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Digital Literacy and E-Module Integration in Online Learning: A Systematic Literature Review Using PRISMA Framework

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Abstract

Background: Digital transformation has accelerated the adoption of online learning, making digital literacy and e-modules essential for effective learning. However, research trends on their integration remain insufficiently explored.
Aims:This study analyzes research trends, intellectual structures, and the role of digital literacy and e-module integration in online learning through bibliometric analysis and a systematic literature review (PRISMA)
Methods:A bibliometric analysis and PRISMA-based SLR were conducted using articles from Scopus and Google Scholar. Data were screened, cleaned with OpenRefine, and analyzed using Biblioshiny and VOSviewer to examine publication trends, collaborations, citations, and research themes.
Results:Publications increased during 2024-2026, with digital literacy, e-learning, online learning, and e-modules as dominant themes. The findings show that digital literacy improves online learning effectiveness, while e-modules enhance engagement, independent learning, and critical thinking. Artificial intelligence and adaptive learning emerged as promising future research topics**.**
Conclusion: Digital literacy and e-module integration are key factors in improving online learning. This study highlights current research trends, identifies research gaps, and provides recommendations for future technology-enhanced education.

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INTRODUCTION

Very rapid developments in information and communication technology have led to major changes in many aspects of life, including in the field of education. The use of technology in the teaching and learning process encourages various innovations such as online learning, e-learning, and distance learning that allow learning to take place more flexibly without being bound by time and place (Setyawan et al., 2024). This change has accelerated since the COVID-19 pandemic forced educational institutions around the world to switch to digital learning methods (Mallik, 2025). This change not only affects the way learning is conducted, but also shifts from a teacher-focused approach to a more student-focused approach. In this context, students are expected to be more independent in managing their learning process (Palanci et al., 2024). However, the success of digital learning is greatly influenced by the ability of individuals to utilize technology in an effective way, which is often referred to as digital literacy or digital competence (Judith & Romina, 2025; Irwan & Kamarudin, 2021).

Digital literacy encompasses a wide range of skills, such as technical expertise in using digital devices, cognitive ability to understand information, and critical ability to assess digital content. This skill is one of the important competencies in the 21st century that has a vital role in supporting the success of technology-based learning. Some studies have even shown that digital literacy has a significant correlation with student learning outcomes, especially in the context of online learning (Ulimaz, 2025). Even so, the implementation of digital learning still faces various obstacles (Senkbeil, 2026). Not all students have sufficient levels of digital literacy, which has an impact on the low effectiveness of the learning process (Pande et al., 2026). In addition, unequal access to technology

between regions, problems with infrastructure, and low readiness of teachers to integrate technology are also major barriers to the implementation of e-learning. This shows that the success of digital learning is influenced not only by access to technology, but also by the readiness of human resources (Bond et al., 2021; Kuluşaklı, 2026)

On the other hand, research also indicates that online learning has many benefits, such as flexibility in timing, easy access to materials, and opportunities to improve independent learning skills (Dhawan, 2020;Bond et al., 2021). However, to achieve maximum learning outcomes, it is important to have a suitable learning design, because without it, these benefits will not have a significant impact on students (Koh & Daniel, 2022). Therefore, innovation in the development of effective media and teaching materials for digital learning is urgently needed. One example is the development of electronic-based teaching materials or e-modules. E-modules are digital learning resources that are made systematically, interactively, and can be accessed independently by students. The use of e-modules has been proven to increase student participation in the learning process and encourage more independent and significant learning (Fahmi et al., 2021; Rahayu & Sukardi, 2021; Yulando et al., 2019) In addition, the e-module can be equipped with various multimedia features such as videos, animations, and interactive quizzes that can increase students' motivation to learn (Fonda & Sumargiyani, 2018).

Furthermore, several studies show that the use of e-modules not only improves learning outcomes, but also serves to strengthen critical thinking skills and ICT literacy in students (Miftakhurrohmah et al., 2023;Sanova et al., 2022). In a distance learning setting, the use of e-modules can help students develop life skills, including independence, a sense of responsibility, and the ability to solve problems (Ahsani & Mulyani, 2020). With the rapid development of technology, recent trends in digital learning show the use of advanced tools such as mobile devices, learning analytics, and artificial intelligence to improve educational effectiveness (Eom, 2023; Li, 2022). This innovation opens up new opportunities to create more responsive, personalized, and data-driven learning. However, this technology still requires good digital literacy support so that it can be used optimally (Pate, 2021)

From this explanation, it can be concluded that digital literacy has a very relevant role in supporting the success of e-learning-based learning, especially in the application of e-modules as learning tools. Although there has been a lot of research on digital literacy and e-learning, there is still a lack of research that appropriately examines the relationship between digital literacy, the use of e-modules, and the effectiveness of learning in certain contexts (Amaliana et al., 2022). Therefore, it is important to conduct this study to analyze the impact of digital literacy on the use of e-modules in online learning and its influence on student learning outcomes (Palanci et al., 2024; Palanci et al., 2024).

METHOD

This study uses a bibliometric analysis method combined with the Systematic Literature Review (SLR) approach with the help of the Bibliometrix application (Biblioshiny) and VOSviewer. This research focuses on the study of digital literacy, the use of e-modules, and its implementation in the context of online learning. The research data was obtained from the Scopus database with a range of publication years 2024 to 2026. This time range was chosen to represent the latest research developments related to digital literacy and digital teaching materials in online learning. The data search process is carried out using the following keyword combinations: ("digital literacy" OR "digital skills" OR "digital competence" OR "ICT literacy") AND ("e-module" OR "electronic module" OR "digital module" OR "learning materials") AND ("online learning" OR "e-learning" OR "distance learning") This combination of keywords is used to capture articles that discuss the relationship between digital literacy skills, use of electronic modules, as well as their implementation in distance learning. All article data obtained is then downloaded in CSV format. The data files are then combined into one and processed using the OpenRefine application to perform data cleaning, such as removing duplicates, correcting writing inconsistencies, and filtering out irrelevant articles. After the cleaning process is completed, 10 valid scientific articles are obtained and ready for bibliometric analysis. The next stage is data analysis using Biblioshiny, which generates a variety of important information. In addition, various visualizations were also generated, such as publication growth graphs per year,

citation graphs, Three-Field Plot (CR–AU–KW) diagrams, analysis of the most relevant sources, and evaluation of the impact of sources using bibliometric indicators such as h-index, g-index, and m-index. Core source identification is also carried out using Bradford's Law. Furthermore, the visualization of the relationship between data is carried out using the VOSviewer application to display network maps (network visualization) and overlay maps (overlay visualizationThis visualization is used to analyze the relationship between keywords, authors, and research topics, so as to identify patterns of relationships and research trends in the fields of digital literacy, e-modules, and online learning. In addition to bibliometric analysis, this study also applies the Systematic Literature Review (SLR) approach. Based on the selection results, a total of 61 documents were obtained, consisting of 32 journal articles, 25 conference papers, 1 review, and 3 book chapters. The selection process is carried out systematically to ensure that the literature analyzed is relevant to the research topic. Overall, this method allows researchers to comprehensively identify research trends, collaboration patterns, and topic developments, especially in the study of digital literacy and the use of e-modules in online learning. This approach also provides a systematic overview of the research structure and the direction of scientific development in the field (Tasdelen & Bodemer, 2025; Gusmaniarti et al., 2026).

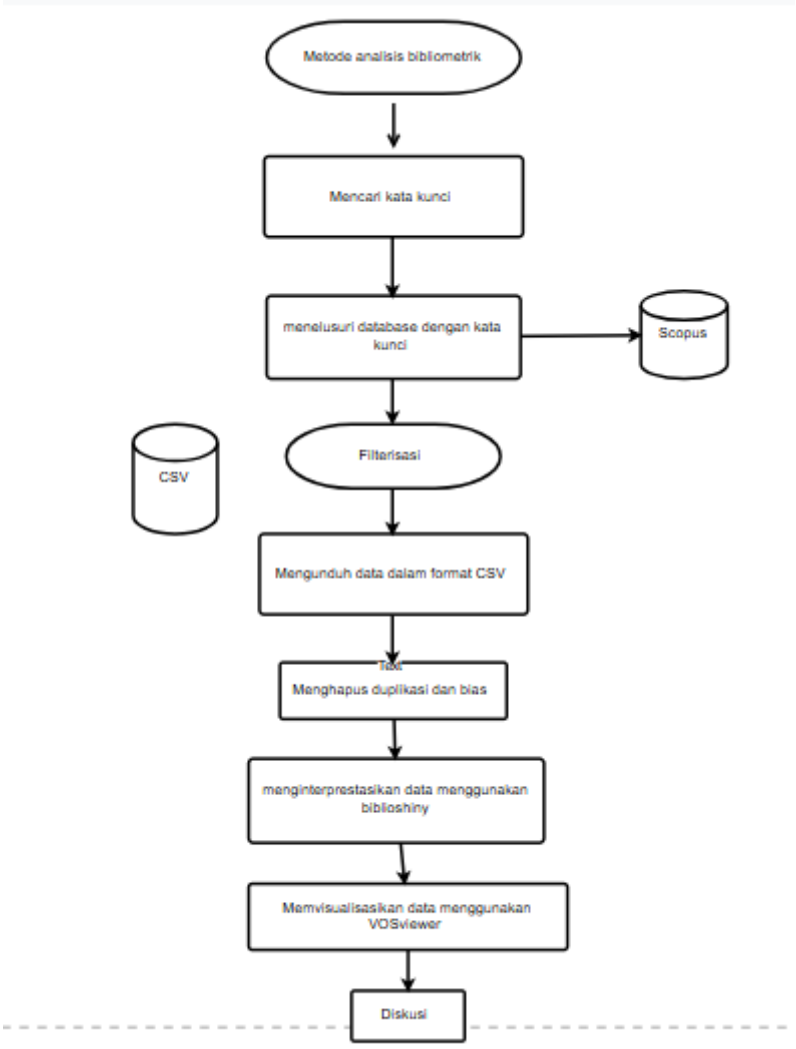

Figure 1 Research Method Flow Diagram

PRISMA Method

This research also uses the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method which functions to present the flow of article selection in a systematic, transparent, and structured manner, starting from the stage of identification, screening, to inclusion of relevant studies. This diagram helps ensure that the literature search and selection process is

carried out validly, avoiding duplication, and making it easier for readers to trace each stage of the literature review

