Bibliometric Analysis: the Graphic Growth of Digital Literacy Research on the Scopus Database in Southeast Asia

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Abstract. Digital literacy has become necessary for all activities worldwide, especially in the era of the Industrial Revolution 4.0. Information related to digital literacy has not been implemented comprehensively in various countries, especially in the Southeast Asia region where Indonesia is located. This research aims to study the status of digital literacy research involving various scientific fields. Bibliometric analysis was used as a method in the analysis process related to scientific literature in a particular field or topic by identifying trends, patterns and relationships in published re-search with the help of Vosviewer and Excel applications to display visualizations of research development maps related to digital iteration in various scientific areas. As much as 6,650 publications were collected from the Scopus database from 2003-2023, but this research only conducted research in Southeast Asia. There were 577 publications in Southeast Asia from 2005-2023. This research used a bibliometric approach in processing data. The results of the bibliometric analysis showed that the most popular keywords in research on digital literacy were COVID-19, online learning, social media, media literacy, and blended learning. The publication with the highest number of citations in digital literacy was Identifying Digital Transformation Paths in the business model of SMEs during the Covid-19 pandemic with 220 citations.

Keywords: Bibliometric, Digital Literacy, Vos Viewer, Southeast Asia

1   Introduction

Continuous technological developments bring significant changes to human life. All activities and activities of the world community are competing to integrate technology's role in various matters. Entering the digital era 4.0, the information society is required to apply digital literacy in their daily lives. Digital literacy is crucial in creating a society that is informed, critical and actively involved in the digital world [1]. Digital literacy includes accessing, understanding, evaluating and using digital information effectively [2]. With these technological developments, various sectors are trying to produce scientific publications related to digital literacy to increase society's ability to care more about the importance of implementing digital literacy.

With widespread discussions regarding digital literacy research in various scientific fields, an analysis is needed to collect research data that continues to increase and is difficult to calculate manually. This activity can be carried out through several analyses, one of which is bibliometric analysis. Bibliometric analysis plays an essential role in identifying research trends, developments and impacts related to digital literacy, especially research in Southeast Asia.

Bibliometric analysis is a method used to measure, analyze and characterize scientific literature in a particular field [3]. By applying bibliometric analysis to digital literacy research, we can identify conceptual developments, key contributors, collaborative networks, and emerging research trends over time. This approach provides insight into the evolution of scientific literature in the context of digital literacy. The study of digital literacy is becoming increasingly important, considering society's challenges and opportunities in the explosion of information and digital technology. The importance of the ability to organize, understand, and critique information found online has encouraged researchers to explore the concept of digital knowledge from various angles. Through bibliometric analysis, researchers can identify topics that dominate discussions, develop research trends, and provide essential contributions by researchers to advance understanding of digital literacy [4].

In this context, this research aims to conduct a bibliometric analysis of scientific literature on digital literacy. Through this analysis, researchers hope to reveal the development of scientific literature in the field, identify keywords and principal contributors, and detail research trends that influence the development of the concept of digital knowledge. The information obtained from this bibliometric analysis can provide insight into the progress of digital literacy research, the extent to which this concept has been explored, and future research directions.

In this article, the researchers will explain the methodology used for data collection, data analysis, and interpretation of the results of bibliometric analysis of digital literacy research. We will present the results of our analysis in the context of the growing scholarly literature on digital literacy, including research trends, key contributors, and the impact of research now available. Researchers hope this research can make a valuable

contribution to understanding digital literacy and how research in this area has shaped our view of digital knowledge in the digital era.

