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Utilization of technology-based learning media in junior high school mathematics learning: A systematic literature review

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ABSTRACT

This study aimed to examine and synthesize research findings on the utilization of technology-based learning media in junior high school mathematics learning. This study employed a Systematic Literature Review (SLR) approach following PRISMA guidelines to ensure a systematic, transparent, and replicable process. Data were collected from the Google Scholar, Garuda, and Sinta databases, resulting in 17 selected articles out of an initial 32,100 records after a rigorous screening process. The findings indicate that technology-based learning media, such as interactive multimedia, instructional videos, Android-based applications, and virtual laboratories, have a positive impact and are generally considered valid, practical, and effective for improving students' conceptual understanding, motivation, engagement, and learning outcomes. The research methods identified include Research and Development (R&D) as the most dominant approach, as well as quantitative, qualitative, and community service or *Pengabdian Kepada Masyarakat* (*PKM*) studies. These media have been applied to various mathematics topics, including algebra, geometry, arithmetic, and statistics. However, most studies are limited by short implementation periods and small sample sizes, and they tend to focus more on product development rather than on long-term impacts or higher-order thinking skills. Therefore, future research should examine long-term effects and develop more innovative, student-centered learning approaches that promote critical thinking and problem-solving skills.

Keywords: learning media; technology; mathematics learning; junior high school level; SLR

1. INTRODUCTION

Learning media play a crucial role in improving the quality of the learning process. In today's learning context, the use of learning media is no longer optional but has become a necessity for teachers. This is due to the increasingly complex world of life, which has led to an increase in the complexity of the learning materials that students must understand. Consequently, the learning process is more challenging. Through the use of learning media, abstract and complex concepts can be presented in simpler and more easily understood forms. In addition to the need factor, the application of learning media is supported by the increasing availability of diverse media as a result of technological advances in various fields (Kusum et al., 2023).

Technological advancements have enabled more interactive and adaptive learning environments through the integration of media, such as instructional videos, interactive software, and web-based applications. These technology-based tools enhance students' engagement, motivation, and understanding by presenting information in accessible and meaningful ways. Moreover, they support personalized learning by accommodating individual needs and promoting active participation in the learning process. This aligns with Zhai et al. (2025), who highlighted that adaptive digital environments can optimize learning experiences through real-time adjustments to students' cognitive conditions. However, the effectiveness of such media remains contingent upon their alignment with student characteristics, as this significantly influences learning motivation (Nugraha et al., 2025).

Mathematics plays a crucial role in the curriculum structure at various levels of education. The success of the mathematics learning process is greatly influenced by the learning strategies implemented, including the choice of methods and the media utilized by teachers in delivering the material. In this context, learning media can be defined as various forms of facilities, technological devices, and learning resources used to support and facilitate learning. The use of appropriate learning media has been proven to have a positive impact on students' understanding of the mathematics material being studied (Maulidia & Lestari, 2024). In the Independent Curriculum, mathematics learning at the junior high school level covers four main areas: algebra, arithmetic, geometry, and statistics. In practice, students experience various difficulties in understanding this material. Several studies have shown that junior high school students are not yet able to optimally grasp geometric concepts (Indrayany & Lestari, 2019; Fitriani et al., 2021).

Research by Wijayanti et al. (2018) states that technology-based mathematics learning media is considered suitable for implementation in the mathematics learning process in schools, especially in the geometry of plane figures. The use of technology-based learning media plays a very important role in today's digital era. The rapid development of technology allows students to access various learning resources and materials, including technology-based mathematics learning media. Therefore, it can be concluded that this study aims to examine and obtain an overview of the results of the application of technology-based mathematics learning media in the mathematics learning process of junior high schools.

