Article

A Bibliometric Analysis of Research on The Use of Technology in Self-Regulated Learning

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Abstract – This study aimed to determine the primary subjects, well-known authors, often-cited sources, most-cited publications, and countries conducting research on the use of technology-related problems in self-regulated learning. Moreover, this study employed bibliometric techniques to discover and analyze the scientific literature for the purpose of providing recommendations for future research directions. Additionally, the descriptive bibliometric analysis method was employed, and 41 publications were selected from the Scopus database using revised data. It was discovered that, out of the years 2011 to 2023, 2023 stood out with the highest number of publications (16 in total). Furthermore, the United States was identified as the most dominant country in this field, with a total of nine publications and five collaborations with other countries. It was also found that 18 of the 41 journals have been published in Q1 journals. This study focused on finding journals that investigated the use of technology in self-regulated learning, specifically in the fields of 1) e-learning and artificial intelligence; 2) learning, higher education, and teaching; 3) self-regulated learning, students, and mobile learning; and 4) education, systematic literature review, and technology. In addition, due to the limitations of the existing search sources, it was expected that future research would consider expanding the scope of findings using other databases as alternatives (such as Web of Science and Google Scholar). This was expected to enable a more comprehensive picture of the use of technology in self-regulated learning.
Keywords: "technology", "self-regulated learning", "e-learning", "education", "bibliometric analysis".

1. Introduction

The advancement of science and technology in the 21st century emphasizes the importance of every country increasing its self-reliance. Indonesia aspires to be an independent, prosperous, and respected nation. Several factors, including natural resources, human resources, and government policies, affect this independence.

The fundamental purpose of education is to provide students with the independence to deal with the challenges of the 21st century, and it plays a significant role in developing human resources in this context. Individuals who possess these qualities—independence,

willingness, and capability—are examples of high-quality human resources. Furthermore, learning independence in students is encouraged by the education sector, which contributes significantly to the development of independent and capable individuals. In addition, enhancing self-regulation in students is one of the most effective methods for fostering learning independence (Badan Standar Nasional Pendidikan, 2010).

The concept of self-regulated learning was first introduced and developed by an educational expert, Zimmerman (1989). The concept of self-regulated learning derives from Bandura's (1986) social cognitive theory, which emphasizes that the interactions between interdependent aspects of personality, behavior, and environment form human behaviors (Bandura, 1997).

Self-regulated learning (SLR) is the process by which learners take the initiative to control their own learning. They set goals, monitor personal progress, and adjust their learning strategies according to their needs (Mirmoadi and Satwika, 2022). Moreover, technology can assist in promoting SRL by providing learners access to tools and resources that will enable them to manage their learning more effectively. For example, having an excellent skill in digital literacy may assist learners in navigating online resources and evaluating the quality of the information they find. In addition, learners may access a wide range of learning materials through online learning platforms, and tools such as learning analytics can be used to monitor their progress and identify areas that require more attention (Kristanto and Pradana, 2022).

There are several studies that have investigated the relationship between the use of technology and SRL. For example, the research conducted by Mirmoadi et al. (2022) discovered that there was a positive correlation between digital literacy and SRL among university students. Additionally, research conducted by Sucipto (2017) revealed that SRL skills among students could be enhanced by using blended learning, which combines online and face-to-face teaching.

In addition, there are several studies that have conducted literature reviews on self-regulated learning. However, to the best of the researcher's knowledge, there has been no research conducting a bibliometric analysis regarding the topic of the use of technology in self-regulated learning. Therefore, this study aimed to fill the gap by conducting a bibliometric analysis of the use of technology in self-regulated learning.

This study aimed to determine the primary subjects, well-known authors, often-cited sources, most-cited publications, and countries conducting research on the use of technology-related problems in self-regulated learning from 2011 to 2023. In addition, this study aimed to provide recommendations for future research directions. The research questions were listed as follows:

1. What are the latest developments in publications regarding the use of technology in self-regulated learning?
2. What are the current citation trends regarding the use of technology in self-regulated learning?
3. What are the patterns of geographical distribution and collaboration between countries in research on the use of technology in self-regulated learning?

4. How do journals rank by quartile score in the context of the use of technology in self-regulated learning?
5. What is the focus of research on the use of technology in self-regulated learning?

