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Bibliometric Analysis of The Use of Science Learning Media In Elementary Schools During A Decade

Anggun Taruna Puspitasari[1*], Wahono Widodo[2], Dian Permatasari Kusuma Dayu[3,]
[1,2,3]Postgraduate, Surabaya State University, Indonesia

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ABSTRACT

This research uses a bibliometric approach to examine how science learning media have been used in elementary schools over the last ten years. The data source used is Dimension AI, with the keywords "science learning media" and "primary school," in the publication range from 2014 to 2024. This research utilizes VOSviewer software to visualize author collaboration patterns, main research topics, and the learning media most frequently used in the study. The results of the analysis show a significant increase in the number of publications related to science learning media in that time period, with a peak in 2023. Additionally, this research found that technology-based learning resources, such as interactive and digital media, function well, dominating research trends. Apart from that, the main themes that are often discussed include the development of digital-based learning tools, student involvement in the learning process, and the effectiveness of using manipulative and interactive media. A trend of increasing collaboration has occurred in recent years, according to the authors' collaboration analysis, indicating that a number of academics and institutions continue to contribute to this field. According to these findings, this research provides important implications for the development of science learning media in the future, especially in improving learning technology and teacher training to utilize this media optimally. Future development steps include the use of technology such as AR and VR, as well as further development of manipulative media that is in line with the learning context in elementary schools.

Corresponding Author:

Anggun Taruna Puspitasari
Postgraduate, Surabaya State University, Indonesia
Email: 24010855022@mhs.unesa.ac.id

1. INTRODUCTION

Students' basic understanding of scientific topics is greatly helped by the existence of Natural Science (IPA) subjects in Primary Schools (SD). At this level, students are introduced to basic scientific concepts that will shape their critical and analytical mindset later in life [1],[2]. However, one of the most difficult things about teaching science to primary school students is getting them to understand abstract topics in an engaging way. This is where the role of creative educational media is crucial. The purpose of teaching science in primary schools is to develop students' capacity for critical and analytical thinking about the world around them [3]. This learning is designed so that students can understand cause-and-effect relationships, natural processes, and scientific

applications in everyday life. Conceptualising fairly complex concepts by students is one of the difficulties in teaching science at the primary school level [4],[5]. A key factor in achieving the goals of science education is the use of appropriate learning resources.

What is meant by 'learning media' is materials or instruments used during the teaching and learning process to help students understand the material more fully [6],[7]. Learning media is a useful tool in science teaching because it helps students learn abstract or difficult concepts that are difficult to understand directly. These media can be digital, manipulative, aural, visual, or a combination of all of them, and all of them are intended to increase student participation in the learning process [8],[9]. Innovation in educational media is essential, especially in science teaching in primary schools. A more real, relevant, and interesting learning environment can be created by using effective learning media, so that it will improve students' understanding of the subject matter taught [10].

Through contextual learning opportunities, interactivity and visualisation, innovative science learning media can also help students understand science topics better. Various types of media, such as digital, manipulative and interactive media, have been developed to increase student engagement and the effectiveness of science learning [11]. A thorough review of research conducted over a period of time is needed to understand the trends and efficacy of using science learning media in primary schools.

It is in this context that bibliometric methods become relevant. Using these techniques, researchers can map research patterns, determine important subjects that are frequently investigated, and look at the contributions made by different authors, organisations, and countries. A method called bibliometrics is used to quantitatively assess and calculate the properties of scientific books [12],[13]. In this study, the publication pattern of the use of science learning media in primary schools over the previous ten years was analysed using a bibliometric approach. This analysis includes various aspects, such as the distribution of publications per year, identification of leading authors, collaboration between researchers, and themes that often appear in research [14]. This research can provide a comprehensive overview of the patterns and trends of research related to science learning media using analytical tools such as VOSviewer, including the identification of dominant topics and relationships between researchers in this field. This will help in understanding the contribution and development of research in the last decade.

The purpose of this study is to examine research trends related to the use of digital learning resources in Indonesian primary schools for the Science curriculum between 2010 and 2020. Specifically, this research will identify the main topics that are frequently researched in this context, such as the effectiveness of digital media in increasing students' learning motivation, the creation of digital learning resources and the difficulties in integrating digital media into the classroom are the main subjects of this research. In addition, during the same period, this research will examine the most commonly used types of digital media in basic science learning, such as learning videos, simulations or educational games. The aim of this study is to determine the main focus areas of previous research in this area and to examine how the use of digital learning media has changed over the past ten years in science teaching at the primary school level.