2. LITERATURE REVIEW

2.1. Instructional Media

Learning media are tools used to assist the process of delivering material from educators to students so that learning objectives can be optimally achieved (Zahwa & Syafi'i, 2022). Learning media are all forms of tools used to convey learning messages through various channels, whether visual, audio, or audio-visual, which can stimulate students' thoughts, feelings, and desires. The use of learning media can make the learning process more effective because it helps students acquire and understand new information, so that learning objectives can be achieved properly (Daniyati et al., 2023). Learning media are generally divided into two types: conventional and digital. The main differences between the two types of media lie in the level of technology utilization, flexibility of material presentation, and opportunities for active student involvement in the learning process (Syafei, 2025).

2.2. Technology-based Learning Media

Digital media, or technology-based learning media, refers to the use of information technology devices and systems, including hardware and software, in the learning process. This type of media includes instructional videos, interactive multimedia, animations, learning applications, and various digital platforms that enable the presentation of material in a diverse, interactive, and contextual manner. Compared to conventional media, technology-based learning media offers several advantages, one of which is its ability to promote students' independent learning. In traditional face-to-face learning, the process tends to be teacher-centered, causing students to become passive, merely listening and taking notes with limited active involvement (Widianto, 2021). The use of technology-based media can overcome this condition by increasing student engagement and learning independence. Furthermore, digital learning media can create interactive and engaging learning experiences that help students better understand mathematical concepts and enhance their learning motivation (Defa et al., 2025).

2.3. Junior High School Mathematics Learning

Junior high school mathematics learning is an interactive process that develops students' critical, creative, and logical thinking skills through the construction of new knowledge, focusing on algebra, geometry, statistics, and numbers. The goal is to improve conceptual understanding, solve problems in everyday life, and develop mathematical reasoning skills. However, in practice, students still experience various difficulties in understanding the material. Several studies have shown that junior high school students are not yet able to optimally understand geometric concepts (Indrayany & Lestari, 2019; Fitriani et al., 2021).

2.4. Systematic Literature Review (SLR)

A SLR is a secondary research method conducted systematically, transparently, and replicably to identify, examine, and synthesize relevant literature, such as journal articles and books, to answer specific research questions. This method aims to present an objective mapping of scientific evidence, identify research gaps, and minimize potential bias in the review process of the literature.

3. RESEARCH METHOD

This study employed a SLR approach following the PRISMA guidelines to ensure a transparent and replicable process. The literature search was conducted across Google Scholar, Garuda, and Sinta using Boolean keywords related to "learning media", "technology" "mathematics learning" and "junior high school." Quality assessment was based on the research design, methodological clarity, sample adequacy, and relevance to the study objectives. From an initial 32,100 records, data cleaning removed duplicates and non-journal documents, resulting in 24,800 records for further screening. Following title and abstract screening based on inclusion criteria (publication year, subject, topic, and media focus), 7,800 articles remained. A full-text eligibility assessment further reduced the number of studies to 100 owing to issues such as inaccessible texts, lack of empirical data, and unclear media descriptions. Finally, 17 articles that met all the criteria were selected for an in-depth analysis. Overall, this systematic selection process ensured that only high-quality and relevant studies were included in this review (see Figure 1).

