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From Geogebra to Canva: Systematic Literature Review on The Shift to Interactive Media Trends in Mathematical Literacy (2020 – 2025)

Irfan Purnomo[1], Yusfita Yusuf[2*], Neneng Tita Rosita[3]

[1,2*,3]Faculty of Teacher Training and Education, Universitas Sebelas April
Jalan Angkrek Situ No. 19, Sumedang, West Java, Indonesia
[1]purnomoirfan@gmail.com; [2*]yusfita@unsap.ac.id; [3]nengtita_fkip@unsap.ac.id

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Abstrak

Penelitian ini bertujuan memetakan tren pengembangan media pembelajaran berbasis teknologi untuk meningkatkan literasi matematika serta menelaah karakteristik efektivitasnya pada publikasi tahun 2020–2025. Metode yang digunakan adalah systematic literature review dengan alur PRISMA. Artikel dikumpulkan melalui penelusuran literatur terstruktur, kemudian diseleksi berdasarkan kriteria inklusi dan eksklusi hingga diperoleh 28 artikel yang relevan. Data diekstraksi untuk mengidentifikasi jenis platform yang digunakan, jenjang pendidikan sasaran, serta temuan utama terkait validitas, kepraktisan, dan efektivitas media terhadap literasi matematika. Hasil kajian menunjukkan adanya pergeseran dari perangkat lunak yang kompleks menuju platform no-code dan gamifikasi, seperti Canva dan Wordwall. Implementasi media paling banyak dilaporkan pada jenjang SMP. Secara umum, media interaktif yang ditinjau dinilai valid dan praktis serta menunjukkan dampak peningkatan literasi matematika pada kategori sedang hingga tinggi. Efektivitas paling kuat muncul ketika media dirancang kontekstual dan mendorong keterlibatan kognitif siswa melalui aktivitas penalaran, pemodelan, dan interpretasi representasi. Temuan ini menegaskan bahwa keberhasilan media lebih ditentukan oleh kualitas desain pembelajaran daripada kecanggihan aplikasinya, serta merekomendasikan strategi integratif dengan memadukan no-code, gamifikasi, dan perangkat math-specific secara terarah sesuai tujuan belajar.

***Kata Kunci**: Literasi matematis; Media pembelajaran interaktif; Systematic Literature Review.*

Abstract

This study aims to map trends in the development of technology-based learning media to improve mathematical literacy and examine their effectiveness characteristics in publications from 2020–2025. The method used was a systematic literature review with the PRISMA flow. Articles were collected through a structured literature search, then selected based on inclusion and exclusion criteria to obtain 28 relevant articles. Data were extracted to identify the type of platform used, the target educational level, and key findings related to the validity, practicality, and effectiveness of the media on mathematical literacy. The results of the study indicate a shift from complex software to no-code and gamification platforms, such as Canva and Wordwall. Media implementation was most commonly reported at the junior high school level. In general, the interactive media reviewed were deemed valid and practical and showed a moderate to high impact on improving mathematical literacy. The strongest effectiveness emerged when the media was designed contextually and encouraged students' cognitive engagement through reasoning, modeling, and interpretation of representations. These findings confirm that the success of media is more determined by the quality of the learning design than the sophistication of the application, and recommend an integrative strategy by combining no-code, gamification, and math-specific tools in a targeted manner according to learning objectives.

Keywords: Mathematical literacy; Interactive learning media; Systematic Literature Review.

I. INTRODUCTION

Globally, various international reports show that mathematical literacy remains a serious challenge in many countries in the era of digital disruption. The results of the 2022 Programme for International Student Assessment (PISA) show a decline in the world's average mathematics scores and reinforce the position of mathematical literacy as a key competency of the 21st century, as it is directly related to the ability to deal with real-world problems in the context of technology, economics, and social life (Prabawati, Santika, & Mulyani, 2024; Kappassova et al., 2025; OECD, 2023). Recent studies confirm that mathematical literacy is not only about mastering procedures and concepts, but also about how individuals are able to formulate, apply, and interpret mathematics in various complex contextual situations (Bolstad, 2020; Kolar & Hodnik, 2021; Syutaridho et al., 2025). The development of digital technology presents both new opportunities and challenges. On the one hand, it provides a variety of interactive learning media, but on the other hand, it widens the gap for students and teachers who are not yet ready in terms of infrastructure and pedagogical competence (Abdulrahaman et al., 2020; Gao & Zhang, 2020; Basir, Agustyani, & Maharani, 2024).