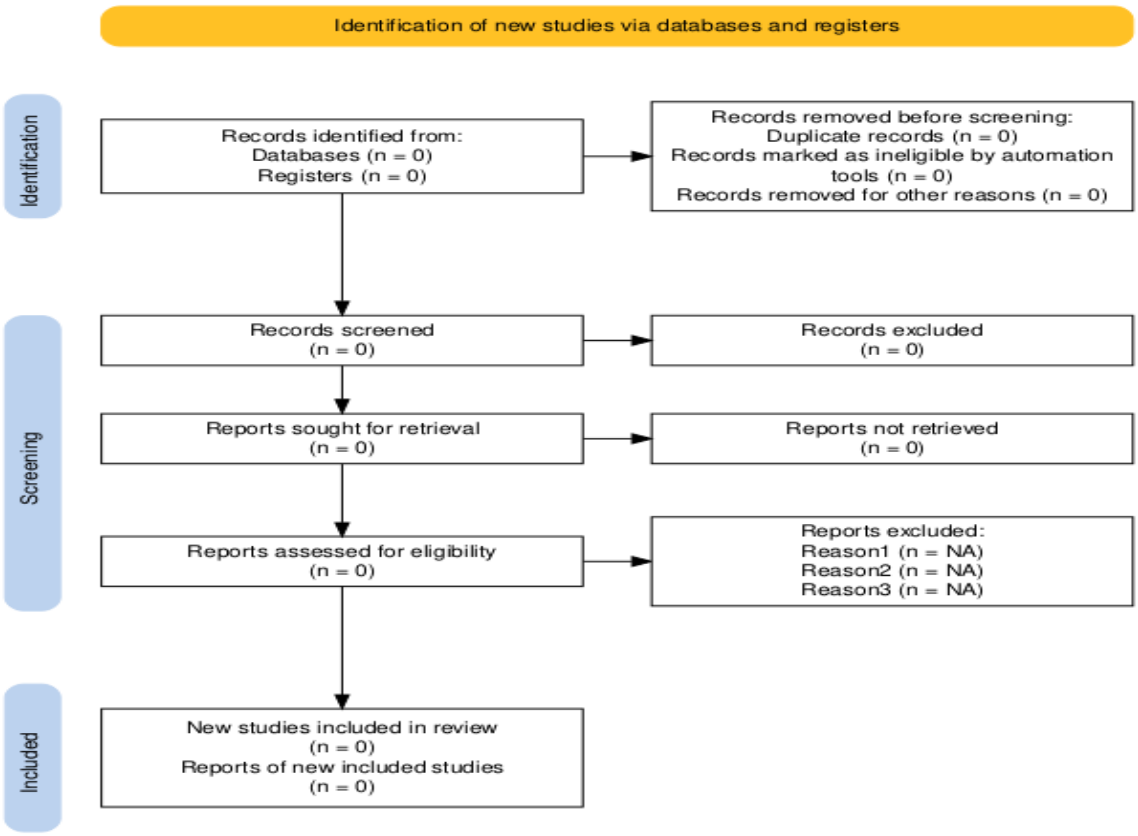

Figure 2. Prism Method Diagram

RESULTS AND DISCUSSION

Results

Bibliometric Studies

In bibliometric analysis, the data search strategy was carried out using the Scopus database which is relevant to the theme of digital literacy research in online learning. The search focused on the relationship between digital literacy, the use of e-modules, and its implementation in the context of online learning or distance learning.

The keyword combinations used in the search process are as follows:

("digital literacy" OR "digital skills" OR "digital competence" OR "ICT literacy")
AND ("e-module" OR "electronic module" OR "digital module" OR "learning materials")
AND ("online learning" OR "e-learning" OR "distance learning")

Based on this search strategy, no initial documents were obtained either from databases or other sources (n = 0). Furthermore, at the initial screening stage before screening, no documents were deleted, either due to duplication (n = 0), marked as unsuitable by the automated tool (n = 0), or for other reasons (n = 0). At the screening stage, no documents can be reviewed (records screened = 0), so no documents are issued (records excluded = 0). The next stage, namely reports sought for retrieval, also does not produce documents (n = 0), and there are no reports not retrieved = 0) Furthermore, at the eligibility assessment stage, there are no documents that can be analyzed (reports assessed for eligibility = 0), and no documents are issued based on certain reasons. In the final stage, there were no new studies included in review = 0 or reports of included studies (0). Thus, the entire data selection process based on the PRISMA method shows that no literature has been successfully identified, filtered, or analyzed in this study. This indicates that the search strategy used

has not yielded relevant data. A possible cause is the use of overly specific keyword combinations, thus limiting the number of results that appear. Therefore, keyword adjustments are needed, such as simplifying terms or using broader synonyms, as well as expanding database sources to make search results more optimal (Mohamad et al., 2026).

Reducing Duplicate Data

The process of reducing duplicate data is carried out based on the results of the literature search that has been obtained. However, because no documents were successfully identified (n = 0), no data could be exported or further processed using the OpenRefine application. In general, OpenRefine is used to perform data cleaning, especially in identifying and removing duplicate data and ensuring consistency in keyword writing. In addition, this application also helps minimize bias due to differences in writing or indexing in databases such as Scopus. In this study, no duplicate data was found because there were no documents at the initial stage of selection. Thus, the final number of documents remains 0 articles, so there is no data that can be further analyzed in a systematic study based on the PRISMA method (Kulaksız et al., 2026).

Metadata	Description	Missing Counts	Missing %	Status
AB	Abstract	0	0.00	Excellent
C1	Affiliation	0	0.00	Excellent
AU	Author	0	0.00	Excellent
CR	Cited References	0	0.00	Excellent
DI	DOI	0	0.00	Excellent
DT	Document Type	0	0.00	Excellent
SO	Journal	0	0.00	Excellent
DE	Keywords	0	0.00	Excellent
PY	Publication Year	0	0.00	Excellent
TI	Title	0	0.00	Excellent
TC	Total Citation	0	0.00	Excellent
ID	Keywords Plus	8	80.00	Critical
RP	Corresponding Author	10	100.00	Completely missing
LA	Language	10	100.00	Completely missing
WC	Science Categories	10	100.00	Completely missing

Figure 3. Meta data on DE/Keword is good.

Furthermore, the process of interpreting bilometric data can be carried out using the Bibliosiny application as follows. Data The main information as a whole is obtained is seen in the picture.

Table 1. Key Information on the data sheet.

Description	Results
Main Information About Data	
Timespan	2024-2026
Sources (Journals, Books, Etc)	10
Documents	10
Annual Growth Rate %	-29.29
Document Average Age	1.2
Average Citations Per Doc	1.3

Description	Results
References	1668
Document Contents	
Keywords Plus (ID)	36
Author's Keywords (DE)	66
Authors	
Authors	25
Authors of single-authored docs	2
Authors Collaboration	
Single-authored docs	2
Co-Authors per Doc	2.5
International co-authorships %	10
Document Types	
article	10
Conference paper	
Reviews	

In Figure 3 above, a summary of bibliometric data from 10 scientific documents published during the period 2024 to 2026 is shown. The documents come from 10 different sources, such as journals, books, and other publication sources. The annual growth rate was recorded at -29.29%, which indicates a decrease in the number of publications in the period. The average age of documents is around 1.2 years, so it can be said that most documents are still relatively new and relevant. Each document receives an average of 1.3 citations indicating that the publication is starting to gain attention in the related field of study. The total number of references used in the entire document reached 1,668, indicating that each article had a fairly strong bibliography. In terms of content, there are 36 Keywords Plus and 66 keywords provided by the author, which shows a fairly diverse scope of research topics. A total of 25 authors were involved in all publications, and there were 2 papers written by only one author, so it can be concluded that most of the research was conducted collaboratively. On average, each document is written by about 2.5 authors. In addition, 10% of publications are the result of international collaboration, which shows that there is cooperation between countries although it is still in limited quantities. All documents in this analysis are in the form of scientific articles, thus confirming that the main focus of the publication is on the delivery of research results(Panagiotakopoulos et al., 2025;Fabre-Mitjans et al., 2025).

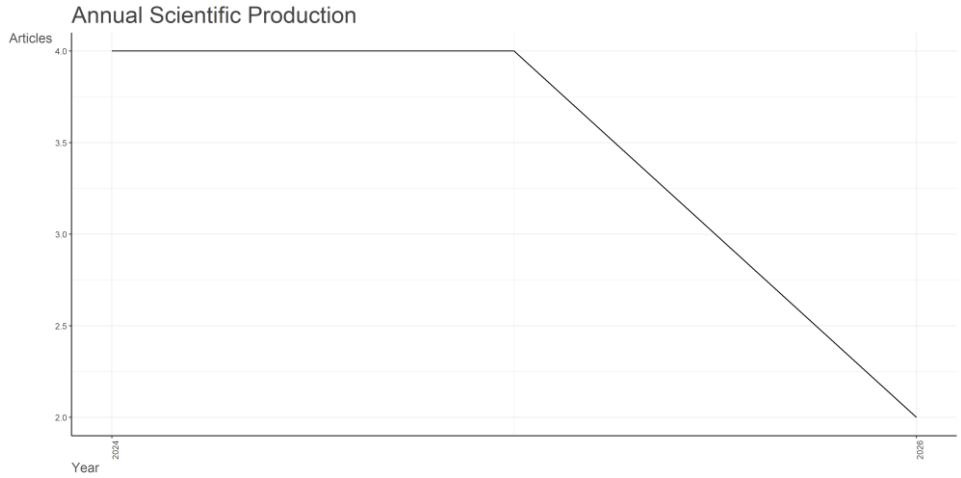

Figure 4. Annual growth chart.

Table 2. Annual Growth.

Year	Articles
2024	4
2025	4
2026	2

Based on graph 4 and table 1 shown, it can be seen that the number of scientific article publications during the period 2024 to 2026 shows a relatively fluctuating pattern and has not shown a consistent upward trend. In 2024, the number of articles published will be 4 articles. This number indicates a fairly good publication productivity at the beginning of the observation period. Furthermore, in 2025 the number of publications will remain at 4 articles, thus showing the stability of scientific productivity compared to the previous year. This condition indicates that research and publication activities are still running consistently for two consecutive years. However, in 2026 the number of publications will decrease to 2 articles. This decline shows a decrease in publication productivity compared to the previous two years (Fay et al., 2026). However, there were still publications that year indicating that research activities were still ongoing. Overall, this data shows that the productivity of scientific article publications during the 2024–2026 period tends to be unstable, with a fixed pattern in the first two years then declining in the last year. The decline in the number of publications in 2026 can be influenced by various factors, such as research limitations, an ongoing publication process, or articles that have not been fully indexed. Nevertheless, the sustainability of publications every year shows that research activities remain active even though they have not experienced sustainable growth (Bazangika et al., 2025).