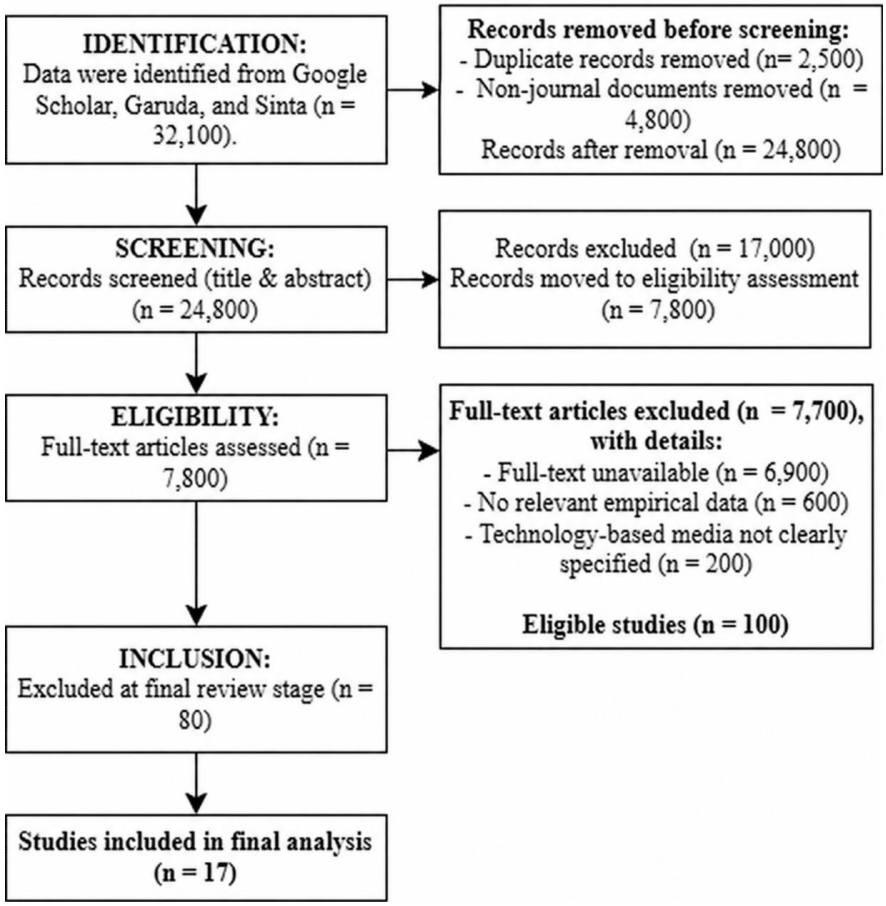

Figure 1. PRISMA Diagram

4. RESULTS AND DISCUSSION

4.1. Results

The results of the 17 literature reviews are presented in Table 1.

Table 1. Reference Sources Meet the Criteria

No	Researcher (Year)	Method	Research Title	Research Result
1	Wiana, et al. (2020)	Research & Development (R&D) with the 4-D research model	Development of Mathematics Learning Media Based on Mathlet Geogebra on the Topic of Linear Equations of One Variable for Grade VII Students	It is valid, practical, and effective in enhancing motivation and conceptual understanding.
2	Handayani, et al. (2020)	Research & Development (R&D) with the Plomp development model	Learning Media Based on the Bruner Model, Local Culture and Scaffolding to Improve Understanding of the Concept of Relations and Functions	It is valid, practical, and effective in supporting conceptual understanding.
3	Cahyady et al. (2020)	Research & Development (R&D) with the ADDIE development model	Development of Fraction Learning Media with a Scientific Approach to Support Efforts to Improve Understanding of Fraction Concepts in Grade VII Students	The study was valid, practical, and effective in improving scores and mastery.
4	Wulandari et al. (2020)	Research & Development (R&D)	Development of Authentic Problem-Oriented Interactive Video Lectures for Social Arithmetic	It is very valid and practical for learning.