In the Indonesian context, students' mathematics literacy performance remains below the OECD average and has been relatively stagnant since the last few PISA cycles (OECD, 2023). A qualitative study of 36 Indonesian mathematics teachers shows that the low PISA 2022 scores are perceived to be related to the pandemic, the curriculum, individual student characteristics, limited resources, and a lack of parental support (Wijaya et al., 2024). Other findings in several regions show that many students experience difficulties when faced with mathematical literacy questions that require reasoning, modeling, and interpretation of real-world contexts, rather than just routine calculations (Ekawati et al., 2020; Harisman et al., 2023). Interviews and observations of teachers indicate that learning activities are still dominated by lectures, routine exercises, and the use of media with minimal interaction, thereby limiting opportunities for students to practice reasoning in authentic contexts (Komarudin et al., 2024; Novita & Herman, 2021).

Mathematical literacy itself is understood in various studies as the ability to use mathematical knowledge to solve real-world problems, think reflectively, and make responsible decisions in social life (Kappassova et al., 2025; Muhaimin et al., 2024). This perspective is in line with the PISA framework, which emphasizes the processes of formulating, employing, and interpreting as the core of mathematical literacy (Bolstad, 2023). The formulate process involves transforming real-world problems into mathematical structures, employ requires the application of concepts and procedures to solve problems, while interpret requires reflection to evaluate the reasonableness of results in the original context (Stacey, 2012). From a social and cultural perspective, low mathematical literacy has the potential to widen the gap in participation in data- and technology-based decision-making, including on issues

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related to family economics, health, and the environment. In the field of education, weak mathematical literacy skills are often associated with a learning culture that is oriented towards single answers, assessments that emphasize speed of calculation, and a lack of space for exploration of meaningful learning experiences (Canbazoğlu & Tarım, 2020; Karadağ Yılmaz et al., 2024).

Various studies show that conventional pedagogical interventions that only modify teaching materials without changing the way students interact with mathematical knowledge tend to produce limited improvements in mathematical literacy (Ekawati et al., 2020; Harisman et al., 2023). In elementary and secondary schools, teachers report difficulties in designing learning experiences that connect the material to real-life situations, especially when learning resources are still limited to textbooks and paper-and-pencil exercises (Susanta et al., 2023). Studies on the development of learning tools in Indonesia show that there have been efforts to enrich the context of questions and scenarios based on everyday life, but without the support of interactive media, many students remain passive and dependent on teachers' explanations (Hidayat et al., 2021). This condition indicates that the transformation of mathematics literacy learning is not only sufficient at the material level, but also in the design of learning interactions. Therefore, interactive learning media is important because it can support all three processes in mathematical literacy: dynamic visualization helps students recognize opportunities to use mathematics, immediate feedback improves mathematical reasoning with an effect size of 2.53 (Juhaevah, 2024), and interactive simulations facilitate the interpretation of solutions in real contexts (OECD, 2023). Without the support of interactive media, students tend to be stuck at the computational level and struggle to develop true mathematical literacy.

Along with the massive use of digital technology in education, interactive learning media such as interactive multimedia, digital educational games, electronic modules, and web-based and mobile applications have begun to be developed to bridge the gap between the demands of mathematics literacy and classroom learning practices (Abdulrahaman et al., 2020; Septiani et al., 2020; Qolbi & Afriansyah, 2024). A systematic review of mobile and game-based learning in STEM education shows that interactivity, immediate feedback, and dynamic visualization can enhance students' cognitive and affective engagement (Gao & Zhang, 2020; Karakoç et al., 2022). In the context of mathematics, Digital Game-Based Learning (DGBL) has been proven to strengthen students' conceptual understanding, motivation, and confidence, especially when games are designed with clear learning objectives and gradual challenges (Dan et al., 2024; Hussein et al., 2022; Kärki et al., 2022). Theoretically, interactive media is in line with the constructivist paradigm and experience-based learning approach, where mathematical meaning is

constructed through exploration of authentic situations and two-way interaction between students and their digital environment.

A number of empirical studies in educational units in Indonesia and abroad indicate that interactive learning media has the potential to improve mathematics literacy indicators. Comparative studies in elementary schools show that students who learn through STEM/STEAM learning based on digital modules and interactive simulations tend to have higher mathematics literacy scores than students who learn through a pencil-and-paper approach (Susanta et al., 2023, 2025). Other studies report that the use of digital technology in mathematics literacy learning can facilitate the modeling of real-world situations and reduce cognitive load in the early stages of understanding (Kurniawan et al., 2024; Novita & Herman, 2021; Yimer, 2020). Various systematic literature reviews on DGBL and online game-based learning in mathematics education have also found that the use of digital games and interactive quiz platforms can improve learning outcomes, motivation, and positive attitudes toward mathematics, especially among Generation Z, who are very familiar with digital technology (Hidayat et al., 2024; Hussein et al., 2022; Yanuarto & Hanum, 2025).

