

## Mathematics Learning Media to Enhance Students' Mathematical Literacy

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**Abstract:** *Mathematical ability is considered essential and plays a significant role in helping students solve problems in their daily lives. One important component of mathematical ability is mathematical literacy, which refers to an individual's capacity to formulate, use, and interpret mathematics in various real-world contexts. However, many students still struggle to apply mathematical concepts to everyday situations. Therefore, a learning approach that enhances students' mathematical literacy is needed, including the use of appropriate learning media. This study employed a systematic literature review of experimental and developmental studies to examine mathematics learning media that enhance students' mathematical literacy. The reviewed literature consisted of national and international journal articles indexed in SINTA and Scopus, published between 2015 and 2025, with students as the research subjects. The results of this study indicate that learning media such as Virtual Mathematics Kits, GeoGebra, Wingeom, Scratch, Wordwall, Kahoot, e-modules, e-LKPD, mathematics comics, Math City Map, and the selection of appropriate learning models are consistently effective in improving students' mathematical literacy. Digital and interactive media enhance mathematical literacy through visualization, interactivity, and dynamic exploration of mathematical concepts, while contextual and non-digital media strengthen students' abilities to formulate, employ, and interpret mathematics through real-life problem-solving and meaningful learning experiences across educational levels.*

**Keywords:** *mathematical literacy, media, mathematics learning*

**Abstrak:** Kemampuan matematika dianggap penting dan akan sangat membantu siswa dalam menyelesaikan masalah di kehidupan sehari-hari. Salah satu kemampuan matematika yang diperlukan adalah literasi matematika. Literasi matematika merupakan kemampuan individu untuk memformulasikan, menggunakan, dan menafsirkan matematika ke dalam berbagai konteks kehidupan sehari-hari. Namun faktanya, masih banyak siswa yang mengalami kesulitan dalam menerapkan matematika ke dalam konteks dunia nyata. Oleh karena itu, diperlukan suatu pendekatan pembelajaran yang mampu meningkatkan literasi matematika siswa, seperti penggunaan media pembelajaran yang tepat. Penelitian ini menggunakan metode *Systematic Literature Review* terhadap penelitian eksperimen dan pengembangan untuk mengkaji media pembelajaran matematika yang berkontribusi dalam meningkatkan literasi matematika siswa. Literatur yang dikaji terdiri atas artikel jurnal nasional dan internasional yang terindeks SINTA dan Scopus, diterbitkan pada rentang tahun 2015 sampai dengan 2025, serta subjek penelitian berupa siswa. Hasil kajian menunjukkan bahwa media pembelajaran seperti *Virtual Mathematics Kits*, *GeoGebra*, *Wingeom*, *Scratch*, *Wordwall*, *Kahoot*, e-modul, e-LKPD, komik matematika, *Math City Map*, serta pemilihan model pembelajaran yang sesuai secara konsisten efektif dalam meningkatkan literasi matematika siswa. Media digital dan interaktif dapat meningkatkan literasi matematika melalui visualisasi, interaktivitas, dan eksplorasi dinamis konsep-konsep matematika, sedangkan media kontekstual dan non-digital memperkuat kemampuan siswa dalam merumuskan, menggunakan, dan menafsirkan matematika melalui pemecahan masalah kontekstual serta pengalaman belajar yang bermakna.

**Kata kunci:** literasi matematika, media, pembelajaran matematika

### INTRODUCTION

In this era of globalization, education plays a crucial role in preparing individuals to face increasingly complex challenges in everyday life. Education is expected not only to develop students' knowledge but also to equip them with essential skills such as critical thinking, problem solving, and the ability to make informed decisions. These

competencies are particularly important in today's society, where individuals are frequently required to interpret information, manage resources, and respond to real world situations that involve quantitative reasoning.

One of the fundamental disciplines that supports these competencies is mathematics. Mathematics education enables students to think logically, systematically, and analytically when solving problems encountered in daily life. According to Hudojo in (Wicaksana et al., 2017), mathematics is a tool for developing ways of thinking. It is abstract, deductive in nature, and concerns structured ideas whose relationships are logically organized. Through effective mathematics learning, students are expected to develop reasoning skills, critical thinking, creativity, and efficiency in problem solving. However, in practice, many students are able to perform routine calculations but experience difficulties when applying mathematical concepts to real life contexts.