2. METHOD

A bibliometric approach was used to analyse trends in the use of science learning media in primary schools over the past decade (2014-2024). The selection of journals to be analysed resulted in 377 bibliographies. The bibliometric method articles were selected because they are able to provide a comprehensive picture of publication trends, collaboration between researchers, and dominant topics in science learning media research. The data in this study was obtained from Dimension AI, a scientific database platform that indexes research articles, conference proceedings, reports, and other research results. Dimension AI was chosen because it covers various publications relevant to the field of education and is able to present complete metadata for bibliometric analysis [15]. The articles analysed in this study were selected based on several criteria. Firstly, the articles had to be published between 2014 and 2024. In addition, the articles selected had to specifically address the subject of the use of learning media in the context of science learning in primary schools. Only scientific articles published in indexed journals or conference proceedings relevant to education will be included in this analysis. Either Indonesian or English can be used to write the article.

The data collection process is done through several stages. First, a literature search was conducted using keywords such as 'Science Learning Media,' and 'Elementary School' in the Dimension AI database. After that, articles that do not match the topic and research criteria will be

eliminated from the analysis. The last stage is metadata extraction, where important information from the article (title, author, institution, publication year, journal, and keywords) is retrieved and organised for further analysis using VOSviewer software. The data that has been collected was analysed using a bibliometric approach with the help of VOSviewer software. This analysis involved several important aspects. Firstly, the number of publications per year was analysed to identify trends in research development and to see whether there has been an increase or decrease in the number of studies related to science learning media in primary schools over the past decade. Secondly, a main topic analysis was conducted using co-word analysis to identify topics that frequently appear in the analysed articles, as well as determining the keywords or terms that are most frequently used in science learning media in primary schools.

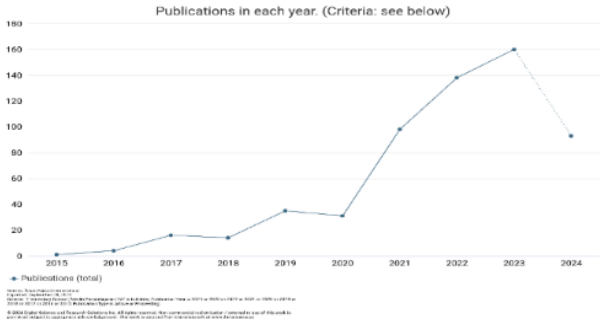
Furthermore, author and institution analysis was conducted to identify authors and institutions that often collaborate in research related to science learning media, as well as analysing the contributions of the most productive authors and the most involved institutions. Finally, citation network analysis is used to identify citation patterns between articles to see the influence of certain works on the development of science learning media research. Through this analysis, it can also be seen which articles or journals have the greatest citation influence. VOSviewer software was used in this study to conduct bibliometric analysis. VOSviewer was chosen for its ability to visualise research networks, including co-author networks, citation networks and keyword maps. VOSviewer was also used to visually identify relationships between researchers and dominant research themes. The findings from this analysis are expected to provide a comprehensive summary of the last ten years of research developments on the use of science teaching materials in primary schools.

3. RESULTS AND DISCUSSION

3.1. Distribution of Research by Year

The graph of the distribution of publications related to science learning media in primary schools in the last decade (2015-2024) shows a quite dynamic trend. At the beginning of the period, from 2015 to 2017, the number of publications was relatively low, with an average of under 20 publications per year. Research on this topic did not seem to be a major focus among researchers in those years. The year 2018 marked a small increase, with the number of publications approaching 40 articles. However, this increase has not been significant, as 2019 saw a slight drop back in the number of publications, which remained at around 40 articles. Nonetheless, from the data, it appears that interest in science learning media research is starting to grow, albeit slowly. Here is Figure 1 Graph of the distribution of publications related to science learning media in elementary schools.