However, a review of the current literature shows that many studies still focus on the effectiveness of one type of media or intervention in relatively limited levels and contexts. Existing systematic reviews and scoping reviews generally examine mathematical literacy in general (influencing factors, student achievement patterns, or prospective teacher readiness), or review game-based learning for mathematics without explicitly linking it to mathematical literacy achievement (Dan et al., 2024; Hidayat et al., 2024; Kappassova et al., 2025; Muhaimin et al., 2024). On the other hand, systematic studies on interactive multimedia for mathematics learning tend to focus more on practical aspects, media feasibility, or the impact on motivation and general learning outcomes, rather than specifically on indicators of mathematical literacy (Daryanes et al., 2023; Pratiwi et al., 2024; Purnama et al., 2024). This gap highlights the need for a comprehensive synthesis that specifically maps the types of interactive learning media used, the target levels, and how these media contribute to improving mathematical literacy.

From a methodological perspective, the majority of studies on interactive learning media for mathematics still use quasi-experimental designs or development research with varying reports in terms of the mathematical literacy indicators measured. Some studies even only use the terms “literacy” or “problem-solving skills” without explicitly referring to the PISA mathematical literacy framework, making it difficult to synthesize the meaning and processes that occur in the classroom (Harisman et al., 2023; Komarudin et al., 2024). In addition, there have not been many studies that explore in depth the experiences of both teachers and students in interpreting media interactivity and its relationship to the process of mathematical literacy, such as how they formulate problems from a digital context, negotiate solution strategies, or reflect on the

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solutions produced. A qualitative synthesis approach through a systematic literature review with an interpretive orientation is relevant to bridge the diversity of empirical findings, as it allows researchers to trace patterns of meaning, experiences, and processes hidden behind learning outcome figures.

Based on this background, this study aims to conduct a systematic literature review of studies that examine interactive learning media to improve mathematical literacy in the 2020–2025 period. This study is expected to provide a theoretical contribution in the form of a conceptual mapping of the relationship between the types of interactive media, the characteristics of education levels, and the results of mathematical literacy after the use of interactive media. In practical terms, the results of this study are expected to be a reference for educators, media developers, and policy makers in designing policies and mathematics learning practices that are more responsive to the demands of mathematical literacy in the digital age.

II. METHOD

This study applies the Systematic Literature Review (SLR) method to identify, evaluate, and draw conclusions based on findings relevant to the research topic. The procedure for conducting this review adopts the methodological framework formulated by (Zawacki-Richter et al., 2020), as follows:

A. Developing Research Questions

Research questions are formulated to address specific needs arising from the study topic. The research questions in this study are as follows:

RQ1. What interactive applications have been most widely developed to improve mathematical literacy from 2020 to 2025? RQ2. What levels of education are most often targeted for the implementation of these interactive learning media? RQ3. How does mathematical literacy improve after using these interactive media?

B. Construct Selection Criteria

This stage involves establishing strict inclusion and exclusion criteria to screen relevant literature. The application of these criteria aims to ensure the validity of the data selection process. Details of the inclusion and exclusion criteria used in this study are presented in the following Table 1.

Tabel 1.
Inclusion and exclusion criteria

Inclusion	Exclusion
An article discussing interactive learning media to improve mathematical literacy skills	Articles that do not discuss the topic of interactive learning media to improve mathematical literacy skills
Articles published in the last five years (2020-2025)	Articles not published in the last 5 years (2020-2025)
Research articles in the form of journals in Indonesian or English	Research articles other than journals in Indonesian or English
Articles accredited by national or international journals	Articles not accredited by national or international journals
Full text	*Unfull text*

C. Develop Search Strategy

The literature search process was conducted systematically through reputable international databases, namely Scopus and Google Scholar. The search strategy applied Boolean operators

(AND/OR) to combine relevant keywords. The series of keywords used were: ("interactive learning media" OR "interactive multimedia" OR "interactive learning media" OR "interactive multimedia") AND ("mathematical literacy" OR "Mathematical Literacy").

The articles that were found were then rigorously selected using inclusion and exclusion criteria (see Table 1) to ensure the quality and relevance of the data. The selected studies were analyzed in depth to examine the role of interactive learning media in improving mathematical literacy. The analysis stages included information extraction, data coding, and systematic interpretation of findings. The complete flow of document search and selection is visualized in the PRISMA diagram in Figure 1.