These challenges highlight the importance of mathematical literacy in mathematics education. Mathematical literacy goes beyond computational skills and emphasizes students' ability to formulate, employ, and interpret mathematics in various real-world situations (OECD, 2023). This includes concepts, procedures, facts, and tools used to describe, explain, and predict phenomena. Mathematical literacy equips individuals to understand how mathematics functions in the world and to make evidence-based decisions and judgments expected of constructive, active, and reflective 21st-century citizens.

Mathematical literacy helps individuals understand the role of mathematics in everyday life and enables them to make appropriate judgments and decisions required of constructive, engaged, and reflective 21st-century citizens (Ramadhani & Sofian Hadi, 2023). Mathematical literacy encompasses activities such as recognizing and understanding the role of mathematics in the world, solving mathematical problems in various contexts, interpreting mathematical statements, and applying mathematics rationally (Zakkia et al., 2019). For example, students with adequate mathematical literacy are able to interpret graphs and tables in news reports, calculate discounts and financial transactions, estimate quantities, and make reasonable decisions based on numerical information. Without these abilities, students may struggle to connect mathematical knowledge learned in school with practical situations they encounter in everyday life.

Mathematical literacy is one of the essential competencies that every individual must possess. Mathematical literacy also enables individuals to understand the role of mathematics in society and to make appropriate judgments and decisions as responsible citizens. This is reflected in international assessments such as the Programme for International Student Assessment (PISA), which evaluates students' ability to apply mathematics in real-world contexts rather than merely recalling formulas. Data from PISA indicate that many students, particularly in Indonesia, still show low performance in formulating, employing, and interpretation of results (OECD, 2023). Similarly, Rifai & Wutsqa (2017) reported that students' mathematical literacy remains relatively low, as

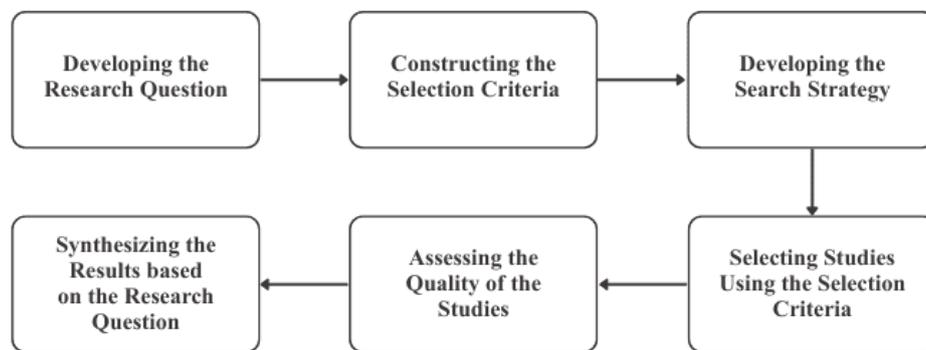
reflected in their very limited ability to formulate, employ, and interpret mathematical results.

These conditions indicate that strengthening mathematical literacy is a crucial objective in mathematics education. One strategic effort to address this issue is through the use of appropriate learning media. Learning media can support students in visualizing abstract concepts, engaging with contextual problems, and actively constructing mathematical understanding. With the rapid development of technology and educational innovation, various forms of learning media, both digital and non-digital have been developed to support mathematics learning.

Based on the background description, this literature review aims to examine mathematics learning media that can be implemented to enhance students' mathematical literacy. The results of this review are expected to serve as a reference for teachers, researchers, and learning media developers in designing more innovative mathematics learning programs that focus on strengthening students' mathematical literacy. Therefore, a literature review entitled "Mathematics Learning Media to Enhance Students' Mathematical Literacy" was conducted.

## METHODS

This study employed the Systematic Literature Review (SLR) method, which aimed to identify, review, evaluate, and interpret all relevant research. The Systematic Literature Review procedure followed the stages proposed by Zawacki-Richter et al. (2020), as presented in Figure 1.



**Figure 1.** Systematic Literature Review Process

The first step involved developing the Research Question, which guided the entire review process. The Research Question (RQ) formulated were: (RQ1) What are the trends in research related to mathematical literacy from 2015 to 2025? and (RQ2) How is learning media used to enhance mathematical literacy? The second step was constructing the selection criteria, which involved determining the criteria to be used for data processing, referred to as inclusion and exclusion criteria. The inclusion and exclusion criteria used in this study are presented in Table 1.