Tren Publikasi dari tahun 2015-2024



Gambar 1. Tren Publikasi

A significant trend of change began to be seen in 2020, where the number of publications increased sharply. From only around 40 articles in 2019, this number jumped to more than 60 publications in 2020. This trend continued with an even greater surge in the following years. In 2021, the number of publications exceeded 100 articles, and this trend further increased until it peaked in 2023 with more than 160 publications. This increase shows the growing attention of researchers to science learning media in primary schools, which is likely driven by technological developments, the need for learning innovation, and the increasing use of digital media in education. However, provisional data for 2024 shows a significant decline, with the number of publications dropping back to around 60 articles. There are several reasons for this decline, such as publishing delays, changes in research focus, or even the influence of external events such as a worldwide epidemic. Overall,

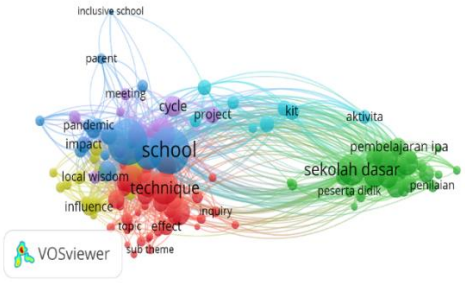
however, this trend illustrates the increasing attention on science learning media over the past decade, with peak productivity occurring in 2023.

The sharp increase in the number of publications between 2020 and 2023 reflects the growing need for innovations in science learning media in primary schools, along with increasing attention to the integration of technology in education. The temporary drop in the number of publications in 2024 may be more the result of technical factors or changes in research dynamics. Either way, this graph indicates that research on science learning media has grown rapidly over the past decade, although there is still room for improvement in the future.

3.2. Research Topics and Themes Trends

Furthermore, the image of the analysis results from VOSviewer shows a visualisation of the keyword network of research related to science learning media in elementary schools. Each colour in the figure represents a research cluster consisting of keywords that often appear together, while the spheres represent the keywords used in the research. The size of the spheres illustrates the frequency of occurrence of the keywords in the research, while the connecting lines show the relationship or connection between the keywords.

Tren Topik dan Tema penelitian



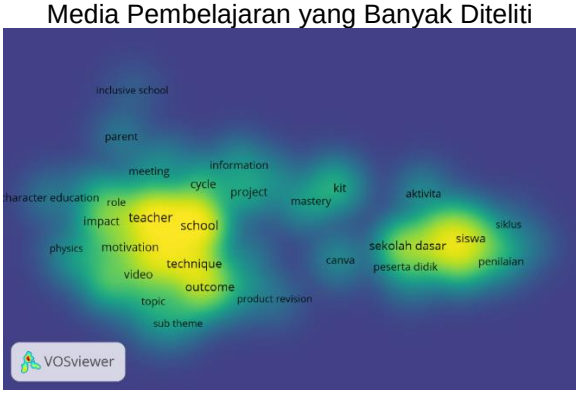
Gambar 2. Tren Topik dan Tema Penelitian

The Green Cluster has a primary focus on keywords such as ‘primary school,’ ‘science learning,’ ‘learners,’ and ‘assessment.’ This cluster represents research centred on primary school science learning and learner evaluation. Themes in this cluster tend to be related to the development of assessment methods and techniques in the context of science learning in primary schools. Red Cluster dominant keywords are ‘technique,’ ‘effect,’ and ‘topic.’ Methods and the effect of learning media on student learning outcomes are the main topics of this cluster. This research cluster may focus on specific teaching strategies and how they affect students' understanding of scientific ideas. Then in the Blue Cluster, the main keywords such as ‘school,’ ‘project,’ and ‘cycle’ indicate an interest in project-based or cyclical approaches to science learning in schools. Studies in this cluster focus on the implementation of projects or ongoing activities as part of learning media, such as the development of science teaching aids or learning kits. The Purple cluster keywords such as ‘inclusive school,’ ‘parent,’ and ‘pandemic impact’ indicate research themes related to inclusive education and the impact of the pandemic. This cluster indicates that there is research focusing on how science learning media is adapted in inclusive schools and the influence of the pandemic on science learning. Yellow clusters of keywords such as ‘local wisdom’ and ‘influence’ indicate research themes related to the application of local wisdom in science learning media. Research in this cluster seems to try to link science materials with local values or concepts, making them more relevant to students' daily lives. From this visualisation, it can be seen that the main topics often researched relate to primary schools, learning techniques, and the impact of learning media on learners. There is also a lot of research on the implementation of project-based learning and the impact of the pandemic on science learning methods. Overall, the main themes that have emerged in research over the past decade include effective learning methods and techniques, implementation of project-based learning media, and assessment and adaptation to changes in education, both due to external (such as the pandemic) and local (such as local wisdom) factors.