2   Methods

Bibliometric analysis and visualization are used in this research with quantitative techniques to identify research samples from a collection of 6650 publications worldwide that match selected keywords extracted from the Scopus database and used as samples in this research. The keyword in this research is digital literacy. Metrics can be seen by looking at the number of posts posted, citations, and overall link strength between subjects with a research focus in 2003-2023, which will be processed using Scopus analysis. Researchers will collect metadata about digital literacy from the Scopus database which focuses on "Title, Abstract and Keywords" in Southeast Asian countries with a total of 577 publications. VOSviewer is a beneficial and popular application for bibliometric analysis. In addition to creating network visualizations, VOSviewer is also used to analyze the evolution of specific domains based on commonly used terms. The five research stages in bibliometric analysis are explained below [5].
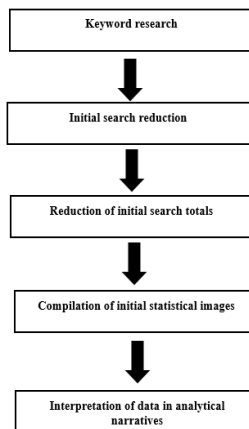

Figure 1. The five steps of the bibliometric analysis process

The five steps of the bibliometric analysis process are shown in the figure above as follows: 1) Carry out keyword research or keyword selection: researchers focus on keywords related to digital literacy and learning outcomes before collecting data; 2) narrow the search scope first; in this case, the researcher uses the Scopus database to search for articles based on a specific set of keywords; 3) the researchers used the VOSviewer program to retrieve all search results manually, reducing the overall volume

of the initial search if necessary; 4) create an initial statistical picture: group the data into topic descriptions, for example by matching visualization results across bibliometric pairs by country, institution, journal, publisher, and author, as well as co-occurrence time of the author keywords; 5) Interpret data in analytical stories: VOSviewer was used to evaluate the data and interpret the study results based on the selection results. The data representation provided by VOSviewer visualization is a map of variables related to keywords and offers potential for publication development. The data analysis method used is a deductive method that starts with general findings and continues to more specific findings, specifically publications published in the Southeast Asia region.

3   Results And Discussion

This research provides data on developing digital literacy publications worldwide and in Southeast Asia. There are a total of 6650 publications in the world, according to Table 3.1 which shows information related to Digital literacy research from various countries from 2003-2023 and the country that has conducted the most research in the field of digital literacy is the United States with a total of 1460 publications according to the table 3.2.

Table 1. Graph of digital literacy research data 2003-2023 in Scopus data (accessed 16 September 2023)
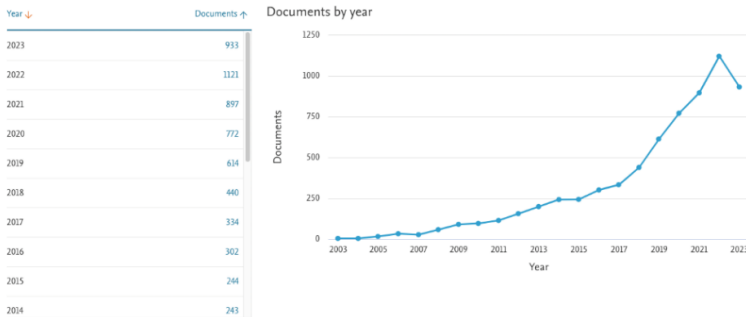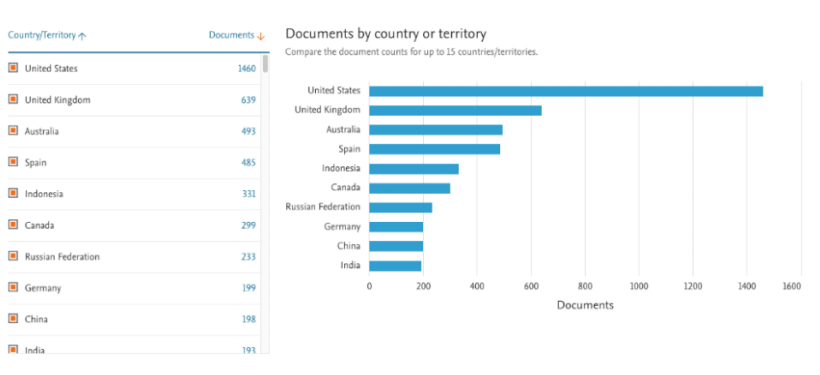
Table 2. Graphs countries with amount study highest related to digital literacy 2003-2023 (accessed 16 September 2023)

Since 2003-2023, there have been as many as 6650 studies focusing on digital literacy, with the most significant number of digital literacy studies being in 2022 with a total of 1121 publications. To be able to get data on countries in Southeast Asia, researchers selected the data they had. The result was that there were 577 publications discussing digital literacy. Indonesia is in first place as a country that carries out a lot of research in the area of digital literacy by contributing 331 publications.