		with the ADDIE development model	Learning in 7th Grade Junior High Schools	
5	Pangestu & Setyadi (2020)	Development Research with the ADDIE model	Development of Android Application Learning Media "Pytha Fun" for Pythagorean Theorem for Junior High School	It is valid, practical, and effective in significantly improving learning outcomes.
6	Pratiwi (2021)	Quantitative Experiment	The Effectiveness of Flipped Classroom Learning on Improving Junior High School Students' Mathematics Learning Outcomes	It is more effective than conventional learning and significantly improves outcomes.
7	Fahmi & Noviani (2021)	Development Research with the ADDIE model	Development of Android-Based Mathematics Learning Media Using Augmented Reality on Curved Surface Solid Material	Highly feasible based on validation and response.
8	Harahap & Lubis (2021)	Research and Development (R&D) with the ADDIE model	Development of Mathematics Learning Media Based on Android for Junior High School Level	It is very feasible and valid for mathematics learning.
9	Suryawan & Permana (2020)	Research & Development (R&D) with the 4-D research model	Geogebra-Based Online Learning Media as an Effort to Improve Understanding of Mathematical Concepts	It is highly valid, practical, and effective in improving conceptual understanding.
10	Rahayu, et al. (2022)	Research & Development (R&D) with the 4-D development model	Problem-Based Learning-Oriented E-Comic Learning Media to Improve Understanding of Social Arithmetic Concepts	Valid, practical, and effective, with mastery exceeding the criteria.
11	Rohmatullah et al. (2022)	Research & Development with the ADDIE model	Development of Android-Based Mathematics Learning Media on Circle Material for Grade VIII Junior High School	It is valid and practical for improving understanding and interest.
12	Kusumawati & Setyadi (2022)	R&D with the ADDIE model	Development of Mathematics Learning Media Based on Powtoon on Social Arithmetic Material	It is valid, practical, and effective in improving learning outcomes and responses.
13	Azis et al. (2023)	Qualitative Descriptive	Implementation of Technology in Mathematics Learning on Flat-Faced Solid Geometry Material	Technology supports effective learning and spatial abilities.
14	Arimbawa et al. (2024)	Research & Development (R&D) with the 4-D model	Development of a Virtual Lab to Improve Critical Thinking Skills of 8th Grade Junior High School Students in Mathematics	It is valid, practical, and effective in improving critical thinking.
15	Azmi et al. (2024)	R&D with the 4-D model	Development of Interactive PowerPoint Learning Media Based on ClassPoint for Junior High School Mathematics	It is valid and practical for supporting interactive learning.
16	Fadillah et al. (2024)	Research & Development (R&D) with the ADDIE model	The Utilization of Canva Application as Mathematics Learning Media on Plane Geometry for Grade VII	It is highly valid, reliable, practical, and effective.
17	Solikah et al. (2025)	Qualitative Descriptive	Optimization of the Utilization of Digital Technology in Mathematics Learning for Grade VII and IX Students at SMP Negeri 9 Surakarta	Effective, practical, and engaging in enhancing mathematics learning outcomes.

The findings indicate that most studies reported positive outcomes, particularly in terms of their validity, practicality, and effectiveness. However, these results are largely based on short-term implementation and small sample sizes of the studies. Based on the reviewed studies, the following presents a classification of learning topics, research subjects, types of research, and types of learning media from the results of the reviewers of the ten pieces of literature.

4.1.1. Learning Topics

Mathematics is taught in stages from elementary school to university, with material coverage tailored to curriculum requirements at each level. At the Junior High School level, in accordance with the Independent Curriculum, the mathematics topics studied include algebra, arithmetic, geometry, and statistics. Based on the analysis of the articles in this study, it is known that various mathematics materials at the Junior High School level have been widely taught with the help of digital learning media.

Various studies on the development of mathematics learning media have been conducted across different topics and educational levels. At the Grade VII level, the developed materials include linear equations in one variable or *Persamaan Linear Satu Variabel* (*PLSV*), social arithmetic, and plane geometry (Wiana et al., 2020; Rahayu et al., 2022; Wulandari et al., 2020; Kusumawati & Setyadi, 2022; Fadillah et al., 2024). At the Grade VIII level, the studies cover fractions, relations and functions, systems of linear equations in two variables (SPLDV), the Pythagorean theorem, coordinate systems, circles, and probability (Cahyadi et al., 2020; Handayani et al., 2020; Azis et al., 2023; Pangestu & Setyadi, 2020; Rohmatullah et al., 2022). Meanwhile, at the Grade IX level, the developed materials include polyhedra (three-dimensional shapes with flat surfaces), curved-surface solids, and geometric transformations (Pratiwi, 2021; Arimbawa et al., 2024; Suryawan & Permana, 2020; Fahmi & Noviani, 2021; Harahap & Lubis, 2021), with additional studies examining quadratic functions (Azmi et al., 2024). Overall, these findings indicate that the development of mathematics learning media has covered a wide range of topics across junior high school.

