

A systematic literature review of mathematics learning media and its contributions

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Abstract: A systematic literature review (SLR) aimed to define the trends and advances in mathematical semiotic reasoning research that have been published in journals with a scopus index, as well as their possibilities. Upon selecting the keyword "learning media" from the liquefaction menu within the scopus database, 213 articles were discovered. Moreover, a total of 18 articles satisfied the requirements for analysis. The PRISMA model is used for inclusion and exclusion. The trend of learning media has increased sharply in 2019-2023 by 15 articles (83.33%). The most dominant research type is the quantitative approach (6 articles). According to the author's nationality and international collaboration, Indonesia has the most authors (9, or 42.85%) of any country. Furthermore, the authors of learning media publications are dominated by the Asian continent 11 authors (52.38%). 8 articles carried out national and international collaborations (53.33%). Regarding keywords from 18 articles, there are opportunities in the future to research related to media learning with numbers, media learning and statistics, media learning with arithmetic, and so on. In addition, the contribution of learning media research in mathematics is in the form of contributions to learning planning, the development of mathematics learning media in other scientific fields, and the implementation of learning.

Keywords: learning media; mathematics; systematic literature review

1. Introduction

Education is a process that not only teaches intellectual abilities in terms of reading, writing, and arithmetic but also as a process of developing the ability of students to be better in cognitive, social, and personal aspects (Dahlia, 2022). Education may also refer to the interactions between teachers and students during the teaching and learning process (Adityo et al., 2023; Stagg Peterson et al., 2019). To accomplish learning objectives, teachers and students both participate in the teaching and learning process. In this case, the role of teachers as educators is also active in providing knowledge to students to have mastery of the knowledge and skills needed in everyday life. This can be realized by teachers creating an effective and interesting learning atmosphere so that students do not get bored easily (Tai & Wei, 2021; Wulandari et al., 2023).

Sometimes the way teachers teach still isn't the best, especially when it comes to studying mathematics. There are still many students who think that mathematics is difficult. This is one of the causes of the way teachers explain with monotonous learning methods or models and sometimes do not use concrete media or real learning media, which can be imagined or imagined by students themselves so that the learning process becomes boring and seems uninteresting (Catalano & Waugh, 2020a).

Particularly when it comes to learning mathematics, there are still situations when the way professors educate isn't the greatest (Mills & Doyle, 2019; Stjernfelt, 2019). Media encompasses all formats utilized in the information distribution process, according to the Association for Education and Communication Technology (AECT) (Zhang & Gao, 2014). The Education Association (NEA) identifies manipulable, visible, readable, and conversational objects as well as appropriately employed instruments in teaching and

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learning activities, which can impact how effective instructional programs are (Smith et al., 2021). Learning media facilitates communication and interaction between educators and students during the teaching and learning process in educational institutions (Catalano & Waugh, 2020a; Mills & Doyle, 2019). In the meanwhile, learning media, according to Suprpto et al., is a helpful tool that teachers can utilize to accomplish objectives. In the meantime, media serves as a supportive instrument for the teaching and learning process, delivering educational materials to meet learning objectives, according to Karmiani (Putra & Milenia, 2021).

As learning media continues to gain recognition and become an important part of mathematics learning, several areas of research and exploration can be undertaken in the future. According to the findings of a search carried out in September 2023 in the most prestigious journal database in the world, Scopus, 213 articles were published with the theme "learning and media" up until that point. These publications must be analyzed in depth so that we can find out information about the existence of mathematics learning media in the future. One of the proposed research and analytical strategies is to conduct a systematic literature review (SLR). A SLR is a research approach that tries to locate, appraise, and construe all relevant study results concerning specific research topics, people, or important occurrences. Prior studies have indicated that the following categories should be examined: international collaboration, funding, author nationality, distribution year, research types, and keywords (Cole, 2019; Culache & Obadă, 2014; Pacheco et al., 2021; Pratama, 2018; Rahardjanto et al., 2022).

In the Scopus database, we have located a single review-based article about educational media. SLRs mentioned in the piece mentioned in "Assessing the Influence of Augmented Reality in Mathematics Education: A Systematic Literature Review" (Pahmi et al., 2023) focus on the object concept of Augmented Reality. Thus, it can be said that SLR in general has not focused on the existential aspects of learning media material in mathematics teaching. The purpose of this systematic literature review (SLR) is to highlight the patterns and contributions to the study of educational materials published in journals with Scopus data indexes, as well as their potential for publication in the future. We expect that this SLR will serve as a helpful resource for academics and scholars investigating the issue, assisting in the development of relevant learning media studies. We publish first-hand, original study pieces that no other scholar has ever written on learning media and their connection to future survival. Functions as a basis for study and is even used to decide the future course of learning media. To offer an idea of the emphasis and alignment of researchers on the issue, we examine the breadth of the material we use, ensuring that it only consists of original articles and studies. We provide an overview of the publishing trends in learning media as recorded by the Scopus database, as well as an appraisal of the contributions and potential future uses of learning media. We also talked about the future of learning media, which will probably serve as a resource for practitioners, policymakers, and other players in the fields of mathematics education, learning, and public application.