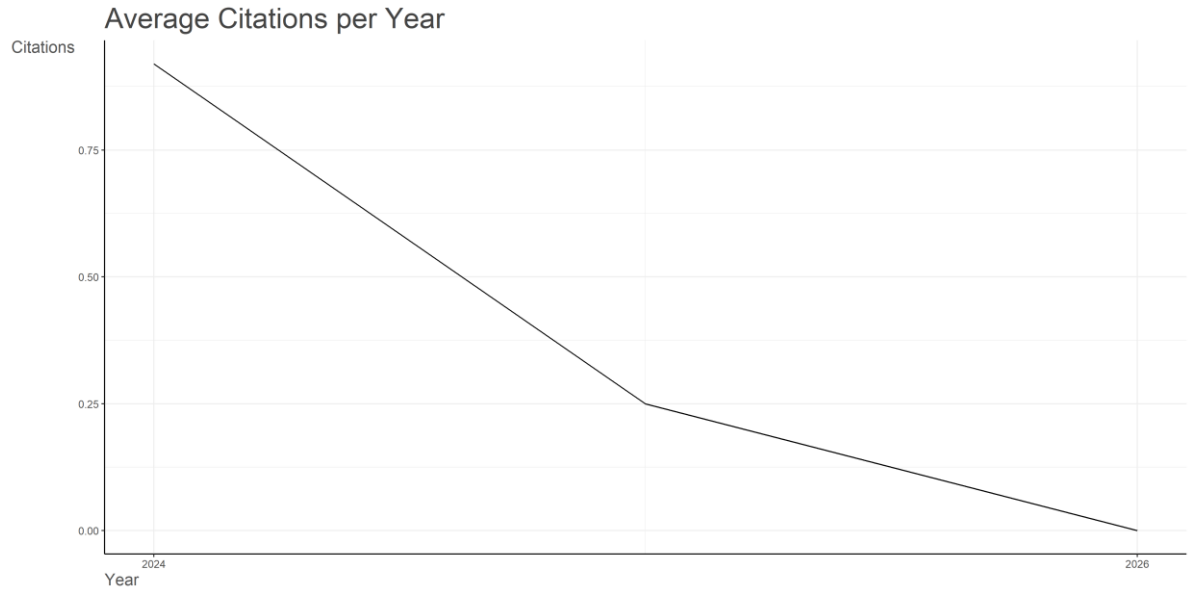

Figure 5 Graph of Citations Per Year.

Table 2. The discussion explains

Year	MeanTCperArt	N	MeanTCperYear	CitableYears
2024	2.75	4	0 92	3
2025	0 50	4	0.25	2
2026	0 00	2	0.00	1

Based on Chart 5 and Table 2 shown, it can be seen that the average citation trend per year has decreased quite clearly. In 2024, the Mean TC value per Year will be at 0.92. Furthermore, in 2025 the value decreased to 0.25, and decreased again in 2026 to reach a low value of 0.00. If you look at the Mean TC per Article, a similar pattern is also seen. The year 2024 shows a high value of 2.75, which indicates that the article in that year has a better citation rate than any other year. However, in 2025 there will be a significant decrease to 0.50, until it finally reaches a low point in 2026 of 0.00.

(Radiopoulou et al., 2026) This shows that even if publications persist, the level of influence or number of citations per article tends to decrease from year to year. In addition, the Citable Years factor also has an important influence on the number of citations. Articles published earlier, such as in 2024, have a longer citation time span of 3 years, so the chances of getting a citation are greater. In contrast, newer articles such as 2025 and 2026 only have 2 and 1 year citation periods respectively, so the number of citations is still relatively low. Overall, these data show that the level of scientific influence of an article is determined not only by the number of publications, but also by the quality of the research and the length of time the article is available for citation. Thus, it is important for researchers to not only focus on (Bazangika et al., 2025) on the quantity of publications, but also improving the quality in order to produce more impactful works and are widely referenced in future research (Raza et al., 2025).

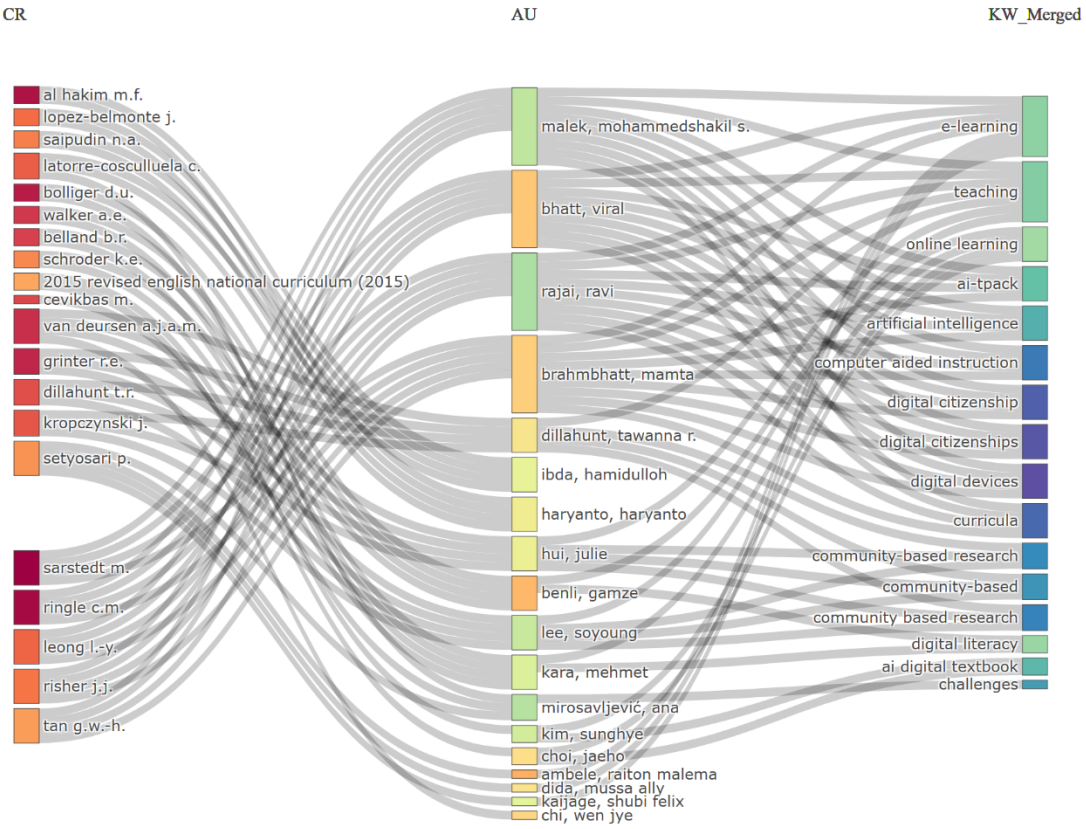

Figure 6. diagram Three-Field Plot

Based on Sankey's visualization of the diagram displayed, it can be seen that there is a clear relationship between the three main components, namely CR (cited references), AU (authors), and KW_Merged (keywords). On the right (KW_Merged), the main keywords that often appear are displayed, such as e-learning, teaching, online learning, ai-tpack, artificial intelligence, computer aided instruction, digital citizenship, digital devices, curricula, community-based research, digital literacy, AI digital textbook, and challenges. The dominance of these keywords shows that the focus of research is mostly related to the use of digital technology in education, the integration of artificial intelligence, as well as strengthening digital literacy and community-based approaches in the learning process. The streams (lines) that connect the three sections show the direct relationship between the references used, the contributing authors, and the research topic being studied. The more and thicker the lines connecting the elements, the stronger the connection and contribution between the reference source, the author, and the research theme. Overall, this visualization provides a comprehensive overview of the intellectual structure in the field of study, including frequently used main references, actively contributing authors, and dominant themes that develop. This can help

researchers understand the research map as well as identify relevant directions and trends in the field of digital technology-based education (Hellwig et al., 2025).

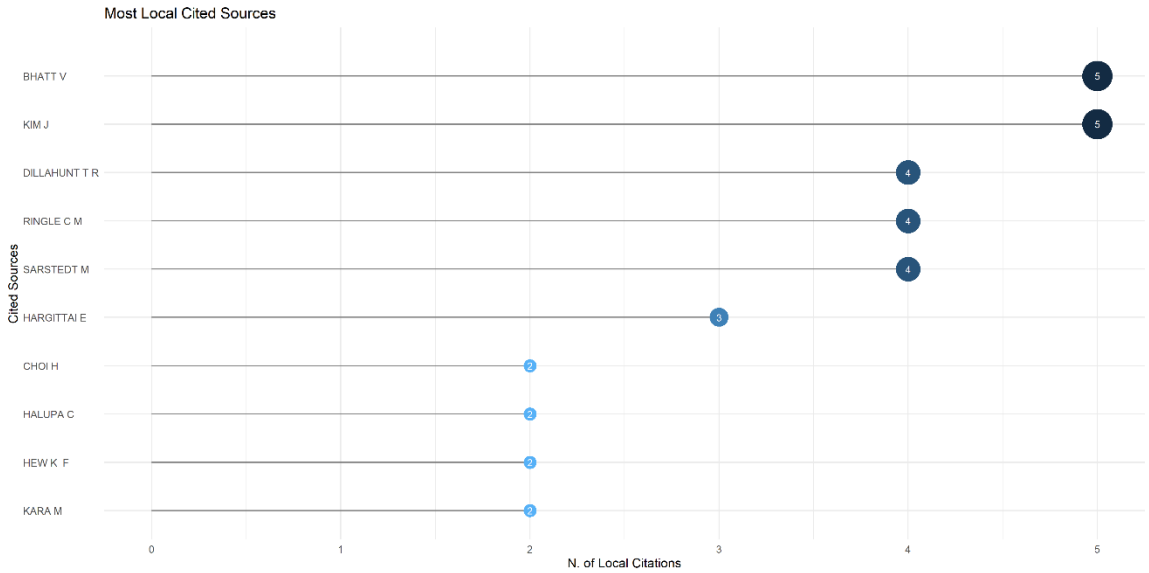

Figure 7 Most Relevant Source

Based on Figure 7, a list of the most locally cited sources in the published analysis is displayed. This visualization is presented in the form of a horizontal point graph, where the horizontal axis shows the number of local citations (N. of Local Citations), while the vertical axis displays the names of the cited authors or sources. From the graph, it can be seen that the sources with the highest number of citations are BHATT V and KIM J, each obtaining 5 citations. Furthermore, DILLAHUNT T R, RINGLE C M, and SARSTEDT M each had 4 citations, showing a fairly significant contribution in supporting the analyzed research. HARGITTAI E is in next place with 3 citations. Meanwhile, several other sources such as CHOI H, HALUPA C, HEW K F, and KARA M each obtained 2 citations. Although the number of citations is lower, the existence of these sources still shows a contribution to enriching the theoretical and reference foundations of research. Overall, the citation distribution in this graph shows that there is no one absolute dominant source, although some authors have a higher number of citations than others. This indicates that the research analyzed utilizes a variety of references, and shows that the field of study studied is broad and multidisciplinary with the support of various relevant scientific sources (Trichkova-Kashamova & Paunova-Hubenova, 2026).