2. Literature Review

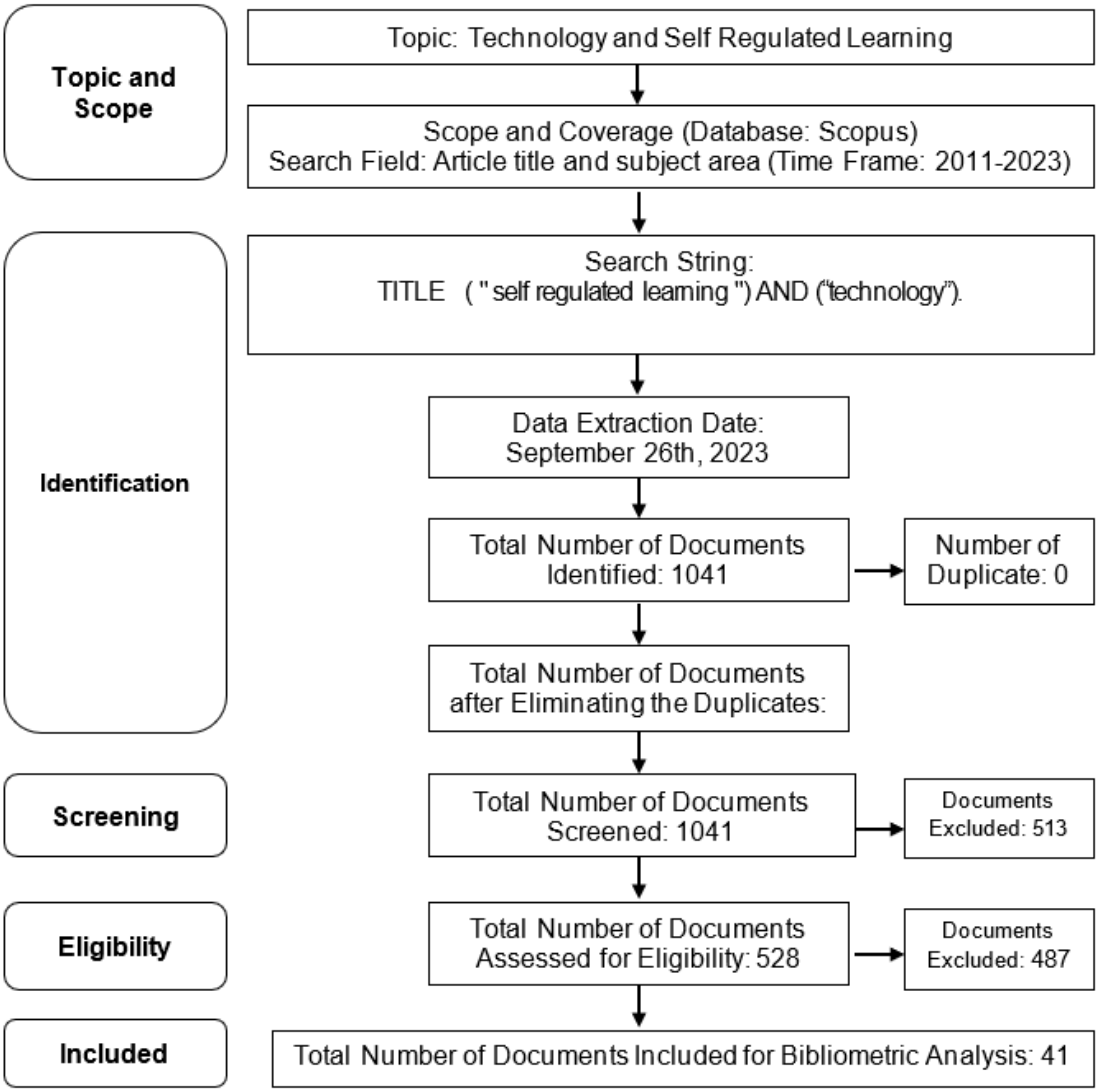
According to Yot-Domínguez and Marcelo (2017), the rapid advancement of science and technology has a significant impact on the development of self-regulated learning (SRL). The research results showed that daily engagement with technology contributed positively to students' self-regulated learning. This factor indicates that digital literacy skills have become a crucial aspect in the advancement of students' self-regulated learning, enriched by the availability of technology (Latifah, 2018). Moreover, Yang and Kim (2014) found that there was a positive and significant correlation between digital literacy and self-regulated learning in a university e-learning environment. Additionally, according to Muthupoltotage and Gardner (2018) there was a similar relationship between digital literacy and self-regulated learning in the context of technology-based learning. Furthermore, Prior et al., (2016) demonstrated that digital literacy has a deeper relationship with self-regulated learning. All of these studies support learning collectivism theory by George Siemens, which states that individuals may learn and share acquired information and skills using internet network technology.