**Table 1.** Inclusion and Exclusion Criteria

<b>Inclusion Criteria</b>	<b>Exclusion Criteria</b>
Literature relevant to the topic of learning media and mathematical literacy	Literature is not relevant to the topic of learning media and mathematical literacy
Literature was taken from national and international journals that are indexed	Literature that is not sourced from indexed national or international journals
Literature that was published between 2015 and 2025	Literature published before 2015
Literature that involves students as research subjects	Literature that does not involve students as research subjects

The third step was developing the search strategy, which involved collecting literature using the Harzing's Publish or Perish application, with Google Scholar and Crossref selected as the databases. The keywords used to search for literature were "learning media" and "mathematical literacy." The initial search resulted in 1.000 articles. In the fourth step, the literature selection process was carried out systematically. First, duplicate articles were removed. Next, titles and abstracts were screened to identify studies relevant to the research topic. From this process, 24 articles were identified as potentially relevant. These articles were then reviewed in full text to ensure alignment with the inclusion criteria.

The fifth step involved assessing the quality of the selected studies using the Quality Assessment (QA) criteria. Each study was evaluated based on two main aspects: (QA1) Is the literature relevant to the topic of learning media and mathematical literacy?; and (QA2) Does the literature come from national or international journals indexed by SINTA or Scopus? Only studies that clearly described their research methodology (for example experimental or developmental research) and reported findings related to mathematical literacy outcomes were included. As a result of this quality assessment process, 15 studies were deemed eligible for further analysis.

The sixth step was synthesizing the results of the Research Question. The selected studies were analyzed by categorizing the types of learning media used, research designs, educational levels, and reported outcomes related to mathematical literacy. This synthesis was conducted to answer the research questions and identify patterns regarding the effectiveness of various learning media in enhancing students' mathematical literacy.

## **RESULTS AND DISCUSSION**

Based on the literature search, 1000 studies were obtained using Harzing's Publish or Perish application from the Crossref database. These 1000 studies were then filtered using the predetermined inclusion criteria, resulting in 24 studies that were relevant to the topic. Subsequently, the literature that passed the inclusion criteria screening was evaluated using the Quality Assessment (QA) criteria. A total of 15 studies passed the Quality Assessment stage and were sourced from SINTA accredited national journals. These 15 studies were then reviewed to obtain answers to the formulated research questions. A summary of the research results in this literature review is presented in Table 2.

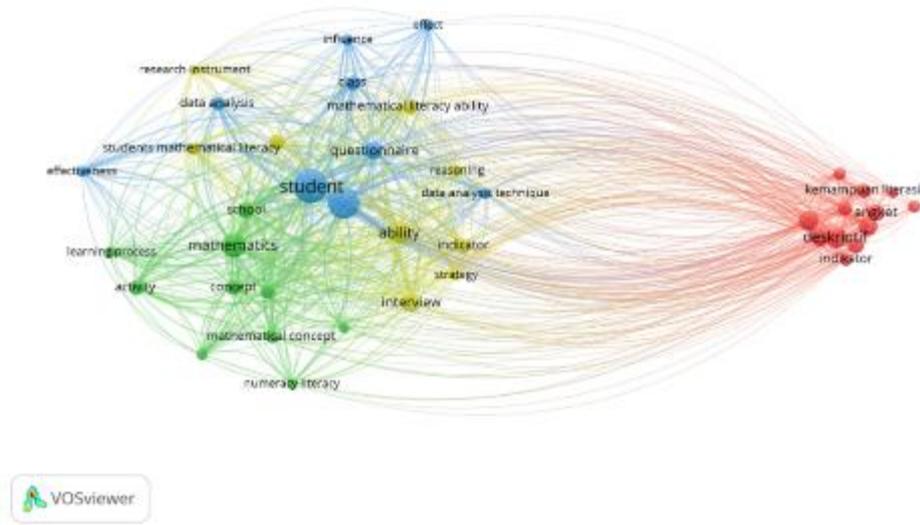
**Table 2.** Research Results from Selected Literature