3.3. The Most Researched Learning Media

With a focus on the type of media used in the study, the visualisation findings from VOSviewer show the most frequently explored representations of subjects and phrases in relation to science learning media in primary schools. Brighter yellow colours indicate areas that were more frequently researched, while green and blue colours indicate lower frequencies.

Media Pembelajaran yang Banyak Diteliti



Gambar 3. Media Pembelajaran yang Banyak Diteliti

Based on the VOSviewer visualisation results, some of the most researched types of learning media in the context of science in primary schools include digital, interactive and manipulative media. Digital media is one of the main focuses of research, as shown by the keywords ‘video’ and ‘Canva’. The use of digital media is considered effective in attracting students' attention while making it easier to convey complex science concepts. Videos, for example, are often used to increase students' understanding and motivation in learning science. This is reflected in the keyword ‘motivation’ which is closely related to digital media in the visualisation.

In addition, interactive media is also a fairly dominant topic. This can be seen from the emergence of keywords such as ‘project’ and ‘kit.’ With the use of real tools that allow direct examination of science materials or through collaborative projects, interactive media empowers students to take an active role in their education. By using this interactive media, teachers hope to improve their students' problem-solving and critical thinking skills through real-world applications.

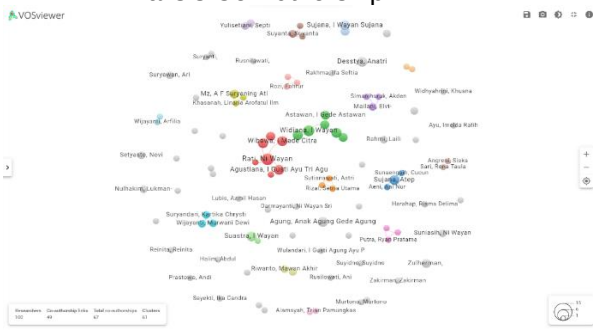
Lastly, manipulative media is also often researched, with keywords such as "cycle," "mastery," and "product revision" indicating the use of physical aids or kits in the learning process. Students can learn through direct engagement with learning items or materials and exploration with the manipulative media, which is then repeated in the learning cycle until they master the concepts taught. These three types of media make a significant contribution to developing the quality of science learning in primary schools.

Research on the use of science learning media is not only focused on students; teachers and the role of schools in helping the implementation of this learning media are also highlighted with keywords such as "teacher" and "school" in the large cluster on the left. In terms of choosing and using the media that best suits the needs of students, teachers often have a great influence. Therefore, the study on the use of manipulative and digital media is inseparable from the influence of teachers and school policies in encouraging the use of technology in learning. Over the past ten years, most of the research has focused on digital and interactive media, with an emphasis on how these tools can improve primary school students' understanding of science. It seems that this media has a good influence on student motivation and learning outcomes, while the role of teachers and schools is also an important aspect in research.

3.4 Author Collaboration

The visualisation results from VOSviewer show a pattern of collaboration between authors in research related to science learning media in primary schools. The co-authoring analysis on this map provides an overview of groups of authors who often work together, shown by colourful clusters that represent a network of author collaborations. Each colour depicts a cluster of authors who are often connected in the same study, indicating the frequency of collaboration in their publications.

Analisis Co-Authorship



Gambar 4. Analisis Co-Authorship

Some writers such as Widiana, I Wayan and Sujana, I Wayan appear to be in large clusters identified as the most active and productive writers in this field. They often collaborate with other writers, both from the same and different institutions. A larger circle size on the visualization indicates that the author has a larger number of publications or has a significant impact in the author's network. For example, authors such as Wibawa, I Gede Citra also have a large circle and often collaborate with several authors in the same cluster, indicating a great contribution to Science Learning media Research. This analysis shows that research related to Science Learning media in elementary schools is not carried out individually, but through extensive collaboration between authors and institutions. This collaborative network has a positive impact on the development of research, as it allows the exchange of ideas, methods and innovations that can support the improvement of the quality of learning media used in primary schools.

3.4 Discussion

3.4.1 The Relationship Between The Results Of The Analysis And The Development Of Science Learning In Elementary Schools.

The findings of the bibliometric analysis show that over the past ten years, there has been a marked increase in the use of science learning materials in elementary schools. The increasing number of studies discussing science learning media, as seen in the visualization of the distribution of years, indicates increasing attention to innovation in science learning at the elementary level. Digital, interactive, and manipulative media are the main focus of research, in line with technological developments and educational policies that encourage the use of more creative and effective media in the teaching and learning process.