Various literature review methods were used to gather existing knowledge and understand the research situation or landscape (Suseelan et al., 2022). Furthermore, research related to the use of technology in self-regulated learning was evaluated using the bibliometric analysis method. According to Phoong et al., (2022) and Zyoud et al., (2017), the bibliometric analysis method is among the most effective methods to analyze a number of studies. Bibliometric analysis is a qualitative and quantitative analysis of a certain subject. According to Roy and Basak (2013), bibliometrics is a standard tool in policy science and research management that helps monitor the growth of literature and research patterns and understand the process of scientific communication and the structure of science through citation relationships in journals and papers. In this context, this study conducted a bibliometric analysis with the aim of comprehending the research landscape of previous studies on the use of technology in self-regulated learning.

3. Methodology of Study

This study used data obtained from the Scopus database as of September 26, 2023. Furthermore, published journal articles serve as data sources. Additionally, the analysis of this study excluded other documents, such as books, proceedings, news, and other forms of documents obtained in the database.

Figure 1. Data Collection Process



Source: Data Processed (2023)

The first identification process involved keywords employed in searching for journal articles in the Scopus database, which are “self-regulated learning” and “technology.”. As a result, 1041 articles were identified. The publications subsequently underwent screening based on certain criteria, including publications written in English and in the form of journal articles. After screening, 528 publications were determined to meet the criteria, while the remaining 513 publications were eliminated.

Following the publications undergoing a screening process, the researcher proceeded to the eligibility process stage, in which the researcher manually assessed the publications to be included in the analysis of this study. The abstracts and titles of the 528 publications were examined, and an assessment was conducted to determine whether they covered or included

relevant variables. At this stage, 41 publications were considered eligible to proceed to the next stage.

During the bibliometric analysis assessment, various tools for data testing were employed. Microsoft Excel was employed to determine the frequency of published material and create charts and graphs illustrating relevant research. Additionally, as highlighted in the research by Kent Baker et al., (2020), VOSviewer (www.vosviewer.com) was essential in the construction and visualization of bibliometric networks. Another valuable tool in the toolkit was "Publish or Perish" by Harzing, which was used to calculate citation metrics and some other frequencies (Ahmi et al., 2019).

4. Findings and Discussion

Following the data collection process for the publications related to the use of technology in self-regulated learning, bibliometric descriptive analysis was then employed to analyze them, obtaining 41 publications within the period of 2011 to 2023 that met the criteria. Moreover, additional topics discussed include the distribution of countries and journals, citation and publication trends, and research focus.

4.1. Publication Trend

Figure 2 shows the total publications on the use of technology in self-regulated learning from 2011 to 2023. In addition, as seen in Figure 2, a total of 41 publications were classified according to the year of publication.

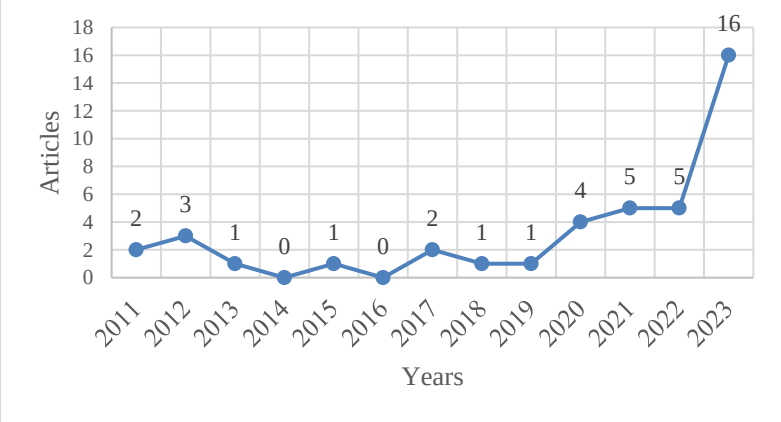


Figure 2. The Total of Publications on the Use of Technology in Self-Regulated Learning from 2011 to 2023
Source: Data Processed (2023)