2. Materials and Methods

2.1 Research framework

The purpose of the systematic literature review (SLR) carried out for this study is to find, evaluate, and analyze the articles with exceptional care and seriousness. Furthermore, answers to research questions are obtained through careful examination (Snyder, 2019; Xiao & Watson, 2019). This comprehensive literature review presented a short assessment of the advancements, contributions, and opportunities for future learning media research. These were explored using a methodical and transparent approach to addressing research topics (Kurniati et al., 2022).

2.2 Research Question (RQ)

To identify the extent of the research emphasis, research questions are defined. Concerning the research inquiries, they are: (1) How are "learning media" publications doing in journals that are indexed by Scopus? This study describes publishing patterns by analyzing the distribution of years, research kind, author nationality, international collaboration, and keywords in each learning media research article. (2) How does "learning media" research contribute and future opportunities?

2.3 Search article and inclusion criteria

The Scopus database's search menu used the keyword "learning AND media" for this inquiry. Article hunts will continue through September 2023 *CSV and *RIS formats are used to store search result data, This is then synchronized with the Reference Manager (Mendeley). Researchers use VOS-viewer software to provide data that is more legible, entertaining, and conversational. Regarding the TITLE-ABS-KEY search history of articles in Scopus (learning AND media AND mathematics AND elementary AND school) AND (LIMIT-TO (SUBJAREA, "MATH") OR LIMIT-TO (SUBJAREA, "SOC")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (LANGUAGE, "English")) AND (LIMIT-TO (OA, "all")). 213 articles were discovered in the search results for these keywords. To exclude and include relevant studies, researchers use the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) approach. This PRISMA model has been widely used by numerous writers in previously published SLR and is consistent with the viewpoint of Gallagher ([Husamah et al., 2022](#); [Rahardjanto et al., 2022](#)). The inclusion criteria in this SLR are based on several important notes, which are as follows: (1) the topic field is "Social Sciences," especially "Mathematics"; (2) publications comprise research and original article kinds; (3) articles are produced in English; (4) papers are only available through open access; and (5) articles are sorted by keywords. "Elementary school, mathematics learning, mathematics education, mathematics, learning media, written communication skill, usage behavior, parental involvement, online media, mobile technologies, metacognitive skills, metacognitive knowledge, mental retardation, media literacy, media education, mathematics problem solving, mathematics achievement, mathematical techniques, mathematic motivation, marionette tangram, Malay traditional game, literature review, learning technology, learning outcomes, learning effectiveness, learning devices, learning device, interactive media, home-school relationships, high school, geometry, game-based learning, experiential learning, ethnoconstructivism, elementary teacher, elementary schools, elementary school teachers, cross-disciplinary curriculum, collectives, collaborative learning, classroom practice, autonomy support, augmented reality, attitudes, assemble sensory-controlled works, Arduino programming, and affordances".

[Figure 1](#) shows the inclusion and exclusion criteria for this inquiry. It is clear from [Figure 1](#) that 213 articles were found at the start of the search. Following the articles' filtering in the "social sciences" and "mathematics" subject categories, 112 articles were found. This indicates up to 101 instances where the criteria are not met. Subsequently, we acquired 89 articles by using the article criterion. 23 papers, including a conference paper, book chapter, review, book, editorial, retraction, brief survey, and erratum, were removed. We'll use 82 English articles after that. This indicates that 7 articles that used Turkish, German, and Spanish were left out.