Table 3. Graph digital literacy research in Southeast Asian countries 2005-2023 (accessed 16 September 2023)
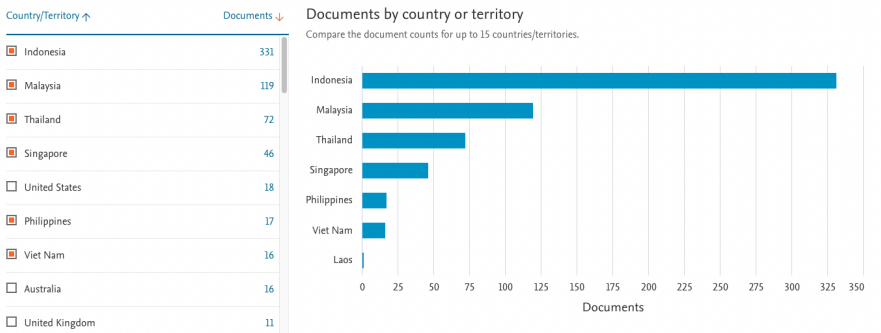
Southeast Asia is a region located in the southeastern part of the Asian continent. This region includes the Indochina Peninsula, the Malacca Peninsula, and the Indonesian Archipelago. Southeast Asia borders China to the north, the Pacific Ocean to the east, the Indian Ocean to the south, the Indian Ocean, the Bay of Bengal and the Indian subcontinent to the west. The countries in Southeast Asia are Indonesia, Malaysia, Singapore, Thailand, Philippines, Brunei Darussalam, Vietnam, Laos, Myanmar,

Cambodia, and Timor Leste. Eleven countries included in the ASEAN countries do not have productivity in studying research in digital literacy. In identifying research in the field of digital literacy, not all countries in Southeast Asia carry out such research. Several countries that do not have Scopus-indexed publications include Timor Leste, Brunei Darussalam, Myanmar, and Cambodia. Indonesia is the country most productive in researching Scopus, followed by Malaysia, Thailand, Singapore, the Philippines, Laos and Vietnam.

Figure 2. Visualization Network Keyword Publication _ Writers around the world (accessed 16 September 2023)

Digital literacy is an individual's ability to use, understand and participate effectively in the digital world. In an increasingly digitally connected world, digital literacy is a key skill required to function well in many aspects of life, including education, work and everyday life. Digital literacy helps individuals identify and avoid potential online risks and threats such as cyberbullying, fraud, computer viruses, and cyber-attacks [6]. A good understanding of digital literacy can improve the online safety of individuals and communities. In the era of fast and widespread digital information, it is important to understand how to identify correct and trustworthy information. Digital literacy helps people develop critical skills to evaluate information sources and avoid the spread of fake news or disinformation.

In the development of publications monitored in the Scopus database throughout the world, it can be seen that digital literacy is connected to several research clusters in accordance with Figure 4.1. The keyword that dominates approaches to digital literacy is

digital literacies. This is because many researchers focus their research on digital literacies, but the meaning of digital literacy and digital literacies is the same.

Figure 3. Visualization Keyword Article Network Writers in Southeast Asian countries (accessed 16 September 2023)

577 publications were collected from 2005 to 2023 in Southeast Asia because Southeast Asia has just been productive in publishing publications with the keyword digital literacy since 2005. The highest order of keywords is digital literacy, COVID-19, online learning, social media, media literacy, blended learning, technology, digital divide, blended learning, technology, information literacy, digital divide, Indonesia, and higher education. Next, co-word analysis of keywords with a minimum of 20 occurrences is carried out by looking at clusters, frequency and link strength in Table 3.4 as well as the relationships between keywords shown in Figure 4.2.