Based on the data collected, it was observed that in 2011, there were only two articles on the topic of using technology in self-regulated learning, and the number of articles published on this topic increased to three in 2012. However, in 2013, the number of articles published on this topic decreased, and there were no articles published on this topic in

2014 and 2016. Moreover, there was a significant increase in the articles published on this topic between 2020 and 2023, with 16 articles published in that year—the highest number compared to previous years (see Figure 2). This fact shows the potential and opportunity for further research on the topic of the use of technology in self-regulated learning, which was the focus of this study.

Table 1 below shows that during the observation period, the most dominant journal that published articles related to the use of technology in self-regulated learning was Sustainability (Switzerland). Furthermore, Computers and Education and New Directions for Teaching and Learning both have the same number of articles published, for a total of 3 articles. In addition, other sources have only published a small number of articles on the topic.

Table 1: The Top 5 Most Productive Journals

Title of the Journal	Total Articles
Sustainability (Switzerland)	5
Computers and Education	3
New Directions for Teaching and Learning	3
Advanced Science Letters	2
Frontiers in Psychology	2

Source: Data Processed (2023)

4.2. Citation Trend

Table 2 shows the citation trends related to the use of technology in self-regulated learning from 2011 to 2023. Furthermore, the 41 publications were grouped by the year of publication. Additionally, Table 2 shows the total number of publications per year, NCP (number of cited publications), TC (total citations), C/P (average citations per publication), and other values as follows:

According to the data in Table 2, 2023 had the highest NCP of all the years, with a NCP value of 5. Furthermore, in terms of citations, publications from 2012 had the highest number of citations, surpassing other years with a total of 112 citations. Despite the fact that the number of publications in 2023 was higher than in previous years, 2012 had a significant research impact. In addition, publications in 2014 and 2016 had the fewest citations.

The number of citations can be used to measure researcher productivity. Furthermore, Table 3 shows the five most cited articles according to the Scopus database. Additionally, the article that has been cited the most is entitled “Mobile Assisted Language Learning in University EFL Courses in Japan: Developing attitudes and skills for self-regulated learning.”.

Table 2: Citation Analysis of Publications

Year	T	NCP	TC	C/P	C/CP	h	g
2023	16	5	22	1.38	4.4	3	4
2022	5	3	4	0.8	1.33	1	1
2021	5	4	54	10.80	13.50	3	5
2020	4	4	34	8.50	8.50	2	4
2019	1	1	26	26.00	26.00	1	1
2018	1	1	86	86.00	86.00	1	1
2017	2	2	40	20	20	2	2
2016	-	-	-	-	-	-	-
2015	1	0	0	0.00	0.00	0	0
2014	-	-	-	-	-	-	-
2013	1	1	24	24	24	1	1
2012	3	3	112	37.33333	37.33333	3	3
2011	2	2	67	33.5	33.5	2	2

Notes. TP=total of publication; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; C/CP=average citations per cited publication; h=h-index; g=g-index. Source: Data Processed (2023)

Table 3: The Top 5 Most Cited Articles

Authors -Title	Publisher	Cited
Kondo et al., 2012: Mobile Assisted Language Learning in University EFL Courses in Japan: Developing attitudes and skills for self-regulated learning	ReCALL	100
Garcia et al., 2018: Systematic Literature Review: Self-Regulated Learning Strategies Using E-Learning Tools for Computer Science	Computers and Education	86
Yot-Domínguez and Marcelo, 2017: University Students' Self-Regulated Learning Using Digital Technologies	International Journal of Educational	80
Kitsantas & Dabbagh, 2011: The Role of Web 2.0 Technologies in Self-Regulated Learning	New Directions for Teaching and Learning	55
An et al., 2021: Technology-Assisted Self-Regulated English Language Learning: Associations with English Language Self-Efficacy, English Enjoyment, and Learning Outcomes	Frontiers in Psychology	32