Tabel 3. Sources' Local Impact

Source	h-index	g-index	m-index	TC	NP	PY-start
Education And Self Development	1	1	0.333	1	2	2024
Journal Of Computing In Higher Education	1	1	0. 500	1	1	2025
Ieee Transactions On Education	1	1	0.333	9	1	2024
International Jurnal Of Educational Technology In Higher Educaion	1	1	0.333	1	1	2024
Techology, Knowledge And Learning	1	1	0.500	1	1	2025

Based on the table displayed, it can be seen that the performance of several scientific journals is based on bibliometric indicators such as h-index, g-index, m-index, total citations (TC), number of publications (NP), and the year of initial publication (PY_start). In general, all journals in the table have the same h-index and g-index values, which are 1, which indicates that each new journal has one article that has at least one citation. The number of publications (NP) is also uniform, namely only one publication for each journal, so that the performance comparison is more determined by the number of citations and the m-index value. The Journal of Education and Learning stands out as

the most influential in this table, with a total citation (TC) of 9, much higher than other journals that received only 1 citation. Although the number of publications is the same, the high number of citations suggests that the published articles have a greater scientific impact. However, the journal's m-index value of 0.333 is still relatively moderate because its publication is relatively new to start in 2024. On the other hand, the Journal of Computing in Higher Education and the Proceedings of the ACM on Human-Computer Interaction have the highest m-index values, which is 0.500. This shows that although the number of citations is still low, the rate of influence of citations per year is relatively better, especially since publication begins in 2025, so the evaluation period is shorter. Meanwhile, journals such as Education and Self Development and the Korean Journal of English Language and Linguistics showed relatively similar performance, with the same h-index, g-index, and number of citations, as well as an m-index of 0.333. This indicates that the scientific contributions of each journal are still in their early stages and have not shown significant differences in terms of impact. Overall, this table illustrates that the entire journal is still in the early stages of productivity and scientific impact. The main difference is seen in the number of citations and the value of the m-index, where some journals are starting to show greater potential for influence even though the number of publications is still limited. Thus, both the quality of the article and the speed of citation accumulation are important factors in assessing the development of the performance of these journals (Alowayr, 2025).

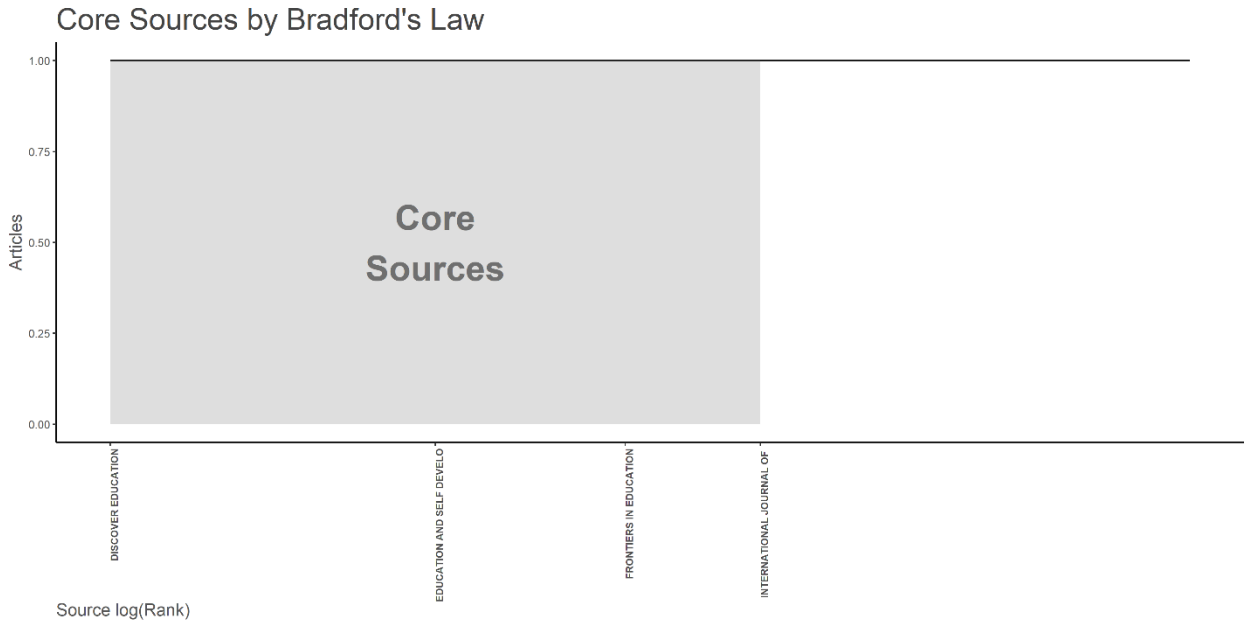

Figure 8. Core Sources by Bradford'd Law.

In the image above, the performance of various scientific journals is shown based on a number of bibliometric indicators such as h-index, g-index, m-index, total citations (TC), number of publications (NP), and the year of initial publication (PY_start). This data provides an overview of the productivity as well as the scientific influence of each journal. The journal Applied Sciences (Switzerland) stands out as the most productive and influential, with a total of 55 publications since 2020 and managing to obtain 1,268 citations. The h-index value of 16 and the m-index of 2.667 indicate that this journal is not only active in publication, but also has a significant impact in a relatively short time. In the next position, the journal Sensors also showed excellent performance. Although it has only started contributing since 2021, the journal has produced 30 publications with a total of 373 citations, and has an h-index of 10 and an m-index of 2,000. This indicates that the published articles are quite consistent in contributing to the development of science. Interestingly, the journal Nature Communications only published six articles, but was able to collect up to 591 citations. This shows that although the number of publications is relatively small, each article has a high quality and a great scientific impact. Meanwhile, journals such as Ultrasound in Medicine and Biology and Advanced Science also showed strong performance. Both have high h-index values compared to the number of publications, which indicates that published articles tend to be frequently

cited and have a significant influence in their field. This confirms that the quality of publication plays a more important role than just quantity. Overall, this table shows that there is a variation in strategy and strength among these journals. Some journals excel in the number of publications, while others are more prominent in terms of citation impact. The combination of productivity and citation quality is the main indicator in assessing the performance and influence of a scientific journal (Arfiah et al., 2025; Hooshyar et al., 2023).

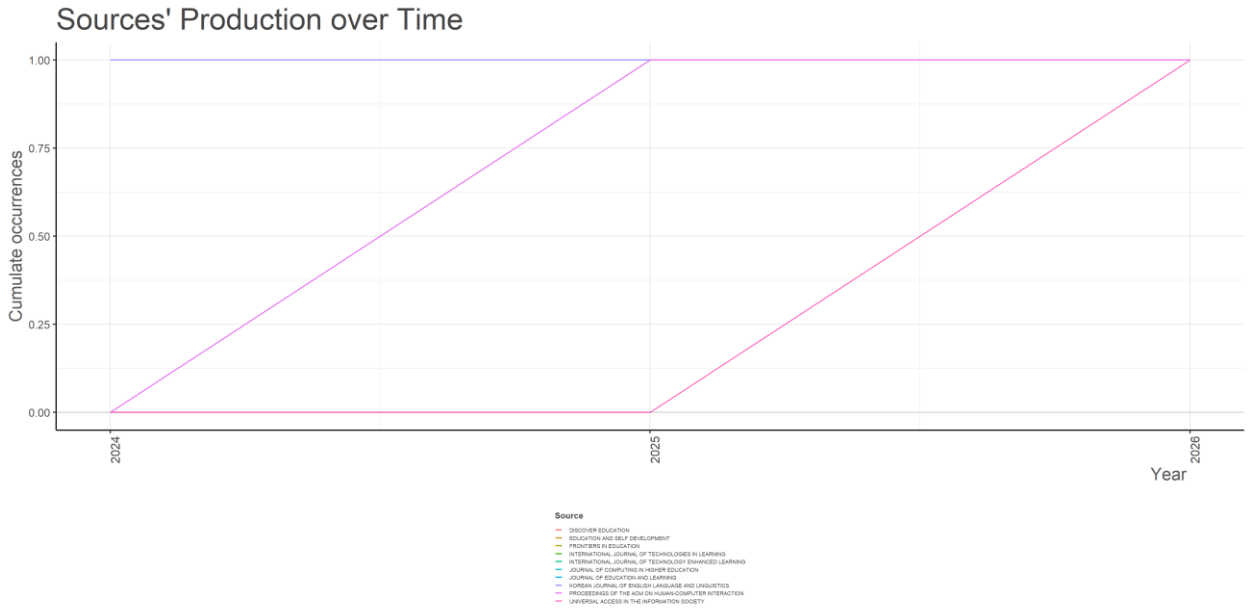

Figure 9. Grafik Cumulate Occurrences

Based on Figure 9 shown, a line graph depicts the production of publications from various journal sources cumulatively in the period of 2024 to 2026. The horizontal axis (X) indicates the year of publication, while the vertical axis (Y) indicates the cumulative number of occurrences from each source. Each line represents different journals, such as Discover Education, Education and Self Development, Frontiers in Education, International Journal of Technologies in Learning, International Journal of Technology Enhanced Learning, Journal of Computing in Higher Education, Journal of Education and Learning, Korean Journal of English Language and Linguistics, Proceedings of the ACM on Human-Computer Interaction, and Universal Access in the Information Society. From the graph, it can be seen that most journals show a very limited pattern of improvement, with cumulative values that only reach 1. Some journals begin to show the emergence of publications from 2024 and immediately reach the cumulative maximum value in the following year, then tend to stagnate until 2026. This indicates that the contribution of publications from each source is relatively small and does not experience significant growth over time. In addition, there are journals that have only started contributing in 2025, which is indicated by the line that rises from zero to one in the period 2025 to 2026. This pattern shows a lag in publication contributions compared to other sources. In general, no single journal dominates significantly in the number of publications, in contrast to the pattern in the previous graph that shows the presence of primary sources. Overall, this graph shows that the distribution of publications between journals tends to be evenly distributed but in very limited quantities. The absence of a significant spike indicates that the research topics analyzed are still spread across multiple sources without the strong dominance of a particular journal. This information gives an idea that scientific contributions are still sporadic and have not been concentrated in certain major journals.