Table 4. Keywords highest in Southeast Asia

Selected	Keyword	Occurrences ∨	Total link strength
☑	digital literacy	250	435
☑	covid–19	24	53
☑	online learning	19	58
☑	social media	17	35
☑	media literacy	14	40
☑	blended learning	13	29
☑	technology	13	26
☑	information literacy	12	38
☑	digital divide	12	37
☑	indonesia	12	27
☑	higher education	11	26
☑	digital competence	10	37
☑	digital	10	25
☑	ict	10	20
☑	thailand	9	20
☑	digital technology	9	18
☑	digital literacy skills	9	13
☑	covid–19 pandemic	8	23
☑	internet	8	22
☑	education	8	19
☑	literacy	8	17
☑	fake news	7	25

Digital literacy, COVID-19, online learning, social media, media literacy, and blended learning have become three trendy topics in this research. Understanding, using and participating in the digital world is becoming increasingly important as the rapid shift to online learning continues. The COVID-19 pandemic forced schools, students, and educators to adapt to virtual learning environments quickly. This causes Covid 19 publications to increase because many researchers are researching Covid 19, especially in 2020. Therefore, digital literacy is an additional skill and an essential need to succeed in an increasingly digitally connected world of education. Through a deep understanding of digital literacy, we can ensure that all students have the access and competencies needed to face the challenges of online learning and exploit the positive potential of technology in the educational process.

Table 5. Six Clusters on Digital Literacy Publications

Cluster 1 (27 Items)	Cluster 2 (27 Items)	Cluster 3 (17 Items)	Cluster 4 (16 Items)	Cluster 5 (15 Items)	Cluster 6 (11 Items)
Adult	Computational Thinking	Data Collection	Computer Aided Instruction	Computer Science	Blended Learning
Aged	Conceptual Framework	Developing Countries	Computer Literacy	Critical Thinking Skills	Digital Devices
Aging	Critical Thinking	Digital	Descriptive Analysis	Digital Citizenship	Digital Learning
Article	Curricula	Digital Divide	Digital Literacy Skills	Digital Competence	Digital Libraries
Controlled Study	Digital Literacies	Digital Economy	Digital Technology	Digital Information	Education
Coronavirus Disease 21	Digital Storage	Digital Skills	Financial Literacy	Digital Literacy	Factor Analysis
Covid-19	Digital Technologies	Digital Transformation	Gamification	Digital Media	Higher Education
Covid-19 Pandemic	E-Learning	E-Government	Ict	Fake News	Information Manage
Female	Education Computing	Electronic Commerce	Learning	Information Literacy	Innnovation
Human	Elementary Schools	Indonesia	Literacy	Media Literacy Misinformation	Motivation
Human Experiment	Engineering Education	Information And Communication Technology	Online Learning	Social Media	University Students
Humans	Industrial Revolutions	Information And Communication Technologies	Online Teaching	Social Networking	
Information Technology	Information Use	Malaysia	Quality Education	Thailand	
Internet	Learning Management	Personnel Training	Self-Directed Learning	Youth	
Internet Literacy	Learning Media	Quantitative Approach	Student		
Major Clinical Study	Learning Outcome	Rural Areas	Technological Developmen		
Male	Learning Process	Training			
Pandemic	Learning Systems				
Pandemics	Mobile Learning				
Perception	Physics				
Qualitative Research	Self-Efficacy				
Quality Of Life	Students				
Questionnaire	Surveys				
Singapore	Teachers'				
Smartphone	Teaching				
Social Support	Teaching And Learning				
Technology	Teaching Materials				

Bibliometric cluster is a term that refers to a group of research or studies that use bibliometric methods to analyze scientific publications and scientific literature. A bibliometric cluster includes a group of studies or analyses focusing on a particular topic or domain using bibliometric techniques. This study divided 6 clusters containing keywords that dominate digital literacy publications. Cluster 1 consists of 27 items, cluster 2 consists of 27 items, cluster 3 consists of 17 items, cluster 4 consists of 16 items, cluster 5 consists of 15 items, and cluster 6 consists of 11 items.