These findings indicate that the utilization of learning media has expanded widely and covers nearly the entire scope of mathematics content at the junior secondary school level. Therefore, learning media are no longer limited to specific topics but have become an essential component of the teaching and learning process, helping students understand concepts more easily, enhancing their learning motivation, and supporting the creation of more effective and meaningful mathematics instruction.

4.1.2. Research Subjects

Based on the overall results of the literature review, the research subjects are predominantly junior high school students, as the primary users of learning media, to evaluate the practicality and effectiveness of digital learning media, thereby determining their feasibility as instructional tools. Several studies have also involved teachers as evaluators or supporting respondents in assessing the feasibility and implementation of media. In general, the focus of these studies is on examining the effectiveness of digital media in improving students' conceptual understanding and mathematics learning outcomes.

4.1.3. Types of Research

Based on the results of the previous literature review, a classification of the research methods used to examine the utilization of digital mathematics learning media at the junior high school level was identified. The analysis indicates that the R&D method is the most commonly employed approach. This finding suggests that most studies focus on developing and evaluating the effectiveness of digital learning media in supporting mathematics instruction at the junior high school level (see Figure 2).

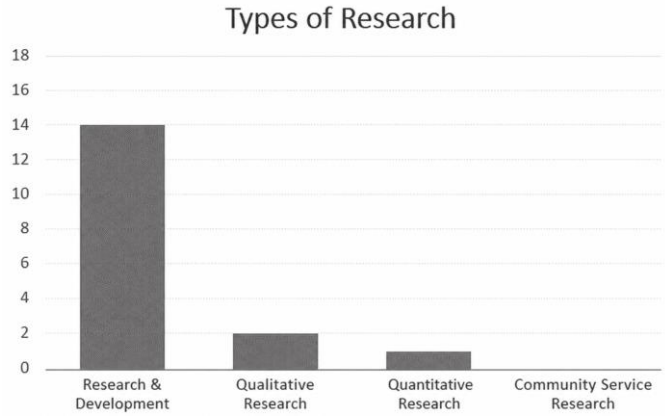

Figure 2. Various Types of Research from the Reviewed Literature

4.1.4. Types of Learning Media

Various types of learning media have been explored and implemented in junior high school mathematics instruction in Indonesia. The literature review revealed that audio-visual animation media are the most dominant type, as reported in several studies (Handayani et al., 2020; Suryawan & Permana, 2020; Fadillah et al., 2024). Visual animation media are also widely utilized, as evidenced by studies conducted by Harahap and Lubis (2021) and Azis et al. (2023). In addition, other forms, such as text-based visual media and animated virtual laboratory media, have been identified in studies by Azmi et al. (2024) and Solikah et al. (2025). However, no studies have specifically examined the use of audio-only or audio-based animated media in mathematics learning. Overall, these findings suggest that learning media that combine visual and audio elements tend to be more widely developed and utilized than those that rely solely on auditory components.

These findings suggest that, in junior high school mathematics learning, digital learning media that simultaneously engage auditory and visual senses (audio-visual), as well as those that rely primarily on visual elements, are more effective and more frequently utilized to support students' understanding of mathematical concepts compared to digital media that rely solely on auditory input (see Figure 3).