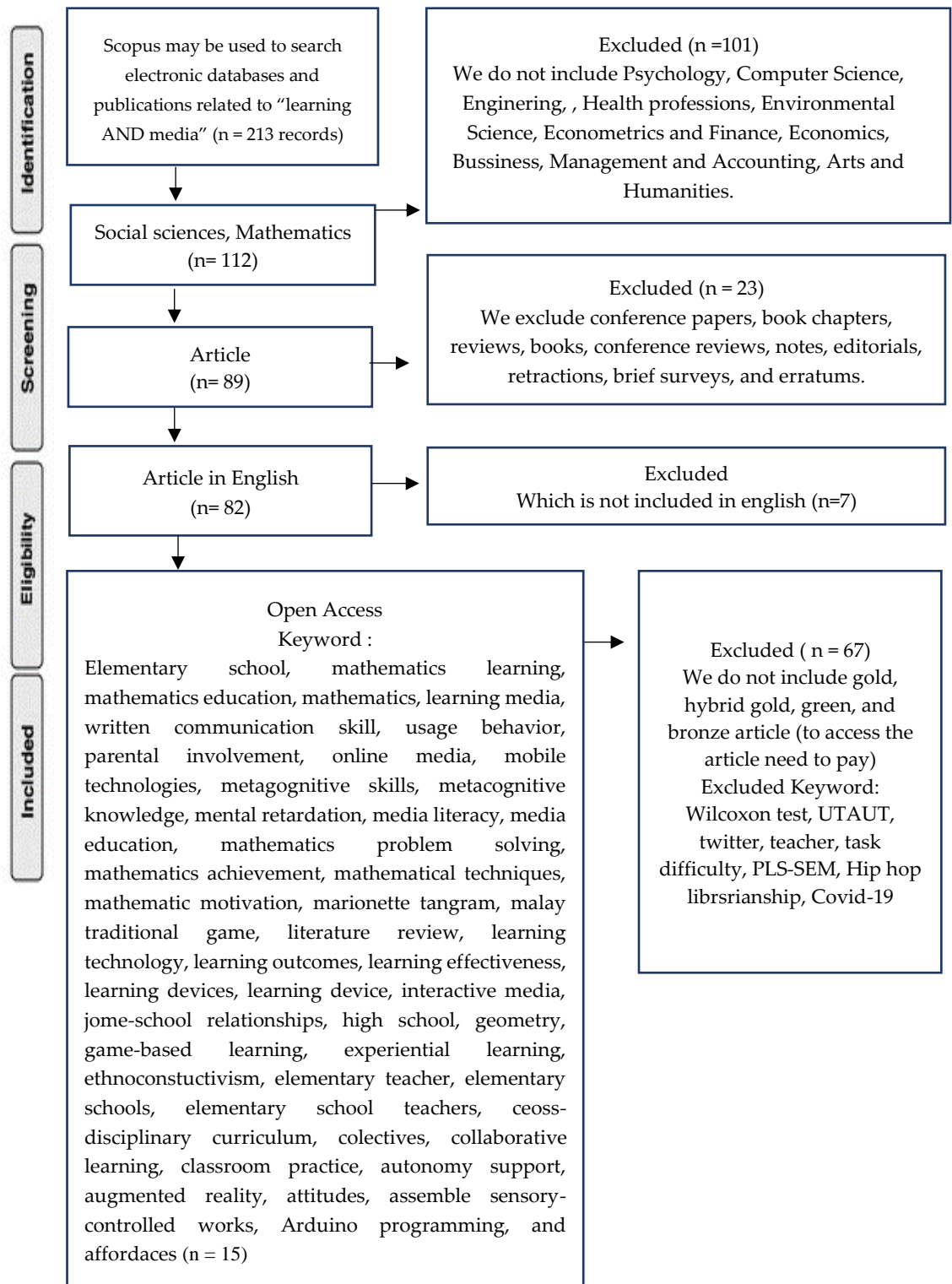


Figure 1. Systematic review flow diagram utilizing the PRISMA paradigm

The next step is to take an article with the keywords "Elementary school, mathematics learning, mathematics education, mathematics, learning media, written communication skill, usage behavior, parental involvement, online media, mobile technologies, metacognitive skills, metacognitive knowledge, mental retardation, media literacy, media education, mathematics problem solving, mathematics achievement, mathematical techniques, mathematic motivation, marionette tangram, malay traditional game, literature review, learning technology, learning outcomes, learning effectiveness, learning devices, learning device, interactive media, home-

school relationships, high school, geometry, game-based learning, experiential learning, ethnoconstructivism, elementary teacher, elementary schools, elementary school teachers, cross-disciplinary curriculum, collectives, collaborative learning, classroom practice, autonomy support, augmented reality, attitudes, assemble sensory-controlled works, Arduino programming, and affordances" and omitted the keywords "Wilcoxon test, UTAUT, twitter, teacher, PLS-SEM, Hip-hop librarianship, and COVID-19". The last step involves a review of previously published articles to make sure they adhere to the issues covered, are published in English, and can be read in full. As a result, of the articles that were received, only fifteen of them satisfied the criteria. The remaining articles were subsequently discarded.

3. Results

3.1 Trend of publication theme learning media

3.1.1 Distribution year

Our search for articles on the subject of media learning turned up the following information: [Figure 2](#) (document by year) explains this issue from 2005-2023.

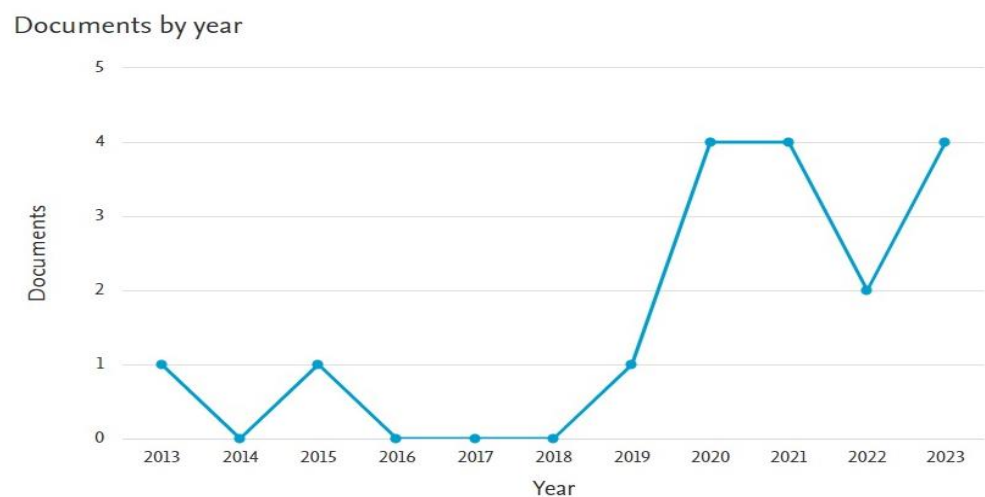


Figure 2. Distribution year of the article

In [Figure 2](#), an article regarding learning media was published in 2013. After that there was a decline in publication in 2014 and in 2015 published another article. In 2016-2018 there was a decline in publications. The number of publications on the topic of learning media has grown by fifty percent, or nine pieces, between 2019 and 2021. After that, there was a decline in publications again, in 2022 only 2 articles (11.11) were published. There has been an increase in publications by 4 articles (22.22%) published in 2023, and it is still highly possible that this topic will be able to increase, given that this data search is conducted until September 2023. Adding articles is still possible if you search for articles until December 2023.