Literature Code	Author, Year	Journal/ Proceedings	Indexing	Research Results
L01	(Sholikhah & Pradana, 2018)	Jurnal Profesi Pendidikan Dasar	Sinta 2	This study was an experimental research with a quantitative approach conducted at the elementary school level. The results show that the Virtual Mathematics Kits (VMK), which contain various software such as GeoGebra, Mathlab, and Office Mix, are effective in improving students' mathematical literacy.
L02	(Gunadi & Aisah, 2019b)	Mathline: Jurnal Matematika dan Pendidikan Matematika	Sinta 3	This study was a development research conducted at the high school level. The results of the pilot test evaluation involving six students showed an average score of 80,8 with the predetermined minimum passing grade set at 75. In addition, the statistical analysis indicated that $t_{hitung} > t_{tabel}$ with $t_{hitung} = 2,68$ and $t_{tabel} = 1,94$ . These results indicated that the mathematical comic media was effective and can be used to enhance students' mathematical literacy.
L03	(Rakasiwi et al., 2019)	AKSIOMA: Jurnal Matematika dan Pendidikan Matematika	Sinta 4	This study was a development research conducted at the elementary school level. The results show that comic based learning media using the picture and picture method can enhance students' mathematical literacy. The media was also declared suitable for use in mathematics learning based on expert validation and student response outcomes.
L04	(Nurdianti et al., 2021)	Jurnal Ilmiah Pendidikan Profesi Guru	Sinta 2	This study was a quasi experimental quantitative research conducted at the elementary school level. The results show that the team quiz learning model supported by concrete media is effective in enhancing students' mathematical literacy.
L05	(Fajriati & Murtiyasa, 2023)	Jurnal Cendekia: Jurnal Pendidikan Matematika	Sinta 4	This study was an experimental research conducted at the junior high school level. The results show that interactive multimedia using GeoGebra and integrated with Realistic Mathematics

Literature Code	Author, Year	Journal/ Proceedings	Indexing	Research Results
L06	(Lestari & Novaliyosi, 2023)	J-PiMat: Jurnal Pendidikan Matematika	Sinta 4	Education learning model is effective in enhancing students' mathematical literacy. This study was a quasi experimental research conducted at the junior high school level. The results show that Wingeom software can enhance students' mathematical literacy. This improvement occurred because the use of Wingeom supported students' memory during the learning process, enabling them to understand the material more effectively.
L07	(Shofia & Setiaji, 2025)	Media Pendidikan Matematika	Sinta 3	This study was an experimental research with a quantitative approach conducted at the junior high school level. The results indicate that the use of Wordwall media integrated with the discovery learning model can effectively enhance students' mathematical literacy, as evidenced by a 76.5% increase in pretest posttest scores.
L08	(Anhar & Sagala, 2025)	Proximal: Jurnal Penelitian Matematika dan Pendidikan Matematika	Sinta 5	This study was a development research conducted at the high school level. The results show that website based learning media can enhance students' mathematical literacy through accessible interfaces and features that encourage active participation during the learning process.
L09	(Prayitno et al., 2025)	JagoMIPA: Jurnal Pendidikan Matematika dan IPA	Sinta 4	This study was a development research. The results indicate that the application of interactive e-modules based on Problem Based Learning can enhance students' mathematical literacy and positively influence their learning outcomes.
L10	(Hura & Siregar, 2025)	SEPREN: Journal of Mathematics Education and Applied	Sinta 4	This study was a development research conducted at the junior high school level. The results indicate that digital worksheets based on Realistic Mathematics Education can significantly enhance students' mathematical literacy.
L11	(Nainggolan et al., 2025)	Fraktal: Jurnal Matematika dan	Sinta 5	This study was a quantitative research conducted at the junior high school level. The results indicate that interactive