Table 4. Most Relevant Authors

Author	Articles	Articles Fractionallzed
Ambele, Raiton Malema	1	0.25
Benli, Gamze	1	0.50
Bhardwaj, Bhavana	1	0.50

Bhatt, Viral	1	0.25
Brahmbhatt, Mamta	1	0.25
Chi, Wen Jye	1	1.00
Choi, Jaeho	1	0.50
Dida, Mussa Ally	1	0.25
Dillahunt, Tawanna R.	1	0.33
Dubey, Aman	1	0.50

In Table 4 above, a list of the most relevant authors is shown based on the number of publications (Articles) and the author's contribution in each article (Articles Fractionalized). The Articles column shows the total number of articles involving the author, while the Articles Fractionalized column reflects the author's contribution by considering the number of collaborators in each publication. Based on the data displayed, all authors have the same number of publications, namely one article. However, the value of Fractionalized Articles indicates the variation in the level of contribution of each author in the writing of the article. Writers like Chi, Wen Jye have the highest contribution value of 1.00, which indicates that the author is likely the only author or has a full contribution to his article. Furthermore, several authors such as Benli, Gamze; Bhardwaj, Bhavana; Choi, Jaeho; and Dubey, Aman have a Fractionalized Articles value of 0.50, which indicates that their contributions are quite dominant in articles with a relatively small number of collaborators. Meanwhile, most of the other writers such as Ambelle, Raiton Malema; Bhatt, Viral; Brahmbhatt, Mamta; and Dida, Mussa Ally has a contribution value of 0.25, which indicates that they contribute to a larger team of writers so that the portion of their contribution is divided. In addition, there are also authors like Dillahunt, Tawanna R. with a score of 0.33, which shows a moderate level of contribution among the number of collaborators who are not too many. Overall, this table shows that although there is no dominant author in terms of the number of publications, there is a fairly clear variation in contributions between authors. This reflects a strong pattern of collaboration in research, where most articles are co-authored by multiple authors with varying levels of contribution.

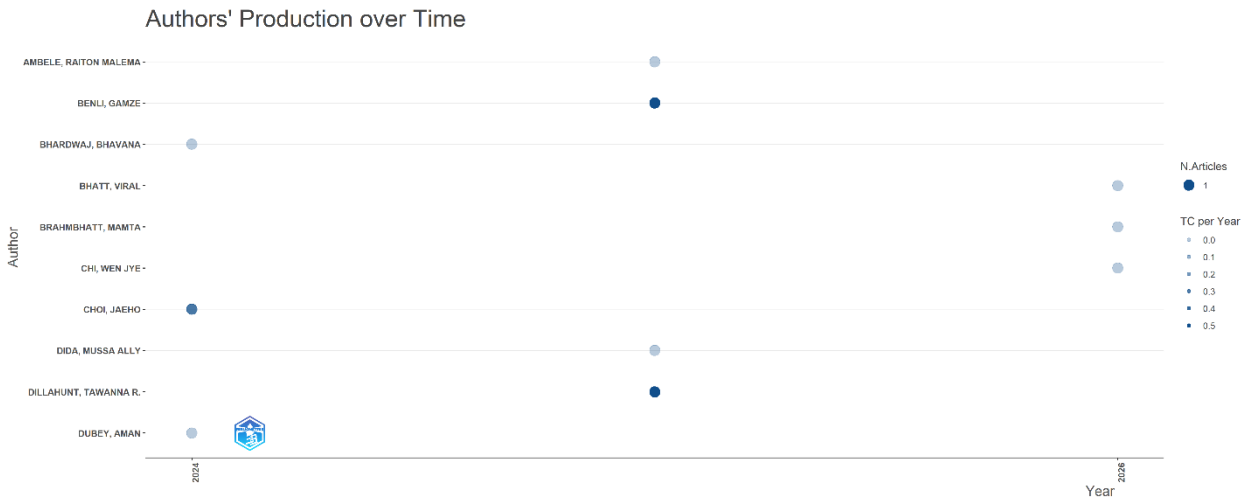

Figure 10. Authors Production over Time.

Figure 10 shows a graph depicting the publication contributions of ten authors in the time span of 2024 to 2026. The author's names are displayed on the vertical axis (left), such as Ambele, Raiton Malema; Benli, Gamze; Bhardwaj, Bhavana; Bhatt, Viral; Brahmbhatt, Mamta; Chi, Wen Jye; Choi, Jaeho; Dida, Mussa Ally; Dillahunty, Tawanna R.; and Dubey, Aman. Meanwhile, the year of publication is indicated on the horizontal (bottom) axis. Each circle in the graph represents one publication, with the size and color of the circle indicating the author's contribution rate (TC per Year), where the larger and darker the color, the higher the contribution. Based on these visualizations, it can be seen that publications are spread over 2024 and 2025, with a tendency to increase activity in 2025. Some writers such as Benli, Gamze and Dillahunty, Tawanna R. show relatively higher contributions, which are characterized by darker circle colors than other authors.

In addition, Ambele, Raiton Malema and Dida, Mussa Ally also showed publication activities in the same year with quite visible contributions. On the other hand, writers like Bhardwaj, Bhavana; Choi, Jaeho; and Dubey, Aman had a relatively lower contribution, indicated by smaller circles and lighter colors. Meanwhile, Bhatt, Viral; Brahmbhatt, Mamta; and Chi, Wen Jye appear to have contributed in a later period (closer to 2026), albeit with a less substantial intensity of contributions. Overall, this graph shows that most authors have a limited number of publications (one article), but with varying levels of contribution. In addition, there is a tendency to increase publication activity in more recent periods, which indicates the development of increasingly active research during this period. This graph provides a clear picture of the distribution of contributions and productivity of each author in the period analyzed.

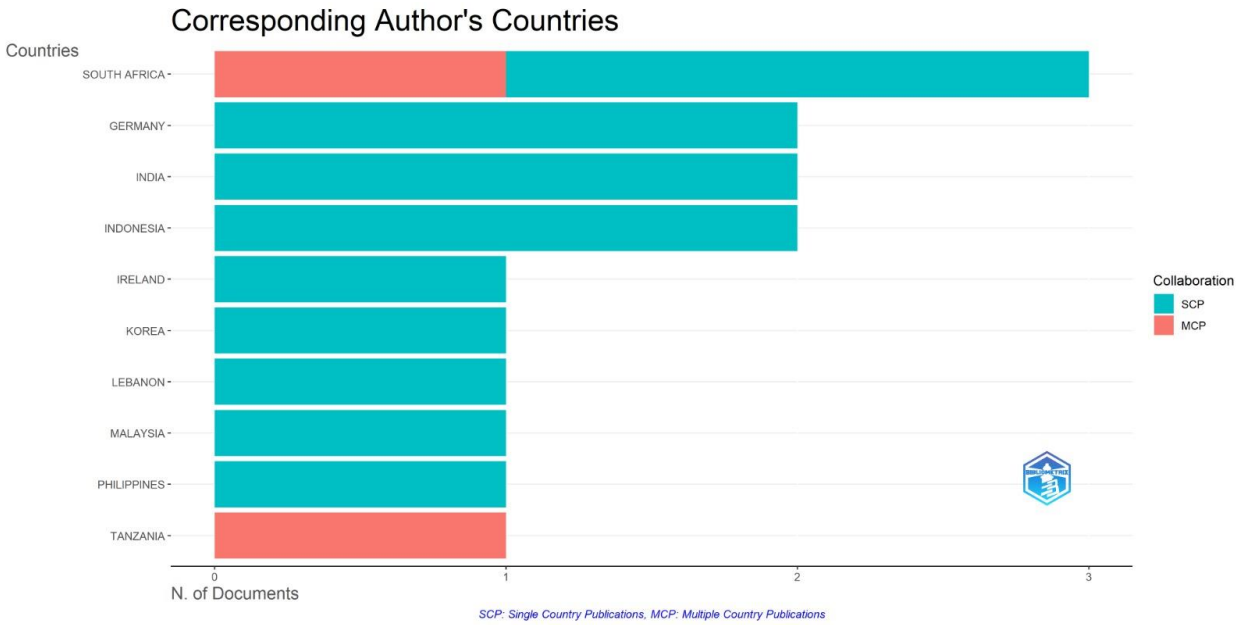

Figure 11 Author's Coreesponding by country.

In Figure 11 above, a horizontal bar graph is shown showing the distribution of the correspondent's country of origin (Corresponding Author's Countries) based on the number of documents produced. The horizontal axis (X) shows the number of publications (N. of Documents), while the vertical axis (Y) shows the names of countries. The color on the bar distinguishes between the types of collaborations, namely SCP (Single Country Publications) which is marked with greenish-blue, and MCP (Multiple Country Publications) which is marked with red. From the graph, it can be seen that South Africa is the country with the highest number of publications, which is as many as three documents. Interestingly, the country's contribution consists of a combination of international collaborative publications (MCPs) and single-country publications (SCPs), which demonstrate active involvement in both global collaboration and domestic research. Meanwhile, Germany, India, and Indonesia each have two publications, all of which fall under the SCP category. This shows that the contributions of the three countries tend to be carried out independently without involving cross-border collaboration. Other countries such as Ireland, Korea, Lebanon, Malaysia, and the Philippines each have one publication, all of which fall under the SCP category. This indicates that the contribution of these countries is still limited and has not shown any international collaboration. Unlike other countries, Tanzania has one publication that is entirely included in the MCP category. This shows that Tanzania's contribution comes entirely from international cooperation, in the absence of a single publication at the national level. Overall, this graph shows that most publications are still dominated by contributions within a single country (SCP), with a relatively low level of international collaboration (MCP). In addition, the distribution of publications also appears to be uneven, where only a few countries have a higher number of contributions, while other countries still contribute to a limited extent.

Table 5 Countries' Scientific Production

Country	Freq
Australia	3
Hungary	2
Netherlands	2
Serbia	2
Spain	2
Sweden	2
Italy	1
Mexico	1
Usa	1

The table above shows the number of scientific publications produced by each country in the period from 2020 to 2025. The data shows the number of scientific publications from various countries, with the "Freq" column indicating the frequency or number of published documents. This list features countries that are active in producing scientific publications, of which Australia is ranked first with 3 publications, making it the most prolific country on this list. In the next position, there are several countries that show a balanced contribution with 2 publications each, namely Hungary, the Netherlands, Serbia, Spain, and Sweden. Meanwhile, other countries such as Italy, Mexico, and the United States (USA) are also included in the list with 1 publication each, although their contribution is not as large as the countries in the top position in that period.