3.1.2 Research Types

[Table 1](#) displays the trends in study types according to "learning media" themes. The majority of research on media learning uses a quantitative methodology (6 articles). Up to four articles of development research, three articles of qualitative research using mixed techniques, and one article of research utilizing a qualitative approach. This demonstrates that while the problem of media learning can be addressed quantitatively, development research and qualitative approaches are not frequently used in the same

context. Some researchers also combine the two using a method and case studies (1 article).

Table 1. Research types for science learning topics

No	Type of Research	Amount	References
1	Quantitative	6	(Sumilat et al., 2022; Syahrial et al., 2020; Syamsuddin et al., 2021; Widodo et al., 2021; Winheller et al., 2013; Yuan et al., 2023)
2	Development	4	(Rezeki et al., 2021; Syamsuddin et al., 2023; Wardani et al., 2019; Zuliana et al., 2020)
3	Qualitative	3	(Calder & Murphy, 2023; Kabongo et al., 2022; Pahmi et al., 2023)
4	Mix-method	1	(Harper et al., 2021)
5	Case study	1	(Lu et al., 2020)

3.1.3 The author's nationality and international collaboration

Figure 3 depicts the trend of the author's nationality in the "learning media" study. The authors originate from nine different nations, as seen in Figure 3. Indonesia is the country that has 9 authors of learning media (42.85%). Authors from the United States rank second in learning media publications, namely 3 authors (14.28%). In third place are authors from Australia and New Zealand, namely 2 authors (9.52%). The fourth place is occupied by authors from Belgium, China, Germany, Spain, and Taiwan, namely 1 author.

Documents by country or territory

Compare the document counts for up to 15 countries/territories.

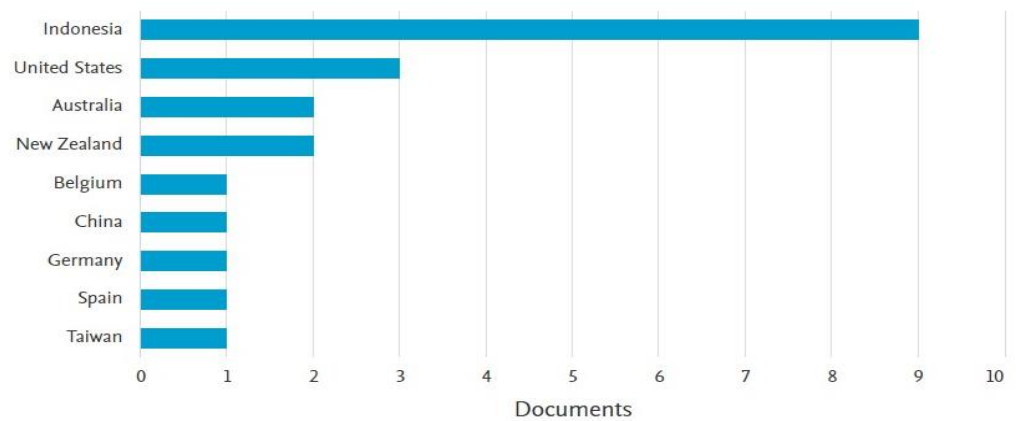


Figure 3. Author's nationality and continentality on learning media themes.

The majority of authors in learning media publications, 11 authors (52.38%), come from Asian countries. This is based on continental origin. Up to four writers (19.04%) from the Australian continent come in second. As many as three authors (14.28%) from the American and European continents occupy the third rank. Figure 4 shows that the authors are dominant from the European continent. In addition, looking at the authors' continental origins shows that learning media publications have not been evenly distributed from all continents. Thus, the urgency of learning media provides an opportunity for further researchers from the African continent to research the topic of learning media in-depth.