Table 6. Publications with citation highest

No	Title	Year	Publisher	Amount quote
1	Identifying digital transformation paths in the business model of SMEs during the Covid-19 pandemic	2020	Journal of Open Innovation: Technology, Markets, and Complexity	220
2	Digital literacy: A prerequisite for effective learning in a blended learning environment?	2016	Electronic Journal of e-Learning	102
3	The Best, the Worst, and the Hardest to Find: How People, Mobiles, and Social Media Connect Migrants In(to) Europe	2018	Social Media and Society	81
4	Self-regulated learning strategies in higher education: Fostering digital literacy for sustainable lifelong learning	2020	Education and Information Technologies	56
5	Digital transformation in financial services provision: a Nigerian perspective to the adoption of chatbots	2021	Journal of Enterprising Communities	53
6	Development of digital literacy indicators for Thai undergraduate students using mixed method research	2018	Kasetsart Journal of Social Sciences	52
7	Digital literacy and knowledge societies: A grounded theory investigation of sustainable development	2016	Telecommunications Policy	44
8	An analysis of digital literacy skills among Thai university seniors	2016	International Journal of Emerging Technologies in Learning	44
9	Measuring digital literacy across three age cohorts: Exploring test dimensionality and performance differences	2020	Computers and Education	42
10	Does digital literacy influence students' online risk? Evidence from Covid-19	2021	Heliyon	40

In the field of bibliometrics, publications with the highest citations are scientific works or articles that have been cited by a significant number of other articles or scientific works in the scientific literature. Articles with the highest citations are often considered works

that greatly impact a particular field or research topic. This citation can come from various sources, including scientific journal articles, books, theses, or other documents.

The publication with the highest citations in the area of digital literacy is Identifying Digital Transformation Paths in the Business Model of SMEs during the Covid-19 Pandemic with 220 citations, Digital literacy: A prerequisite for effective learning in a blended learning environment? With 102 citations, and The Best, the Worst, and the Hardest to Find: How People, Mobiles, and social media Connect Migrants In(to) Europe with 81 citations.

It is important to remember that the assessment of a scientific work is not only based on the number of citations alone. The context and relevance of the citation are also essential. Sometimes, a single publication with few citations can significantly impact if the citations come from very important or influential research. Conversely, a highly cited publication may be less relevant if most citations are unrelated to the topic or substantial intellectual contributions. So, publications with the highest citations have received a high number of citations in bibliometric analysis, which can be an important indicator in assessing the influence and impact of scientific work in the scientific community.

4   Conclusion

Bibliometric analysis focuses on digital literacy publications published in Southeast Asia in the Scopus database from 2002-2023. The analysis results show that the digital literacy research trend has experienced a significant increase from 2017 to 2023, with 577 publications. Six clusters in the publications in this research were obtained during the last eight years. Cluster 1 consists of 27 items, cluster 2 consists of 27 items, cluster 3 consists of 17 items, cluster 4 consists of 16 items, cluster 5 consists of 15 items, and cluster 6 consists of 11 items. In developing digital literacy publications, if we look at countries with publication productivity worldwide, the United States occupies the first position in digital literacy publications.

Meanwhile, in Southeast Asia, the country that is most productive in publishing in the area of digital literacy on Scopus data is Indonesia, followed by Malaysia, Thailand, Singapore, the Philippines, Laos and Vietnam. The publication with the highest citations in the field of digital literacy is Identifying digital transformation paths in the business model of SMEs during the Covid-19 Pandemic with 220 citations.

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