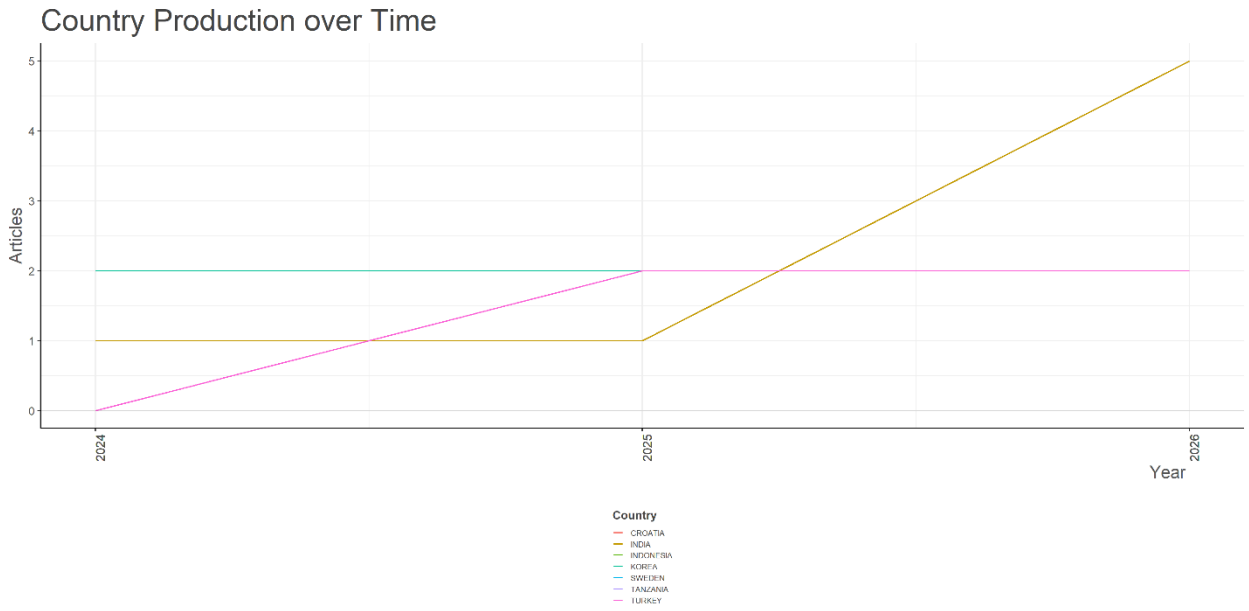

Figure 12. Graph Countries' Production over Time.

Figure 12 above shows a graph depicting the development of the number of scientific publications from several countries in the time frame of 2024 to 2026. The horizontal axis (X) indicates the year of observation, while the vertical axis (Y) indicates the number of articles published. Each country is represented by lines of different colors, which reflect the dynamics of publication productivity over time. Based on the graph, it can be seen that there is one country that shows the most significant increase, namely the country represented by the golden line. The number of publications increased gradually from 1 article in 2024 and 2025, then jumped sharply to 3 articles in 2025 and reached a peak of 5 articles in 2026. This trend shows that there is a fairly rapid growth in research productivity in the final observation period. Meanwhile, several other countries showed a more stable pattern. The country represented by the light blue line maintains a constant number of publications, which is about 2 articles annually from 2024 to 2026. On the other hand, the country with the pink line shows an initial increase from 0 articles in 2024 to 2 articles in 2025, then tends

to stabilize until 2026. In addition, there are also other countries that started with a relatively low number of publications, which is about 1 article, and gradually increased until it reached 2 articles at the end of the period. Overall, this graph shows that most countries are experiencing an increasing trend in publications, both steadily and significantly, with the most notable spike occurring in either country by 2026.

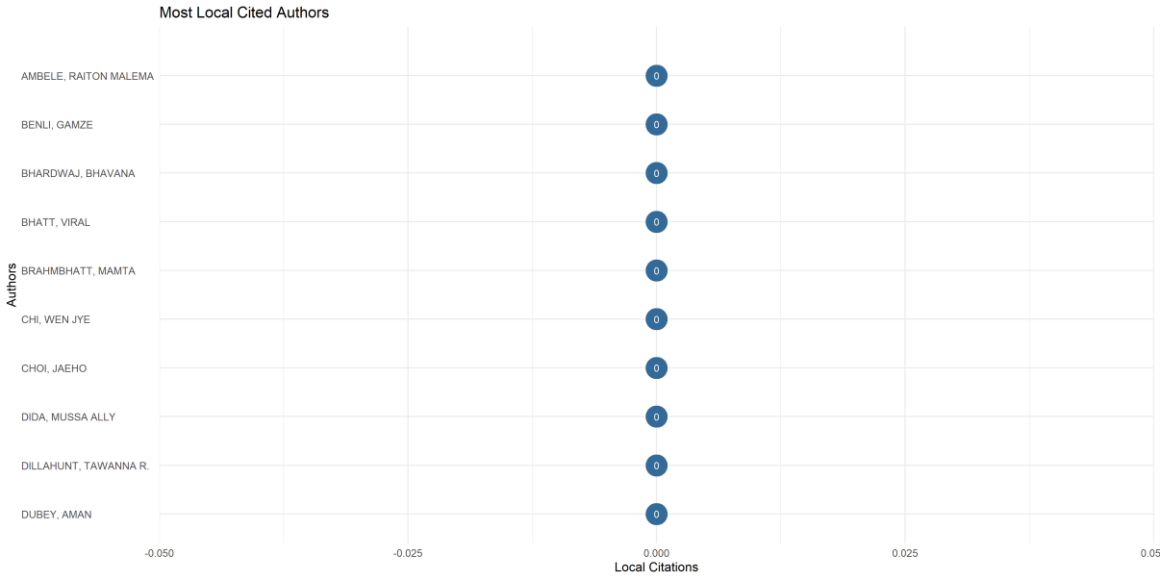

Figure 13 Most Cited Countries.

Figure 13 above shows a graph titled "Most Local Cited Authors" visualized in the form of a horizontal bubble to show the number of local citations received by the top ten authors. The horizontal axis represents the number of local citations, while the vertical axis displays the names of the authors being analyzed. In this visualization, the size and color of the bubbles generally reflect the level of citation intensity obtained by each author. Based on the data displayed on the graph, it can be seen that all authors such as Ambele, Raiton Malema; Benli, Gamze; Bhardwaj, Bhavana; Bhatt, Viral; Brahmbhatt, Mamta; Chi, Wen Jye; Choi, Jaeho; Dida, Mussa Ally; Dillahun, Tawanna R.; to Dubey, Amanmemilik i the number of local citations of 0. This is indicated by the exact position of all bubbles being at zero point on the horizontal axis, as well as the number "0" listed inside each bubble. This condition indicates that in the period and dataset analyzed, there have been no local citations of the scientific work of these authors. Despite this, they are still listed as the top ten authors in this category, which indicates that the distribution of local citations is still at the baseline level (zero) and has not shown any variation or dominance of citations among the authors analyzed (Pallavi et al., 2022).

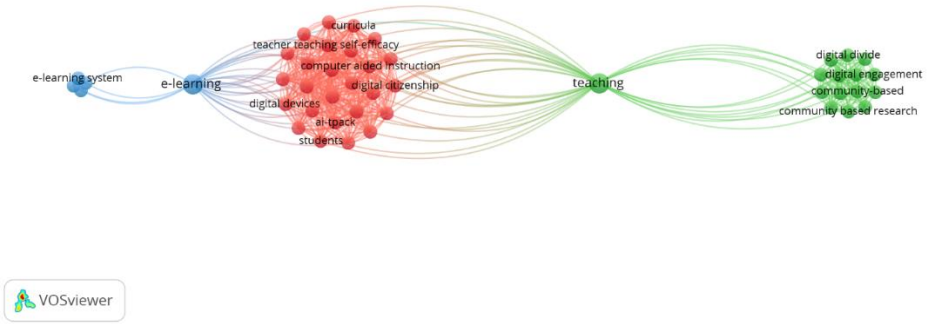

Figure 14. Relationship map

Figure 14 above shows a keyword co-occurrence map visualized using the VOSviewer software, which illustrates the relationships between topics in a research area. Each node (dot) represents a keyword, while a connecting line indicates the linkage or co-emergence between keywords in a scientific publication. Different colors indicate the grouping of themes (clusters) based on the proximity of the relationship between terms. On the left (in blue), you can see keywords such as e-learning and e-learning system that form separate groups. This cluster describes the initial focus on online learning systems as a foundation for educational technology-based research. Furthermore, in the middle part (in red), there is a denser cluster with various keywords such as students, digital devices, digital citizenship, computer aided instruction, teacher teaching self-efficacy, and curricula. This cluster shows the main focus of research on the implementation of technology in the learning process, including the role of teachers, student readiness, and the integration of digital devices in education. The density of nodes in this section indicates that the topics have a high research intensity and are closely interrelated. In the middle there is also the keyword teaching (green) which acts as a bridge between the learning technology cluster in the middle and the cluster on the right side. This shows that the concept of teaching is a central point that integrates various approaches in educational research. On the right side (in green), there are keywords such as digital divide, digital engagement, community-based, and community-based research. The cluster reflects a broader research focus on the social impact of educational technology, including the digital divide and community engagement in community-based learning processes. Overall, this visualization shows that research in this area has evolved from focusing on e-learning systems, then moving to the implementation of technology in learning, to finally leading to social issues such as community engagement and the digital divide. This confirms that educational technology not only plays a role in the teaching and learning process, but also has wider implications for society (Hamid et al., 2017).

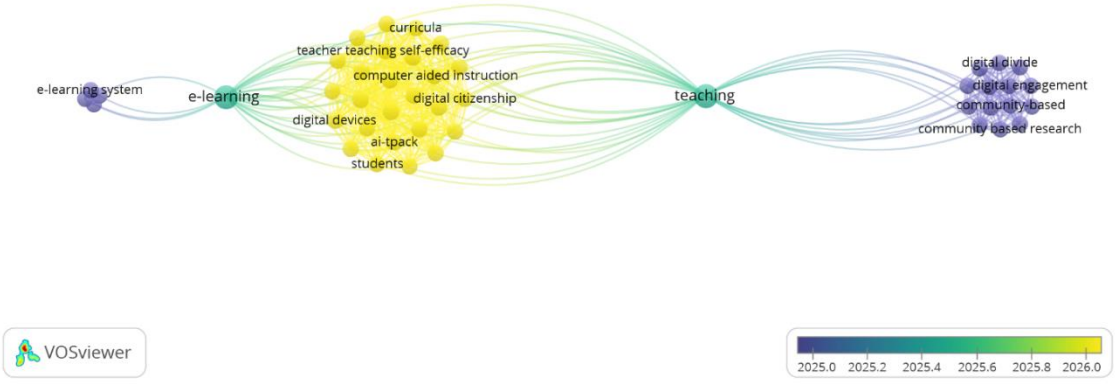

Figure 15. network visualization

Figure 15 above shows a map of the keyword network that illustrates the interconnectedness of various topics in scientific research through visualization using VOSviewer software. Each point on the map represents an important keyword, while the connecting line shows the co-occurrence relationship between keywords in scientific publications. Based on this visualization, it can be seen that the topics of "teaching" and "e-learning" play a role as the main center that connects various research groups. On the left, there is a cluster that focuses on digital learning systems, marked by keywords such as e-learning system and e-learning. This cluster shows attention to the development and implementation of technology-based learning platforms. Meanwhile, in the middle, there is a fairly dense yellow cluster, covering keywords such as digital devices, students, digital citizenship, computer aided instruction, and teacher teaching self-efficacy. This cluster describes the research focus on the learning process, the role of teachers and students, and the use of digital technology in

increasing the effectiveness of learning Topic teaching is the main link that links the learning technology cluster with other clusters on the right side. On the right side of the map, there are groups that focus on social and community aspects, with keywords such as digital divide, digital engagement, community-based, and community-based research. This cluster shows that the research also highlights the gap in digital access and community engagement in the context of technology-based learning. The color gradation on the map indicates the development of the research time, where lighter colors indicate a newer topic. This can be seen in the middle cluster which is dominated by yellow, indicating that issues related to the use of digital technology in learning and the role of students are the latest research trends. Overall, this network map shows that the main focus of the research lies in the integration between digital technology and the teaching process, with an emphasis on the role of teachers, student engagement, as well as social issues such as the digital divide. This reflects that the development of e-learning is not only related to technology, but also to the pedagogical dynamics and social context that accompany it.