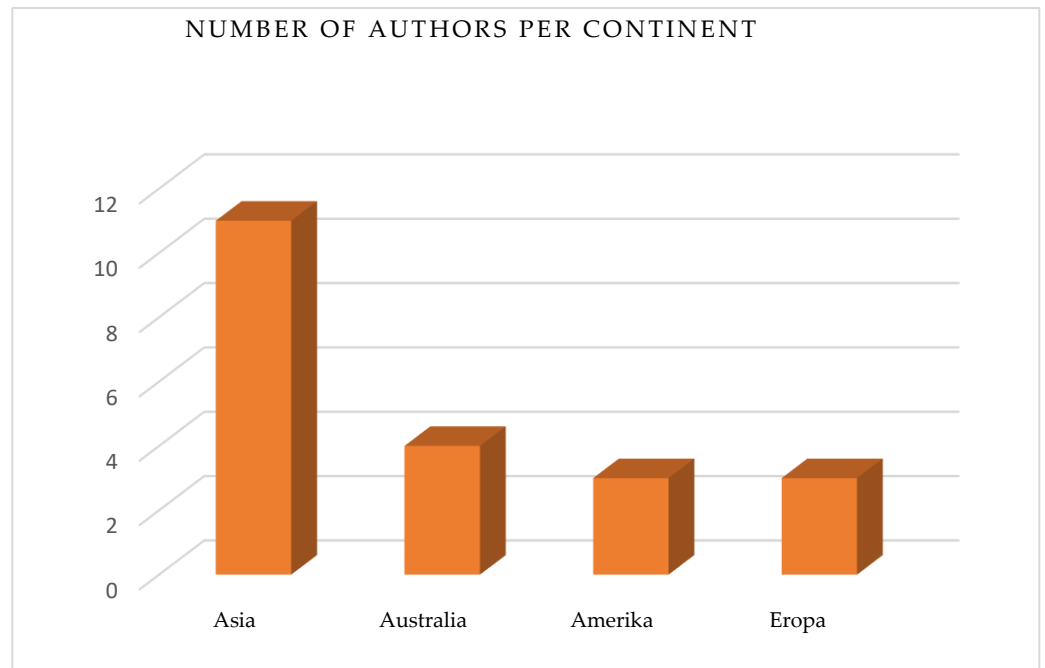


Figure 4. Number of authors per continent

Furthermore, Author collaboration in the publication of articles is depicted in [Figure 5](#), along with author collaboration at the national and international levels as well as author collaboration when conducting research and publication alone.

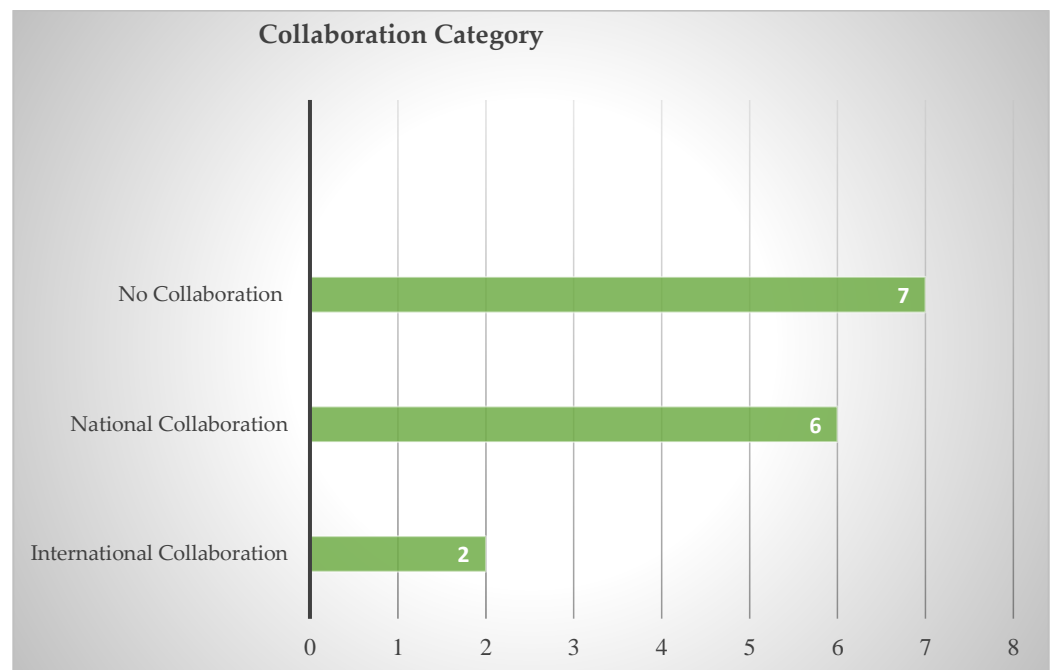


Figure 5. Collaboration category

[Figure 5](#) indicates that a greater number of papers (up to 7 articles or 46.66%) were published with a non-collaborating status collectively producing up to 8 papers (53.33%) in national and international journals. There are a total of 15 publications available, and [Figure 6](#) below illustrates how many scientists wrote a single article.

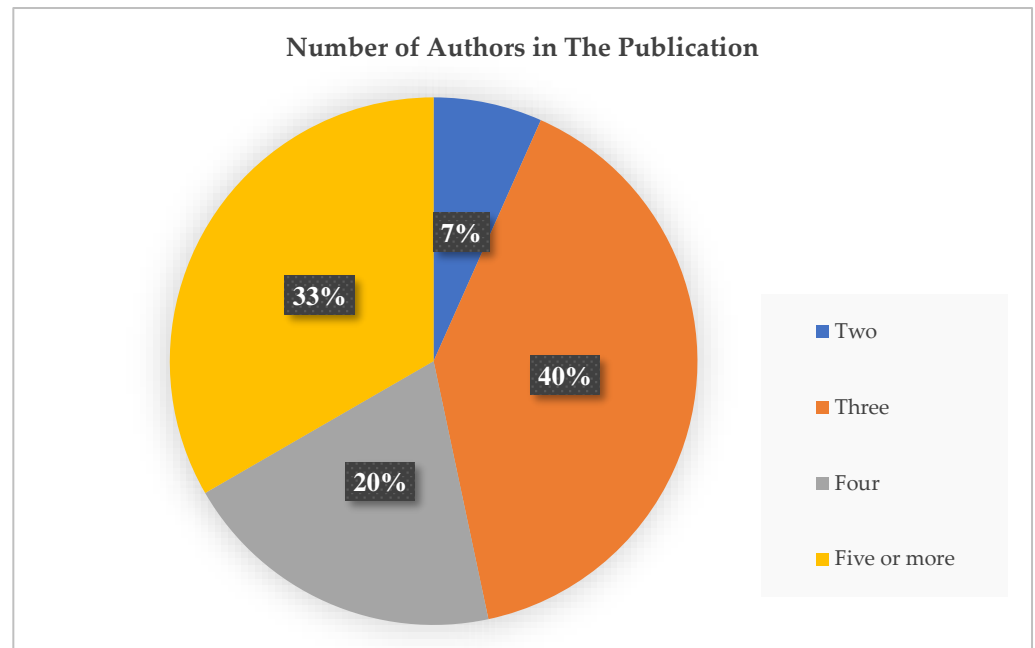


Figure 6. Shows The Number of Authors In The Publication.