Studies highlighting the use of interactive media, Canva, and videos show how important digital technology is in improving students' understanding of difficult and complex science ideas [16]. The use of manipulatives in science experiments and project-based learning are two examples of interactive media that have been shown to be useful in helping elementary school students develop critical thinking and problem-solving skills [17]. Research on the use of real tools (kits) to facilitate experimental learning also shows that manipulative learning media provides opportunities for students to learn by doing, which is a successful approach in science education.

Furthermore, research subjects and themes show a strong correlation between creative and interesting teaching strategies and the creation of science learning media in elementary schools. This is consistent with the increasing focus of the curriculum on student-centered approaches, experiments, and project-based learning [18],[19]. Therefore, the identified research trends show direct relevance to the current needs of science learning in elementary schools.

3.4.2 Implications For The Development Of Learning Media In The Future.

The findings of this study provide several important implications for the development of learning media in the future. First, because digital media such as videos and interactive platforms have proven to be effective, the development of more sophisticated and accessible digital media for teachers and students needs to be accelerated. In addition, the use of manipulative tools that support experiment-based learning should be expanded, given their effectiveness in helping students understand science concepts concretely. It is important to consider the use of augmented reality (AR) and virtual reality (VR) technologies to enhance the educational experience of elementary school children [20], [21].

Second, collaboration between researchers and education practitioners needs to be continuously encouraged. The author's analysis shows that there is substantial research

collaboration in the field of science learning media. However, this effort should be more focused on collaborating with educators who are actively involved in the teaching and learning process. This strategy will ensure that the teaching materials produced are in accordance with the needs and context of the industry. Finally, in facing curriculum developments and global challenges, researchers and developers of learning media must consider factors such as inclusivity, sustainability, and adaptation to new technologies in the design of learning media. Improving the quality of science learning in elementary schools requires the use of media that accommodates various learning styles and student needs.

To improve the effectiveness of science learning in elementary schools, several suggestions for developing learning media need to be considered. First, the use of digital and interactive media, such as videos and technology-based applications, is very important to improve students' understanding of abstract science concepts. The development of mobile applications, online learning platforms, and the use of augmented reality (AR) and virtual reality (VR) can make the learning process more interesting and interactive [8]. It is important to ensure that these media can be easily accessed by teachers and students, especially in areas with limited technological infrastructure. In addition, manipulative media such as experiment kits also need to be developed to facilitate experiment-based learning that helps students understand concepts more concretely. Developers should focus on innovating teaching aids that are student-friendly, easy to use, and support critical thinking and problem-solving skills.

In addition, collaboration between researchers, developers, and education practitioners is also the key to success in developing learning media that is relevant and in accordance with educational needs in the field. Teachers need to be involved in the media design and testing process to ensure that the media is applicable and effective when used in the classroom. To ensure that teaching materials are accessible to all students, including those with special needs, developers must also consider inclusivity. In addition, the media developed must be flexible and able to adapt to different school contexts, both in rural and urban environments. Finally, media development must consider the principle of sustainability, such as using environmentally friendly or energy-efficient technology, and ensuring that the media can continue to be updated along with developments in technology and educational curriculum. With these steps, it is hoped that science learning media in Elementary Schools can continue to develop and support the improvement of the quality of education in a sustainable manner.

4. CONCLUSION

The conclusion of this study shows that the use of science learning media in Elementary Schools has increased significantly over the past decade, as indicated by the bibliometric analysis. This study provides important insights for the development of science learning media in the future. Digital, interactive, and manipulative media have proven to be the main focus of research and have great potential for further development. The implications of these findings emphasize the importance of continuous and collaborative innovation in creating learning media that can accommodate students' needs and support the achievement of 21st century competencies, especially in the context of science education in Elementary Schools. First, the findings showing an increasing trend in the use of digital and interactive media confirm that technology plays an important role in improving the quality of learning. Therefore, teachers and educational institutions must be more adaptive in utilizing technology-based media such as videos, learning applications, and online platforms to provide a more interactive and engaging learning experience for students. The use of this technology allows students to better understand complex science concepts through better visualization and a more enjoyable approach. Second, these findings also imply that the development of learning media should pay more attention to direct student involvement through manipulative media, such as experiment kits and teaching aids. This media helps to strengthen critical thinking and problem solving skills that are essential in science education. The success of this media requires more intensive training for teachers, so that they can integrate the media effectively in daily teaching. It can also be a recommendation for further research steps.

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