Review (SLR)

Table 7. SLR Study Data

No	Type	Quantity
1.	Article	32
2.	Conference paper	25
3.	Reviews	1
4.	Book chepter	3
	Total	**61**

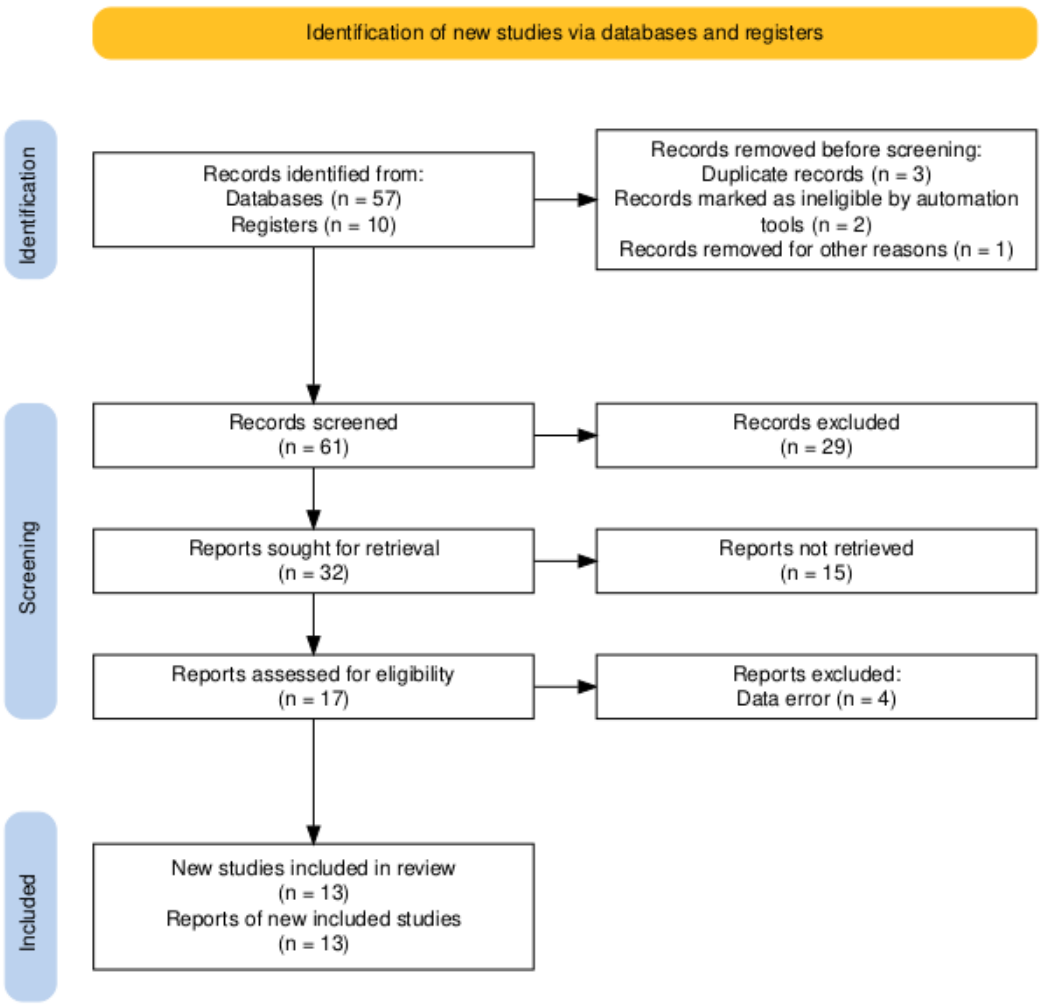

Figure 16. Prism Method Result Diagram

Figure 16 shows that the process of selecting articles in this systematic review follows the guidelines of PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) which is presented in the form of a flowchart. This process consists of four main stages, namely identification, screening, eligibility, and inclusion. At the identification stage, the researchers identified a total of 67 records, which were obtained from two main sources, namely 57 records from databases and 10 records from registers. Before entering the screening stage, the data is preempted. A total of 6 records were deleted, consisting of 3 duplicate records, 2 records that were marked as unsuitable by automation tools, and 1 record that was deleted for other reasons After the initial deletion process, the number of data that was continued to the screening stage was 61 records. At this stage, a review is carried out based on the title and abstract. As a result, as many as 29 records were issued because they did not meet the inclusion criteria that had been set. Furthermore, a total of 32 records were declared relevant and continued to the next stage, namely reports sought for retrieval. However, in the process of obtaining complete documents, there were 15 reports that were not successfully obtained (reports not retrieved). Thus, only 17 reports can be further analyzed at the eligibility stage (reports assessed for eligibility). At the eligibility stage, an in-depth evaluation of the content of the article as a whole is carried out. Of the 17 reports, there were 4 reports that were issued because they experienced data errors, so they did not meet the criteria for further analysis. In the final stage, namely inclusion, as many as 13 studies were declared to meet all criteria and included in a systematic review (new studies included in review). This number is equal to the number of study reports analyzed, namely 13 reports of included studies. Overall, this selection process showed that out of 67 initial records, only 13 studies made it to the final stage (approximately 19.4%), which reflects that the selection process was carried out rigorously, systematically and based on clear criteria to ensure the quality and relevance of the literature analysed.

The following is a more appropriate classification of research methodologies based on the type of research (quantitative, qualitative, systematic, observational, experimental, and conceptual), with the number of papers and the percentage:

Table 8. Main Classifications in the Ecilit AI Methodology Table

Category	**Number of Papers**	**Percentage**
Quantitative	2	15%
Qualitative	2	15%
Mix	0	0%
Systematic review	6	46%
Obsetvasional	1	8%
Experimental	0	0%
Conceptual	2	15%
Total	13	100%

Based on the classification table of the research methodology, the distribution of methods in 7 articles that passed the final stage of selection showed a fairly diverse variety of approaches, although there was one more dominant method. The most widely used method is systematic review, with a total of 3 articles (43%). This suggests that most research focuses on the analysis, synthesis, and evaluation of existing literature. The dominance of this approach indicates that the field of study studied is still at the stage of concept mapping and strengthening the theoretical base, so a comprehensive literature review is needed. Furthermore, quantitative, qualitative, observational, and conceptual methods each have the same number, namely 1 article (14%). The use of quantitative methods shows that there is an attempt to measure phenomena objectively through statistical analysis. Meanwhile, the qualitative approach emphasizes more on a deep understanding of the

phenomenon being studied. The observational method reflects research conducted through direct observation of real conditions in the field, while the conceptual approach focuses on the development of ideas, theories, or frameworks of thought in a field of study. On the other hand, mixed and experimental methods were not found in the articles analyzed (0%). This shows that research that combines quantitative and qualitative approaches as well as experiment-based research is still very limited in this study. Overall, the distribution of these methodologies shows that research in this field is still dominated by a literature-based approach, with relatively minimal empirical research involvement. Therefore, further research has a great opportunity to develop experimental and mixed methods, so that it can produce more comprehensive, applicative findings, and have a stronger level of validity.

The following is the classification of Main Findings based on the type of research methodology (quantitative, qualitative, systematic, observational, experimental, and conceptual):

Table 9. Classification of Main Findings

Category	Number of papers	Percentage	Examples of keywords
Integration of Technology in Education	2	15%	e-learning, online learning, artificial intelligence, digital devices
Impact on Learning	2	15%	teaching, students, computer aided instruction
Achievement of the SDGs (SDG 4)	0	0%	digital literacy, digital citizenship
User Acceptance and Readiness	6	46%	teacher self-efficacy, curricula
Challenges and Obstacles	1	8%	digital divide, challenges
Model/Framework Innovation	0	0%	e-module, AI digital textbook
Implementation Effectiveness	2	15%	System evaluation
Policy Recommendations	0	0%	Educational strategy
Total	**13**	**100%**	

Based on Table 9, the main findings of the 13 articles that passed the PRISMA selection showed that the most dominant research focus was in the category of acceptance and user readiness, with a total of 6 articles (46%). This shows that most of the research focuses on aspects of user readiness, such as teacher competence, *teacher self-efficacy*, and readiness to integrate technology in the learning process. These findings indicate that human factors, particularly the role of educators and users, are key elements in the successful implementation of educational technology. Furthermore, the categories of technology integration in education, impact on learning, and implementation effectiveness each have the same number, namely 2 articles (15%). This shows that the research also discusses quite a lot of how technologies such as *e-learning*, *online learning*, and *artificial intelligence* are applied in learning, as well as how they impact learning processes and outcomes. In addition, studies related to the effectiveness of implementation show that some research has begun to lead to the evaluation of the successful use of technology in the context of education. Meanwhile, the category of challenges and obstacles was only found in 1 article (8%), which highlighted issues such as *the digital divide* and various obstacles in the application of technology. On the other hand, the categories of SDGs achievement (SDG 4), model/framework innovation, and policy recommendations were not found in the articles analyzed (0%). This shows that research that explicitly links educational technology to sustainable development goals, the development of innovative models, and policy recommendations is still very limited. Overall, the distribution of these findings shows that research in this area is still focusing on aspects of user readiness and the implementation of technology in learning. Meanwhile, studies that lead to model innovation, contribution to the SDGs, and the development of technology-based education policies still need more attention. Therefore, further research has a great opportunity to develop more comprehensive

studies, especially in the aspects of policy evaluation, learning innovation, and contribution to continuing education.