Figure 6 findings indicate that three writers continue to dominate learning media publications. 2 publications are the result of international collaboration. Interesting data obtained when examining national collaboration comes from one institution and there is even collaboration between university academics and teachers in schools. Thus, these authors seem to collaborate between fields of science between agencies to obtain complete and detailed data.

3.1.4 Keywords

The trend of keywords that writers commonly use while writing about the topic "learning media" is shown in Figure 7. 34 keywords must be chosen for the type analysis based on co-occurrence with unit analysis of "all keywords" and complete counting technique. A keyword must appear at least once. The keywords used are affordances, elementary schools, game-based learning, geometry, learning effectiveness, learning media, mathematical techniques, mathematics, media educations, software products, software testing, students, surveys, Wilcoxon test, elementary school, attitudes, high school, mathematics achievement, quality of school life, self-efficacy, deep approach to learning, mathematics problem solving, metacognitive knowledge, metacognitive skills, Arduino programming, assemble sensory-controlled works, cross-disciplinary curriculum, elementary teacher, ethanoconstrucvism, mathematics learning, stem literacy, teacher, educational teaching media, marionette tangram, maka diperoleh data seperti di bawah ini.

It appears that the most keywords in a row are used in 15 articles, namely learning media, elementary schools, mathematical techniques, student, geometry, media educations, game-based learning, software products, mathematics, software testing, affordances, Wilcoxon test, surveys, it's already intertwined with each other.

3.2 Learning media research contributions and future opportunities

Figure 8 presents the contribution information that was derived from the examination of 15 papers. The information presented in Figure 8 indicates that there are three distinct areas in which learning media research has contributed: learning media's role in learning planning, learning media's development in other scientific domains, and learning's actual application. The greatest contribution of learning media research is leading to the implementation of learning. A total of 9 articles discussing the

implementation of learning (Calder & Murphy, 2023; Harper et al., 2021; Pahmi et al., 2023; Sumilat et al., 2022; Syahrial et al., 2020; Syamsuddin et al., 2021; Widodo et al., 2021; Winheller et al., 2013; Yuan et al., 2023). Furthermore, research on learning media also advances the creation of learning media in other scientific domains, as evidenced by five publications (Lu et al., 2020; Rezeki et al., 2021; Syamsuddin et al., 2023; Wardani et al., 2019; Zuliana et al., 2020). Finally, 1 article contributed to lesson planning (Kabongo et al., 2022).

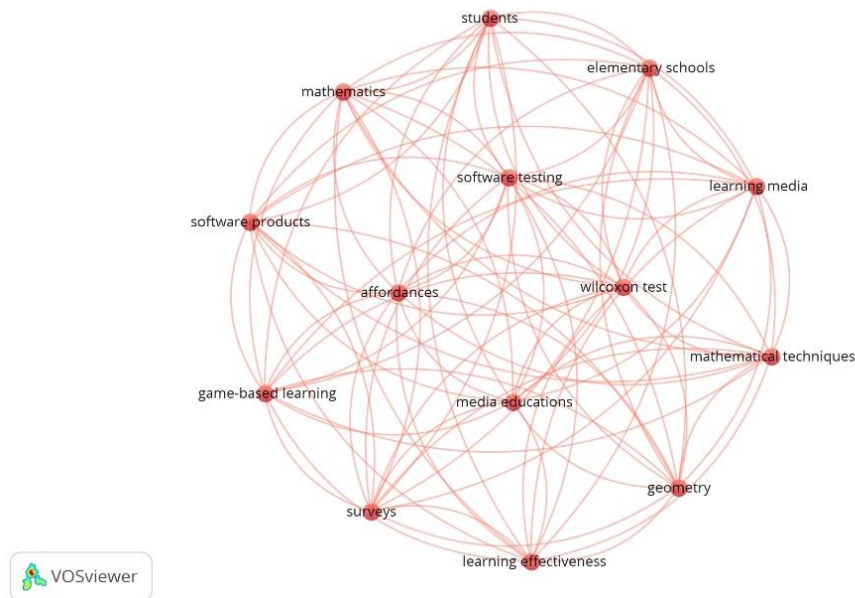


Figure 7. VOS-viewer Display (“Co-Occurrence → Keywords”)