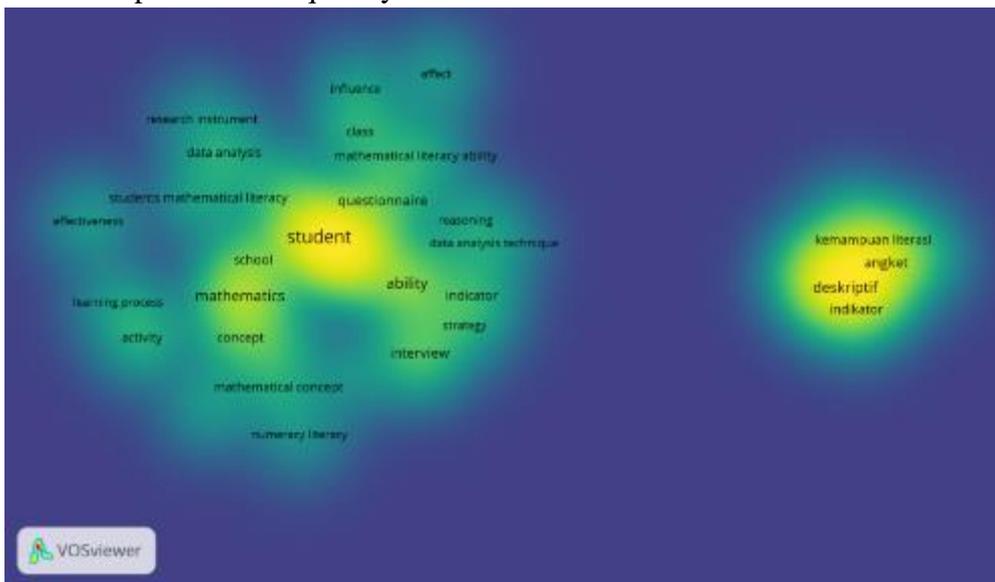
Literature Code	Author, Year	Journal/ Proceedings	Indexing	Research Results
		Pendidikan Matematika		magazine e-modules in STEAM based learning can enhance students' mathematical literacy. These e-modules are considered effective because they are aligned with the learning material and support the learning process.
L12	(Mardiyah & Kusmaryono, 2025)	Jurnal Jendela Pendidikan	Sinta 5	This study was a quantitative research conducted at the high school level. The results indicate that Kahoot media integrated with the Culturally Responsive Teaching based Problem Based Learning model can enhance students' mathematical literacy.
L13	(Nurhabibah, 2025)	SIGMA Kajian Ilmu Pendidikan Matematika	Sinta 4	This study was a quantitative research conducted at the high school level. The results indicate that the GeoGebra application implemented through Joyful Learning can enhance students' mathematical literacy and has a significant effect on their learning outcomes.
L14	(Nurjanah & Agustyaningrum, 2025)	GERVASI: Jurnal Pengabdian kepada Masyarakat	Sinta 4	This study was a research-based community service project. The results indicate that Math City Map can significantly enhance students' mathematical literacy. Through outdoor activities using Math City Map, students are encouraged to actively participate in solving problems in real-life situations.
L15	(Wati et al., 2025)	Jurnal Pendidikan MIPA	Sinta 2	This study was a development research conducted at the junior high school level. The results indicate that Scratch, developed with the support of Canva and PowerPoint, is effective in enhancing students' mathematical literacy.

**(RQ1) What are the Trends in Research Related to Mathematical Literacy from 2015 to 2025?**



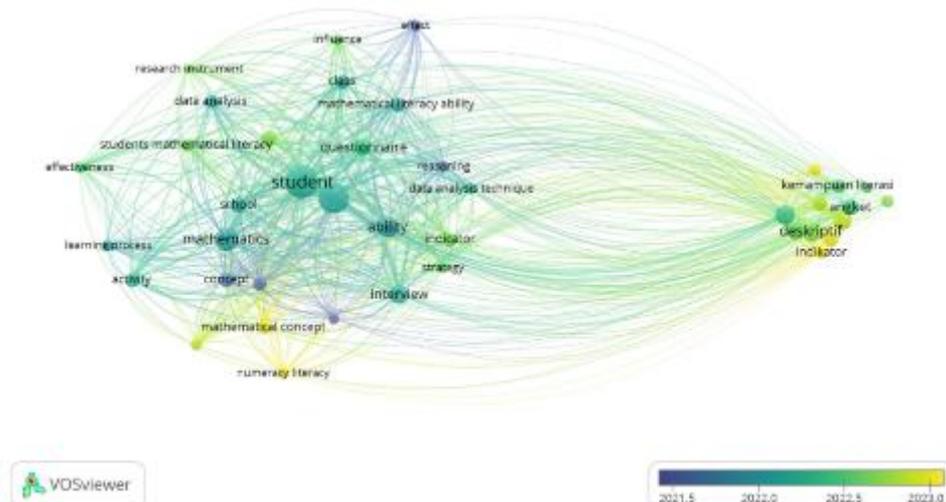
**Figure 2.** Network Visualization with the Keyword Mathematical Literacy

