i>Discourse</i>	87	17.40	87.00
Tsai, Shillair, & Cotten (2017)	Social Support and Playing Around: An Examination of How Older Adults Acquire Digital Literacy with Tablet Computers	<i>Journal of Applied Gerontology</i>	79	19.75	26.33

Notes. TC=total citations; CY=citations per year; CPA=citations per author

Figure 5 presents the mapping of citations for documents with a minimum of 10 citations. It illustrates the key authors in the field and how their ideas were situated in relation to each other.

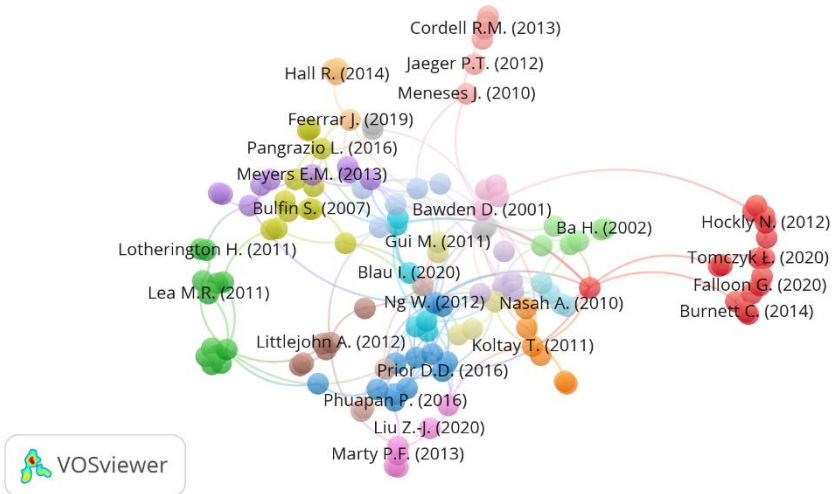


Figure 5. Network visualisation map of citations of digital literacy documents by authors

Countries of origin are further reflected in Figure 6 below.

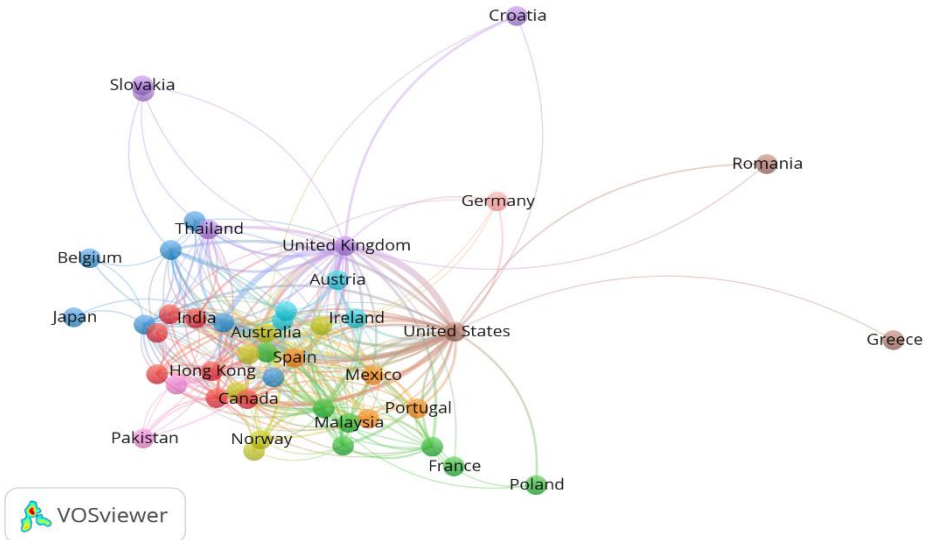


Figure 6. Network visualization map of citations of digital literacy documents by country, with a minimum of five documents per country and a minimum of five citations per country.

#### **4. Discussion**

From 1997 to 2021, there was an upward trend in the number of publications on digital literacy, which amounted to a total of 1156 documents. The statistical findings revealed novel correlations between the distribution of publications across nations and the subject of discussion at the global level, which is primarily centered in industrialized nations. This trend is not unexpected, given that the majority of article submissions come from nations that are well-developed in the concept and process of digital technology development, as well as its influence on society.

For future research, it is equally important to take notice of the keywords dominating the subject of study, particularly in the most prestigious journals. This research gives an evaluation of the relationship between the total number of citations and the number of cited references for all papers that have been cited. The statistics also indicate that there are an average of 399 citations per year, which means that approximately 34% of the publications are mentioned annually. Digital literacy has become a permanent fixture. In a variety of ways, it affects both developing and developed nations.

Literature on digital literacy provides a number of compelling and opposing hypotheses that must be examined for sustainable economic growth and development. The globe is confronting an unprecedented economic and multi-dimensional crisis, necessitating that intellectuals devote their time to research in order to find remedies for the lingering quagmire. The world is interconnected and intertwined with digital platforms, and there is an urgent need to enhance digital literacy for the benefit of less developed nations.

## **Conclusions**

In this study, an analysis was conducted based on (1) how digital literacy research has progressed, (2) what key topic areas have been discussed in digital literacy research, and (3) what characteristics of scientific collaborations in digital literacy research among authors of different countries are. Also thoroughly addressed were analyses of digital literacy articles by country, by year, and language. In addition, studies were conducted demonstrating the overall number of total 1156 documents' citations and the number of citations per year in average. We analyze the global trends and patterns in the scholarly research published on digital literacy between 1997 and 2021. Without a doubt, our findings demonstrate that there are growing interest in digital literacy especially in the last five years. When digital literacy is increased across communities on a global scale, the world will become a better place. The task for academics is to perform additional study on digital literacy in order to construct digital economies that are coherent and competitive on the global market. For the least developed nations to be completely integrated into the global digital economy, a specific digital literacy education is necessary.

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### **Author contributions**

Ideally, author and co-authors who contributed to the work are listed below along with their contributions:

Mohd Hafizi AHSAN and Sri NURHAYATI were responsible for the design and development of the data analysis.

Mohd Hafizi AHSAN and Sri NURHAYATI were responsible for data collection and analysis.

Saidatul Akmar ISMAIL and Masitah AHMAD were responsible for data interpretation.

Mohd Hafizi AHSAN wrote the first draft of the article.

Saidatul Akmar ISMAIL wrote and finalized the article to the completion and ready for submission.

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The authors declare that we have no relevant or material financial interests that relate to the research described in this paper.

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