In research that has been cited 100 times entitled "Mobile Assisted Language Learning in University EFL Courses in Japan: Developing attitudes and skills for self-regulated learning," it was explained that the project involved researchers at a Japanese university exploring the application of Mobile Assisted Language Learning (MALL). They developed learning modules with the aim of improving students' TOEIC listening and reading test scores. Additionally, an e-learning tool for computer science students was the

topic of the second most cited research, which was conducted by Garcia et al. (2018) and cited 86 times. The purpose of the tool was to support and implement the use of SRL (self-regulated learning) strategies categorized by the Zimmerman and Martinez-Pons taxonomy. This research aimed to provide answers to the question of how these strategies were applied in the context of modern learning technologies.

4.3. Collaborative Relationships Between Countries

According to Table 4, there are 20 countries that have contributed to the publishing of articles about the use of technology in self-regulated learning. The United States has the most publications, with 9 articles and 95 citations. Indonesia comes in second with 7 articles and 51 citations, followed by Taiwan, China, Spain, and Malaysia. In addition, the data distribution indicates that the Asian continent has a significant influence on this topic, as evidenced by the publication of 26 articles in total—a substantial number when compared to the publications from other continents.

Figure 3 shows the research collaboration between countries, in which a total of 7 out of 20 countries in the dataset were found to have academic collaboration for at least 1 publication. Furthermore, according to Figure 3, there are two clusters involved. The large nodes represent the intensity of collaboration. Based on Figure 3, the first cluster shows that the United States has more collaboration activities with European countries such as the Netherlands, Germany, Australia, and Finland. Additionally, in the second cluster, it can be seen that Hong Kong and Singapore have a collaboration; however, only Hong Kong has a collaboration with the United States.

Figure 3. Patterns of State Collaboration
Source: Data Processed (2023)

4.4. Distribution of Journal Rangkings

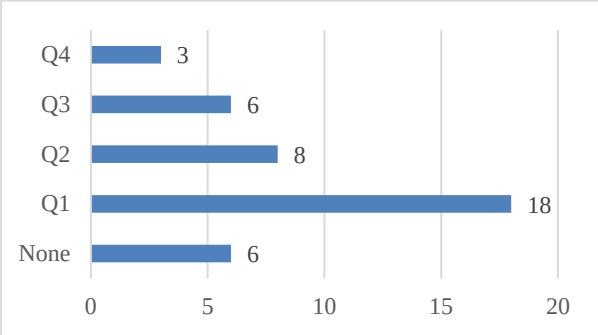
The Scimagojr website provides information on journal rankings by quartile value (Q) related to publications on the use of technology in self-regulated learning. Additionally, Figure 4 shows information about the journal rankings.

Table 2: Top Countries by Number of Publications and Citations

No	Country	Documents	Citations
1.	United States	9	95
2.	Indonesia	7	51
3.	Taiwan	5	24
4.	China	4	44
5.	Spain	3	81
6.	Malaysia	3	16
7.	Australia	2	96
8.	Canada	2	20
9.	Germany	2	10
10.	Hong Kong	2	10
11.	Singapore	2	5
12.	Japan	1	100
13.	Macao	1	32
14.	Finland	1	10
15.	Netherlands	1	10
16.	Iran	1	3
17.	Norway	1	6
18.	Greece	1	0
19.	Nigeria	1	0
20.	Turkey	1	0

Figure 4 shows that the majority of publications in journals related to research on the use of technology in self-regulated learning fall into the Q1 category, with 18 journals. In the second position, there are 8 journals that fall into the Q2 category. In addition, 6 journals have no quartile assessment, indicating the need for improvement in writing about the use of technology in self-regulated learning in order to be published in journals that have been assessed by quartiles.