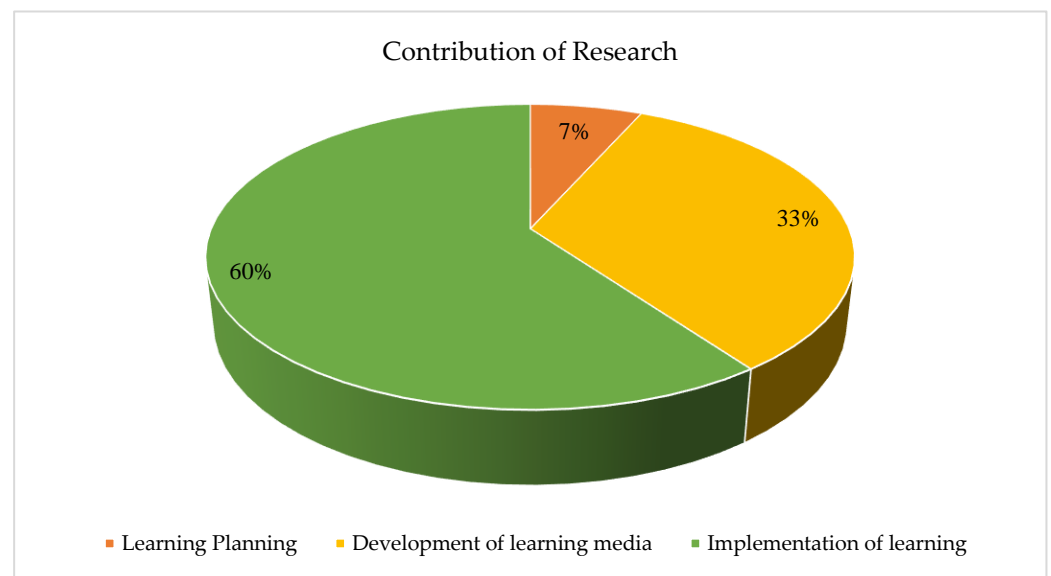


Figure 8. Learning media research contributions

4. Discussion

4.1 Trends in publications on learning media themes

4.1.1 Distribution year

Learning media publications began in 2013 (Winheller et al., 2013). Research on media learning in the first decade has not been so developed. But in 2015 there was another publication of learning media. The trend of learning media has increased sharply

in 2019-2023 by 15 articles (83.33%). Publication is still possible to continue to grow because the search is carried out until September 2023.

In the last 5 years, this research is inseparable from the important role of media development in mathematics learning. Media is one component in learning resources, and at the same time is a form of solving learning according to educational technology through a systematic plan. Media use in teaching and learning is one component of educational technology (Lacković & Popova, 2021). In addition to the important role of media development, it is no less important to implement it in learning. As for related articles (Calder & Murphy, 2023; Harper et al., 2021; Pahmi et al., 2023; Sumilat et al., 2022; Syahril et al., 2020; Widodo et al., 2021; Yuan et al., 2023).

4.1.2 Research types

According to the search results among fifteen articles in mathematics learning media, the most common style of research is the quantitative approach. Six papers employed a quantitative methodology, four others used development research, and three articles used a qualitative approach. The other piece takes a case study and mixed-method approach. This indicates that, depending on the researchers' aims, purpose, and requirements, the topic of learning media can be tackled using development research, case studies, quantitative and qualitative methodologies, or a mixture of the two (mixed methods).

Mathematics' complexity, both in terms of learning and practical applications, is evidenced by the use of both qualitative and quantitative approaches, as well as the combination of the two, in diverse study types (Caballero-Julia & Campillo, 2021; Potapova et al., 2019). Especially in learning situations, the phenomena that occur are very complex, and therefore, his research requires the use of complementary quantitative and qualitative paradigms (Caballero-Julia & Campillo, 2021; Doina et al., 2012). These data findings support the notion that the mixed-method or case study approach can be used to further investigate this area of inquiry.

4.1.3 Author's Nationality and International Collaboration

The ranking of the majority of learning media authors is occupied by authors from Indonesia as many as 9 authors (42.85%). Authors from the United States rank second in learning media publications, namely 3 authors (14.28%). In third place are authors from Australia and New Zealand, namely 2 authors (9.52%). The fourth place is occupied by authors from Belgium, China, Germany, Spain, and Taiwan, namely 1 author.

The majority of authors in learning media publications, 11 authors (52.38%), come from Asian countries. This is based on continental origin. Up to four writers (19.04%) from the Australian continent come in second. As many as three authors (14.28%) from the American and European continents occupy the third rank. The authors' continental origin shows that learning media publications are not evenly distributed across all continents. Thus, the urgency of learning media provides an opportunity for further researchers from the African continent to research the topic of learning media in-depth.

Papers that were published with no requirement for collaboration (up to 7 articles, or 46.66%). Collectively produced up to 8 papers (53.33%) in national and international journals. One publication that included international collaboration was discovered to have been completed. These results highlight the need for enhanced international collaboration in learning media research. International collaboration faces certain challenges in the Asian environment (Simpson & Archer, 2019). Language hurdles, financial difficulties, a lack of time for in-person meetings, and certain political challenges are a few potential problems (Husamah et al., 2023; Nurwidodo et al., 2023).

4.1.4 Keywords

The terms that were found among the 15 educational materials articles are learning media, elementary schools, mathematical techniques, student, geometry, media education, game-based learning, software products, mathematics, software testing, affordances, Wilson tests, and surveys. Judging from the activity, these keywords are already related to each other.

Based on keyword analysis of 15 articles using the vos-viewer application, some information related to gap research was obtained. In this learning media there has been research directly related to geometry, but mathematics learning in elementary schools not only discusses or teaches geometry but also there are other fields, such as arithmetic, numbers, statistics, and so on. therefore, it was found that there was no direct research on learning media and arithmetic, learning media with statistics, learning media with numbers, and so on (Ekowati & Suwandayani, 2020; Raskadi, 2023). So this is a great opportunity for further research related to media learning and arithmetic, media learning and statistics, and media learning and numbers.