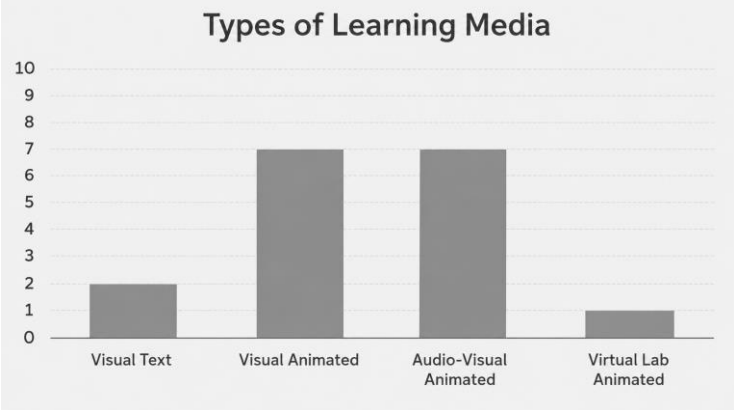

Figure 3. Various Types of Learning Media from the Reviewed Literature

4.2. Discussion

The findings of this study indicate that the use of technology-based learning media in junior high school mathematics has been widely implemented and generally produces positive outcomes, particularly in improving students' conceptual understanding, engagement, and learning performance. Media such as audio-visual animation and interactive digital platforms play an important role in transforming abstract mathematical concepts into more concrete and accessible forms for students. Most of the developed media also meet the criteria of validity, practicality, and effectiveness, and are typically developed through a systematic R&D approach involving both teachers and students. However, the effectiveness of these media depends not only on the technology itself but also on how it is designed and integrated into the learning process. Studies that combine digital media with structured learning approaches tend to achieve better outcomes, indicating that instructional design is the key factor in learning success.

Despite these generally positive findings, several limitations remain. Many studies have been conducted over short periods and have involved small sample sizes, which limits the generalizability of the results. In addition, research focus is still dominated by media development rather than the evaluation of long-term impacts or higher-order thinking skills. The integration of more advanced approaches, such as adaptive and personalized learning, remains limited. Digital learning environments can either support or hinder students' cognitive processes, depending on their design. Therefore, effective digital learning should consider students' cognitive conditions to optimize their learning experiences (Zhai et al., 2025).

Furthermore, the existing literature is still dominated by visual and audio-visual media, while other forms of learning media have received less attention. This highlights the need for more diverse and accessible approaches, especially in contexts with limited technological resources such as the Philippines. Overall, the use of technology in mathematics learning should go beyond simply adopting digital tools

and instead focus on meaningful, student-centered, instructional design. Learning media should be developed in an interactive, contextual, and cognitively appropriate manner to enhance conceptual understanding and promote higher-order thinking. Future research should employ more rigorous methods, examine long-term impacts, and expand the scope of studies to produce more comprehensive and generalizable findings.

5. CONCLUSION

Based on the analysis of 17 articles, it can be concluded that technology-based learning media play a very important role in junior high school mathematics learning, particularly in attracting students' interest, increasing engagement, and supporting improved learning outcomes. The use of technology enables a more interactive and engaging presentation of materials, helping students understand abstract mathematical concepts more concretely. However, although most studies report positive results, there are still several limitations, such as the lack of long-term studies, relatively small sample sizes, and the dominance of research focused on product development rather than in-depth evaluation. Therefore, future research should adopt more comprehensive and rigorous methodologies and develop more innovative and student-centered approaches so that the use of technology in mathematics learning can have more optimal and sustainable impacts.

Ethical Approval

This study did not require formal ethical approval because it was conducted as a SLR and did not involve direct human participants, experimental procedures, personal data, or sensitive information. All data analyzed in this study were obtained from publicly accessible academic sources, including published journal articles relevant to technology-based learning media in junior high school mathematics learning. The study was conducted in accordance with generally accepted ethical standards for educational and social science research.

Informed Consent Statement

Informed consent was not applicable to this study because it did not involve direct interaction with human participants. The materials analyzed were derived entirely from publicly available academic publications.

Authors' Contributions

IGDPS contributed to the conceptualization of the study, research design, data collection, data analysis, interpretation of findings, and writing of the original draft of the manuscript. RYS contributed to the data analysis, validation of research instruments, interpretation of results, and revision of the manuscript. IWPA contributed to the supervision, methodological guidance, critical review of the manuscript, and final approval of the version to be published. All authors have read and approved the final version of the manuscript.

Disclosure Statement

The authors declare that there are no conflicts of interest related to the conduct, authorship, or publication of this research.

Data Availability Statement

All data used in this study were derived from previously published journal articles in public academic databases. No new data were generated in this study.

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