Based on Figure 2, VOSviewer displays a bibliometric map that illustrates the relationships among related terms. Several different colors appear, indicating the presence of multiple clusters in the data. In Figure 1, four colors are shown, representing four clusters, each consisting of different items. These items are represented as circles whose sizes correspond to their frequency of occurrence the more frequent the term appears, the larger the circle. The lines connecting the circles represent the relationships between keywords. The visualization results show that the “mathematical literacy” keyword is included in cluster 4, with 36 links and 328 occurrences. These interconnected keywords represent the topics most frequently studied in the research.



**Figure 3.** Density Visualization with Keywords Related to Mathematical Literacy

Figure 3 shows that the brighter the yellow color, the larger the circle representing the term, indicating that the term has been used in many studies. Conversely, if the color is faint and nearly blends with the background, it suggests that only a few studies have used that term.



**Figure 4.** Visualization of Research with Keywords on Mathematical Literacy in 2015-2025

Figure 4 shows that the research trend on mathematical literacy from 2015 to 2025 can be distinguished by color. Brighter colors indicate that the keyword has continued to be frequently used in more recent studies, while darker colors represent studies published in earlier years. Research on mathematical literacy is projected to continue through 2025. Overall, the trend from 2015 to 2025 shows an increase in the strategies used in mathematics learning, particularly through technology, innovative approaches, learning media, and the growing emphasis on character development and affective competencies.

### **(RQ2) How is Learning Media Used to Enhancing Mathematical Literacy?**

Mathematical literacy is the ability to formulate, employ, and interpret mathematics in various real-world contexts. In everyday life, mathematical literacy is reflected in one's mathematical thinking skills and the ability to solve problems across different situations (Apriliana & Nindita, 2023). Based on the findings from the reviewed literature, it can be concluded that the use of learning media, both digital and non digital, consistently contributes positively to enhancing students' mathematical literacy across various educational levels. The media used include digital media, educational comics, digital modules, interactive quiz applications, project based media, and outdoor learning activities. Although each media has its own characteristics and implementation methods, all have demonstrated significant effectiveness in supporting mathematics learning, particularly in enhancing mathematical literacy.

The use of digital media has been shown to enhance conceptual understanding and mathematical literacy, as well as to provide meaningful learning experiences through technology. The digital media referred to includes the Virtual Mathematics Kits (VMK), such as GeoGebra, Mathlab, and Office Mix, which are designed to present dynamic and

manipulable visualizations of mathematical concepts, thereby making it easier for students to understand the material (Sholikhah & Pradana, 2018). In addition, GeoGebra integrated with the Realistic Mathematics Education learning model and Joyful Learning has proven effective in enhancing mathematical literacy by increasing learning motivation and supporting students in understanding abstract mathematical concepts through visualization (Fajriati & Murtiyasa, 2023; Nurhabibah, 2025). Other digital media, such as Wingeom and Scratch, offer materials, sample questions, and student worksheets while providing interactive and engaging environments that help students understand the content more easily. These platforms can attract students' interest and motivation, ultimately contributing to the enhancement of mathematical literacy (Lestari & Novaliyosi, 2023; Wati et al., 2025). Additionally, websites developed in an appealing and student centered manner can encourage active participation throughout the learning process and further enhance mathematical literacy (Anhar & Sagala, 2025). Overall, digital media enhances conceptual understanding and mathematical literacy by offering visualizations and interactivity that simplify complex ideas. Through these features, digital media helps make abstract concepts more concrete and supports a more engaging and meaningful learning experience.

Digital media that are not categorized as applications, such as e-modules and e-LKPD, also play an important role in enhancing mathematical literacy. E-modules equipped with sample questions are considered practical and effective for enhancing mathematical literacy and positively influencing students' learning outcomes (Prayitno et al., 2025). STEAM based learning supported by interactive magazine style e-modules has also been proven effective in facilitating the learning process and strengthening students' mathematical literacy (Nainggolan et al., 2025). In addition, e-LKPD based on Realistic Mathematics Education shows a significant impact on enhancing mathematical literacy through activities designed to actively engage students in meaningful learning (Hura & Siregar, 2025). Both e-modules and e-LKPD provide practical, interactive, and easily accessible learning materials, making them highly effective in supporting mathematical literacy development. By encouraging active involvement and offering structured learning content, these media help students better understand mathematical concepts and enhance their learning outcomes. The accessibility and flexibility of e-modules and e-LKPD also enable students to learn more independently, engage optimally, and strengthen their mastery of the material.