Figure 1. Ranking Based on Journal Quartile Score

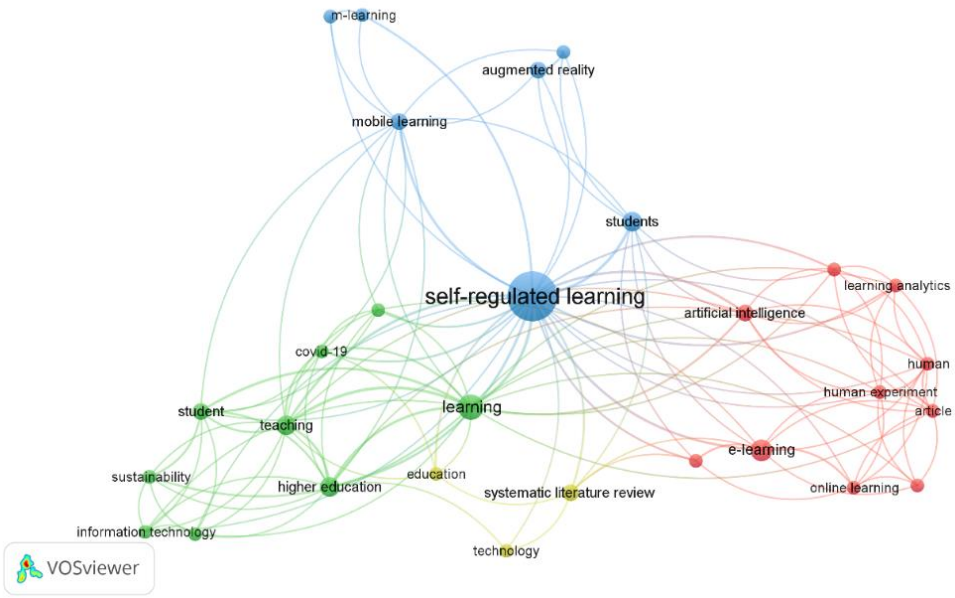


Source: Data Processed (2023)

4.5. Research Focus

At this stage, a threshold was set by selecting keywords that co-occurred in at least two publications. In other words, only keywords that co-occurred in two or more publications were displayed through analysis using VOSviewer. Moreover, as seen in Figure 5, the number was drastically reduced to only 29 keywords from the initial 227 keywords after applying the threshold.

Figure 2. Keyword Co-occurrence (Threshold ≥ 2)



Source: Data Processed (2023)

The research focus is illustrated by different clusters in Figure 5 above, each of which is distinguished by different colors. The colors reflect the research clusters on the use of

technology and its impact on self-regulated learning. There are four clusters, with the dominant cluster being red, followed by green, blue, and yellow.
The research focus was divided into four segments:

1. The red cluster consists of 10 elements, and based on the size of the circles in the cluster, it can be concluded that the keywords e-learning, artificial intelligence, and articles are the main focus of research along with self-regulated learning.
2. The green cluster consists of 9 elements, and based on the size of the circles in the cluster, it can be concluded that the keywords learning, higher education, and teaching are the main focus of research along with the use of technology.
3. The blue cluster consists of 7 elements, and based on the size of the circles in the cluster, it can be concluded that the keywords self-regulated learning, students, and mobile learning are the research focus.
4. The yellow cluster consists of 3 elements, and based on the size of the circles in the cluster, it can be concluded that the keywords education, systematic literature review, and technology are the research focus.

The four components of the research focus described above can be used as a guideline for other researchers that aim to conduct future research using the topic of the use of technology in self-regulated learning to determine the research focus to be investigated.

5. Limitations of the Study

This study has limitations in that the data analyzed was sourced from the Scopus database, which, although extensive, did not cover all relevant sources. Other databases, such as the Web of Science (WoS), Google Scholar, and others, may provide additional information. The data for this study were retrieved on September 26, 2023, implying that the data did not include research conducted after that date, leading to potential minor variations.

6. Conclusions

Based on the study's findings and discussion, it can be concluded that 2023 is the year with the highest number of articles published, which is 16 publications, compared to other years. Moreover, the most significant year for citations related to the use of technology in self-regulated learning was 2012, with 112 citations. Additionally, the United States emerged as the leading country in the overall analysis conducted, contributing 9 articles with 95 citations and establishing 5 collaborations with other countries. Furthermore, 18 of the 41 journals were published in Q1 journals. In addition, the research focus on the use of technology in self-regulated learning includes: 1) e-learning, artificial intelligence, and articles; 2) learning, higher education, and teaching; 3) self-regulated learning, students, and mobile learning; and 4) education, systematic literature review, and technology.

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