The following is the classification of the Summary based on the type of research methodology (quantitative, qualitative, systematic, observational, experimental, and conceptual) from 7 papers:

Table 10. Major Classifications in the Elicit AI Summary Table

Category	Number of papers	Percentage	Key examples
Integration of Educational technology	2	15%	E-learning, online learning, AI
Impact of learning	2	15%	Teaching, students, learning outcomes
Achievement of the SDGs (SDG4)	0	0%	Digital literacy, inclusive
Evaluation of system implementation	2	15%	Effectiveness of digital platforms
Model / Framework innovation	0	0%	AI-TPACK, e-module
Perception & readiness of the user	6	45%	Teacher self-efficacy, students readiness
Challenges & obstacles	1	8%	Digital divide, challenges
Policy recommendations	0	0%	Educational Strategy
	13	**100%**	-

Based on the Table of 10 Main Classifications in the Summary of Elicit AI (13 selected papers), it can be explained that the distribution of research topics shows a tendency to focus on aspects of perception and user readiness in the application of educational technology. The Perception & User Readiness category was the most dominant with 6 papers (45%), indicating that most of the research highlighted human factors, such as teacher readiness, teacher self-efficacy, and student readiness to adopt learning technologies. Meanwhile, several other categories have a relatively balanced proportion, 2 papers (15% each), namely Educational Technology Integration, Impact on Learning, and System Implementation Evaluation. This shows that research also discusses the use of technology such as e-learning, online learning, and artificial intelligence, as well as their impact on learning processes and outcomes. In addition, studies related to implementation evaluation show that some research has led to measuring the effectiveness of digital-based learning systems. On the other hand, the Challenges & Obstacles category was only found in 1 paper (8%), which raised issues such as the digital divide and various obstacles in the application of educational technology. Meanwhile, the categories of SDGs Achievement (SDG 4), Model/Framework Innovation, and Policy Recommendations were not found in the analyzed papers (0%). This shows that research that specifically links educational technology to sustainable development goals, the development of innovative models, and education policies is still very limited. Overall, these results suggest that research in this area tends to focus on user readiness and the implementation of technology in learning. However, there is still a need to strengthen the aspects of challenges in the field, innovation in learning models, and policy formulation so that the application of educational technology can run more effectively, evenly, and sustainably. The following is the classification of Study Design from 7 studies in the form of a table with categories, number of papers, and percentages

Table 11. Main Classifications in the Elicit AI Study Design Table

Study design	Number of papers	Presentase	Unique Feature
Cross-sectional	2	15%	Surveys, one-time data collection
Ekperimental	0	0%	Trial learning model
Qualitative	2	15%	Interviews, case studies

Study design	Number of papers	Presentase	Unique Feature
Longituginal	0	0%	Time development analysis
Systematic review	6	46%	Literature revue, SLR
Cases/controls	1	8%	Development of models/theoretical frameworks
Descriptive	3	15%	General observation without in-depth analysis
Total	**13**	**100%**	

Based on Table 11 of the Study *Design Classification*, it can be explained that out of a total of 13 papers analyzed, the research design shows quite diverse variations, although dominated by certain approaches. Systematic *review* design was the most dominant with 6 papers (46%), indicating that most studies focused on literature review through *the Systematic Literature Review (SLR)* method. This indicates that the field of research is still in the stage of concept development and theoretical mapping, so it requires synthesis from various previous studies. Furthermore, *cross-sectional*, *qualitative*, and *conceptual* design each had 2 papers (15%). The *cross-sectional* design suggests that multiple studies are conducted by taking data at a time, generally through surveys or questionnaires to describe specific conditions quickly. Meanwhile, a *qualitative* approach is used to explore a deeper understanding of research experiences, perceptions, and contexts. Conceptual design focuses on the development of models, frameworks, or theoretical ideas in the field of educational technology. In addition, *observational* designs were found in only 1 paper (8%), which suggests that research based on direct observation of phenomena in the field is still limited. On the other hand, *experimental*, *longitudinal*, and *descriptive* designs were not found in the papers analyzed (0%). This indicates that studies that directly test the effectiveness of interventions, observe long-term changes, and are purely descriptive in nature. Overall, these results suggest that the analyzed research tends to be dominated by literature-based approaches and conceptual analysis, with the support of several empirical studies such as *cross-sectional* and qualitative. However, research with experimental and longitudinal designs is still needed to provide stronger empirical evidence and describe the dynamics of change in the long term. The following is the classification of Future Research Recommendations based on the type of research methodology (quantitative, qualitative, systematic, observational, experimental, and conceptual):

Table 12. Main Classifications in the Future Research Elicit AI Table

Category	Frequency	Urgency Levels	Representative Examples
Validation of the model/ Framework	2	High	Testing of empirical data-driven models
Studies longituginal	6	High	Study of behavioural change/ Long-term learning outcomes
Advanced systematic review	6	Critical	Meta-analysis/new topics based on broad literature
Observational studies	1	Medium	Observation of implementation in a real environment
Experimental study	0	High	Hands-on trial of new methods/technologies
Conceptual development	0	Medium	Development of new theories or frameworks
Mixed approach	1	Emerging	Integration of quantitative & qualitative data
Total	**13**		

Based on the results of the analysis of future research using Elicit AI on the 13 articles studied, it can be seen that the direction of future research is dominated by the need for reinforcement in advanced systematic review, which reaches the largest proportion of 46%. This shows that research in this field still requires a more comprehensive synthesis of literature to identify trends, research gaps, and strengthen existing theoretical foundations. In addition, research that leads to

model/framework validation and conceptual development each has a proportion of 15%. This indicates that it is still necessary to test technology-based learning models, such as e-learning and AI, through empirical data, as well as the development of theoretical frameworks that are more relevant to the development of educational technology. On the other hand, observational research has only a proportion of 8%, which suggests that direct observation-based studies of implementation in the field are still limited. Meanwhile, experimental, longitudinal, and mixed-approach studies were not found (0%), indicating a significant gap in research focusing on direct testing of interventions, long-term analysis, and integration of quantitative and qualitative methods. This condition indicates that research in this field still tends to focus on literature review and concept development, but it is not supported by strong empirical evidence. Therefore, in the future, it is necessary to increase research with experimental, longitudinal, and mixed methods designs as opportunities (emerging research) to produce more comprehensive, applicative, and validity findings. Overall, this distribution reflects that research is still at the stage of strengthening the theoretical foundation and synthesis of the literature, with great opportunities for the development of experiment-based research and integrative approaches in the future.

Discussion

The synthesis of the bibliometric analysis and the Systematic Literature Review (SLR) conducted in this study demonstrates that digital literacy and e-module integration have become central components in improving the quality and effectiveness of online learning. Bibliometric findings indicate that research published between 2024 and 2026 predominantly focuses on digital literacy, e-learning, online learning, artificial intelligence, and digital teaching materials, reflecting a growing scholarly interest in technology-enhanced education. The Three-Field Plot and keyword analysis further reveal strong conceptual connections between digital literacy, e-learning, artificial intelligence, and community-based educational approaches, suggesting that current research is increasingly directed toward creating more interactive, learner-centered, and technology-supported learning environments. Furthermore, the systematic literature review confirms that digital literacy is a critical competency for enabling students to effectively access, evaluate, and utilize digital learning resources, while e-modules contribute significantly to enhancing learning engagement, independent learning, critical thinking, and ICT literacy. The integration of multimedia elements, such as videos, animations, and interactive assessments within e-modules, provides richer learning experiences and facilitates students' conceptual understanding in online environments. Nevertheless, the successful implementation of digital literacy and e-module-based learning remains dependent on several supporting factors, including educators' digital competencies, instructional design quality, equitable access to technological infrastructure, and students' readiness to participate in self-directed learning. These findings suggest that strengthening digital literacy should be accompanied by continuous innovation in digital learning materials and pedagogical strategies to maximize the effectiveness of technology-enhanced education in the future (Sudestra et al., 2026).

Implications

The findings highlight the importance of strengthening digital literacy as a core competency for both students and educators in technology-enhanced learning environments. Educational institutions should integrate digital literacy into curriculum development while encouraging wider implementation of interactive e-modules capable of promoting independent learning, critical thinking, and active student engagement. In addition, policymakers should provide greater institutional support for digital infrastructure, teacher professional development, and technology integration to maximize the effectiveness of online learning systems.

Research Contribution

This study contributes a comprehensive bibliometric analysis and systematic literature review regarding digital literacy and e-module integration in online learning. Unlike previous studies that mainly discuss digital literacy or e-learning separately, this study integrates publication trends, citation performance, collaboration patterns, keyword mapping, and systematic evidence into a single comprehensive framework. The findings provide updated insights into current research

developments while identifying research gaps that can guide future studies and educational policy development in digital learning.

Limitations

Several limitations should be acknowledged in this study. First, the bibliometric analysis was conducted using publications retrieved within a limited publication period (2024-2026), which may not fully represent the long-term evolution of research in digital literacy and online learning. Second, the analysis relied primarily on selected indexed publications, potentially excluding relevant studies from other databases. Finally, this study employed bibliometric and systematic review methods without conducting empirical validation of digital learning interventions; therefore, future experimental research is required to verify the practical effectiveness of the proposed educational innovations.

Suggestions

Based on the findings of this study, the following recommendations are proposed:

1. Future studies should expand bibliometric analysis by incorporating additional international databases such as Web of Science, ERIC, and Dimensions to obtain broader research coverage.
2. Researchers should conduct experimental and longitudinal studies to evaluate the effectiveness of digital literacy programs and interactive e-modules in improving students' learning outcomes, critical thinking, and digital competence.
3. Educational institutions should strengthen professional development programs that prepare teachers to integrate digital technologies, e-modules, and artificial intelligence into online learning practices.
4. Future research should explore the integration of artificial intelligence, adaptive learning systems, learning analytics, and personalized e-modules to support more effective and sustainable digital learning environments

CONCLUSION

This study shows that studies on digital literacy, e-learning, and the use of e-modules in digital-based learning are still developing, but have not shown consistent and stable growth. Based on bibliometric analysis, publications in the 2024–2026 period tend to fluctuate with a decreasing tendency in the last year. This indicates that research activities in this field are not fully sustainable. In terms of citations, there has been a decrease in the level of scientific influence from year to year, which shows that the number of publications is not always directly proportional to the academic impact. Nevertheless, existing research still shows that digital literacy plays an important role in increasing the effectiveness of online learning, especially when supported by the use of e-modules that are able to increase students' independence, engagement, and critical thinking skills. In addition, the pattern of author collaboration and country distribution shows considerable international engagement, but is still dominated by single or limited collaborations. Overall, this field is still in the early stages of development so it requires further research strengthening, especially those that focus more on the real impact of the integration of digital literacy and e-modules in the modern learning process.

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AUTHOR CONTRIBUTION STATEMENT

The first author conceived and designed the study, developed the research methodology, conducted the bibliometric analysis and systematic literature review, interpreted the data, and prepared the original manuscript. The co-authors contributed to the study conceptualization, data validation, critical review of the literature, manuscript editing, and revision. All authors reviewed, approved, and agreed to the final version of the manuscript before submission.

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