Another learning media that can be used to enhance mathematical literacy is educational comics, which are categorized as non-digital media. Educational comics that contain mathematical content are often referred to as mathematical comics. Learning with mathematical comics enables students to follow the storyline presented, which in turn facilitates the development of mathematical literacy. Students are not only reading passively but are also actively interpreting and understanding mathematical concepts through engaging illustrations and narratives. Research by Gunadi & Aisah (2019a) and Rakasiwi et al. (2019) shows that mathematical comics are effective in enhancing students' mathematical literacy. These comics help students understand mathematical

concepts by connecting them to real-life contexts that are visualized through images, making the material more meaningful and easier to grasp.

Several studies have employed activity and game based learning media such as Wordwall, Kahoot, and Math City Map. The use of Wordwall integrated with the discovery learning model has been shown to effectively enhance students' mathematical literacy through active, engaging, and enjoyable learning experiences (Shofia & Setiaji, 2025). Similarly, Kahoot used within a Culturally Responsive Teaching based Problem Based Learning model has proven effective in enhancing mathematical literacy by providing interactive learning opportunities and allowing students to experience real-world problem solving (Mardiyah & Kusmaryono, 2025). In addition, the Math City Map application supports mathematical literacy development through outdoor activities that require students to solve real-life contextual problems. Overall, the use of game based learning media helps enhance mathematical literacy by inviting students to learn while playing in a fun and meaningful way, thereby encouraging active participation and deeper understanding.

Mathematics activities can be carried out outdoors by integrating technology such as Math City Map, which has been shown to significantly enhance students' mathematical literacy (Nurjanah & Agustyaningrum, 2025). Learning with Math City Map not only makes mathematics more relevant to students' daily experiences but also increases their interest and engagement with the material. By combining real-world exploration with interactive technological features, Math City Map encourages active student involvement, making the learning process enjoyable and meaningful. In addition, team quiz learning supported by concrete media helps students remain active and motivated in understanding the material, as the learning process involves direct observation and enjoyable hands on experiences (Nurdianti et al., 2021). During the activity, students are guided to understand material presented in the form of contextual problems, allowing them to experience deeper and more meaningful learning. Through Math City Map and team quiz activities using concrete media, students do not learn passively but are actively involved in connecting mathematical concepts with real situations around them. By working with problems relevant to everyday life, students develop the ability to apply mathematical knowledge in real contexts, an essential aspect of mathematical literacy.

## **CONCLUSION AND SUGGESTION**

Based on the results of research on mathematics learning media, it is evident that various types of media, both digital and non-digital, are effective in enhancing students' mathematical literacy. Digital media such as Virtual Mathematics Kits, GeoGebra, Wingeom, Scratch, learning websites, and game based platforms like Wordwall and Kahoot play an important role in helping students understand concepts through visualization and interactivity, making abstract mathematical material more concrete and engaging. Non application digital media such as e-modules and e-LKPD also make a positive contribution by providing structured, accessible learning resources that encourage active student participation. Meanwhile, non-digital media such as

mathematical comics, as well as outdoor activity based media like Math City Map, offer contextual learning experiences that help students connect mathematical concepts with real-life situations. Overall, these various learning media have been proven effective in supporting students' ability to formulate, employ, and interpret mathematical concepts, thereby significantly enhancing their mathematical literacy.

Based on these findings, several suggestions can be proposed for future research. First, further studies are recommended to conduct long-term or longitudinal research to examine the sustainability of students' mathematical literacy development when learning media are implemented over extended periods. Second, future research may explore more deeply the integration of learning media with various instructional approaches, such as Problem-Based Learning, Realistic Mathematics Education, Discovery Learning, and culturally responsive teaching, to identify the most effective combinations for enhancing mathematical literacy. Third, comparative studies examining the effectiveness of different types of learning media across educational levels and mathematical topics are suggested to provide more comprehensive insights. Finally, future research could also investigate the impact of learning media on other related competencies, such as students' problem-solving skills, critical thinking, and learning independence, in relation to mathematical literacy.

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