4.2 Media learning research contributions and future opportunities

Educational media and its function Three features distinguish mathematics research: the use of learning media in learning design, the production of learning media in other scientific disciplines, and learning implementation. The most debated contribution of learning media research is learning media research on the application of learning, which has engaged many students, instructors, and parents in its implementation. The contribution of learning media research to the implementation of learning has involved elementary school (Calder & Murphy, 2023; Sumilat et al., 2022) and high school (Winheller et al., 2013) and both (Syamsuddin et al., 2021). In addition, its implementation not only involves regular children but also involves dyscalculia children who have learning disabilities with one of its characteristics, namely chaos in counting (Widodo et al., 2021). One article shows the use of AR media in learning involving teachers and students (Thorne et al., 2021). The research in its implementation involves teachers as well as parents (Harper et al., 2021). However, in reality, children who have learning barriers or ABK types are not only dyscalculia but there are many others. Further study on the application of learning in children with learning obstacles, such as deafness, hearing impairment, mental impairment, speech impairment, visual impairment, and other learning impairments, is thus much required (Pratiwi et al., 2020).

The next contribution to learning media research, namely the development of learning media. Many media developments have been developed by researchers such as the development of teaching materials for Reflective Thinking Student Worksheets (SWRT) (Syamsuddin et al., 2023), the creation of educational resources such as student activity sheets (SAS), and learning implementation plans (LIP) (Rezeki et al., 2021), the development of Marionette Tangram media (Zuliana et al., 2020), creation of software-generated cube net learning media (Wardani et al., 2019). This educational media's development still needs a great deal of work. Considering that mathematics learning in class is not only explained but also requires concrete objects to better understand the concept. Learning media is a tool in the learning process (Catalano & Waugh, 2020b; Suryaningrum et al., 2020).

Learning planning is the final area in which learning media research has contributed. Making rational decisions about specific learning objectives while utilizing all of the learning resources and potentials at one's disposal is the process of learning planning (Suwandayani et al., 2021). For learning planning to be well structured, education requires a foundation of thinking or provision of knowledge that supports the preparation of learning planning (Chong et al., 2019; Wu & Fitzgerald, 2021). Before teaching, it would be nice for an educator to also have a plan or lesson plan. For the teaching and learning processes to be implemented effectively in the classroom and for

the students to respond favorably to the teacher's supplied material. One of these eight articles has helped with learning planning. Namely [Kabongo et al., \(2022\)](#) who explained the learning plan from one of his workshops. This is a great opportunity in the future to investigate more deeply about lesson planning. Considering the significance of lesson planning in a classroom setting for teaching and learning.

5. Conclusions

The results of this systematic literature review provide substantial and fascinating insights into the "learning media" publishing pattern in Scopus-indexed journals, the importance of learning media research, and prospects. This analysis explains publishing patterns by examining the distribution of years, research kind, author nationality, international collaboration, and keywords in each paper. Based on the results of the distribution year, 2013 ([Winheller et al., 2013](#)). Research on media learning in the first decade has not been so developed. But in 2015 there was another publication of learning media. The trend of learning media has increased sharply in 2019-2023 by 15 articles (83.33%). Publication is still possible to continue to grow because the search is carried out until September 2023. Relating to research type, 6 articles use a quantitative approach. While the other 4 articles use development and qualitative research as many as 3 articles. The other piece takes a case study and mixed-method approach. This shows how, based on the researchers' aims, mission, and requirements, future research can be broadened through case studies or the mixed-method technique.

Indonesia is the nation with the greatest number of authors, with 9 authors (42.85%), according to the author's nationality and worldwide collaboration. The second most authors are the United States with 3 authors (14.28%). In third place are authors from Australia and New Zealand, each with 2 authors (9.52%). The fourth place is occupied by authors from Belgium, China, Germany, Spain, and Taiwan, namely 1 author.

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How does "learning media" research contribute to today and future opportunities? Three categories best describe the contribution of learning media research: learning media development, learning media planning, and learning implementation. The contribution of this learning media research leads to the implementation of learning, as many as 9 articles, contributions to the development of learning media published by 5 articles Finally, contributions are given 1 article on learning planning. The contribution of learning media research leads to the implementation of learning that has involved students, teachers, and parents. The implementation also involves children who have

learning barriers, namely dyscalculia. But in fact, children who have learning barriers or ABK types are not only dyscalculia but there are many others. Therefore, This presents an excellent chance for additional research on how learning is implemented in kids with learning disabilities. barriers such as deaf, disabled, mentally impaired, speech impaired, visually impaired, and other learning delays (Pratiwi et al., 2020). The contribution of learning media research to the development of learning media has been developed not only using concrete media but also using technology such as applications, the web, and others. The next contribution of learning media research is learning planning. This learning planning still needs a lot of research considering the importance of learning planning in teaching and learning activities. So this is a great opportunity in the future to be more in-depth regarding learning planning research. Thus, there is a strong chance that learning media research will be thoroughly investigated in the future.

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Umi Hanifah, research design and article writing; Dyah Worowirastri Ekowati, research and survey coordination; Dian Fitri Nuraini, Data Collection and Research Liaison.

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Conflict of Interest:

The author declares that there is no conflict of interest in the conduct of the research and publication of the article.

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