Based on initial searches, a total of 202 articles were found (160 from Google Scholar and 42 from Scopus). After screening and eliminating articles that did not meet the criteria (studies excluded), a final result of 28 articles was obtained that were deemed eligible for analysis.

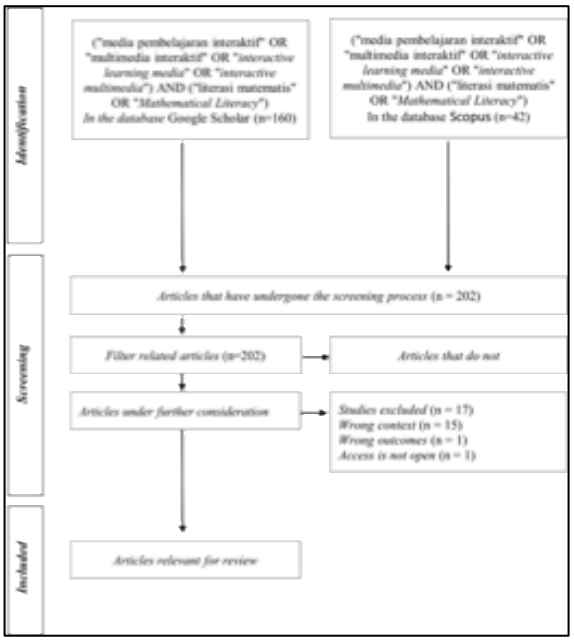

Figure 1. Stages of article search and document selection using the PRISMA method.

D. Select Studies Using Selection Criteria

The selection of studies was conducted by establishing strict inclusion criteria. The selected articles were those published between 2020 and 2025, sourced from Google Scholar and Scopus databases, and specifically discussed the use of interactive learning media to improve students' mathematical literacy.

From the initial search, a total of 202 articles matching the keywords were found. After screening, 157 articles were excluded because they did not meet the inclusion criteria. This process resulted in 45 selected articles, which were then processed to the full-text retrieval and eligibility testing stages.

E. Assess the Quality of Studies

The data found was evaluated using quality assessment criteria to ensure the credibility of the study. The criteria were formulated into three key questions: QA1. What interactive applications are commonly used to improve students'

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mathematical literacy from 2020 to 2025? QA2. Why are these interactive learning media suitable for improving students' mathematical literacy skills? QA3. How did students' mathematical literacy skills improve after using these interactive learning media?

This process involved reading the full text of 45 candidate articles. The researchers conducted a final screening to ensure that the articles answered the three questions above and had a good publication reputation. Of the 45 initial studies, 17 articles had to be excluded due to inappropriate context (n=15), irrelevant findings (n=1), or inaccessible manuscripts (n=1). This final selection process left a total of 28 main articles ready for analysis.

F. Synthesis Result of Research

At this stage, findings from the collected data are analyzed and synthesized systematically to answer the problem formulation or Research Questions (RQ) that have been established.

G. Report Finding

This stage is the final step in the SLR procedure, where all findings that have been synthesized are documented and compiled into a systematic scientific report to describe the research results in their entirety.

Table 2.
Research Results

Author & Year	Article Title	Application Interactive	Subject Research	Key Findings
Rofiq & Rachmawati (2022)	"Penerapan *Math-In: Mathematics Adventure Game* Terintergrasi *Augmented Reality* Sebagai Inovasi Media Literasi Matematika Berbasis *Gamification"*	*Augmented Reality* (AR)	Elementary School	The study concluded that MATH-IN has significant potential to improve student motivation and mathematical literacy through exploratory learning experiences based on Augmented Reality (AR).
Supianti et al. (2022)	*"Development of Teaching Materials for E-Learning-Based Statistics Materials Oriented Towards the Mathematical Literacy Ability of Vocational High School Students"*	Edmodo	Vocational High School	The results show that this media is highly valid and effective in significantly improving students' mathematical literacy, with an N-Gain score of 0.6 (moderate category).
Chen (2022)	*"Measurement, Evaluation, and Model Construction of Mathematical Literacy Based on IoT and* PISA"	Web IDE	High School	This IoT-based measurement model has been proven to have high output quality and minimal error in quantitatively evaluating mathematical literacy, as well as ensuring the security of assessment data.
Akbar et al. (2023)	*"The Development of Animation-Based Learning Media on Students' Mathematical Literacy Ability"*	*Microsoft PowerPoint*	High School	This animation-based media proved to be highly valid, practical, and effective, marked by positive responses and a mathematics literacy

Author & Year	Article Title	Application Interactive	Subject Research	Key Findings
				test completion rate of 66.67%.
Firdaus et al. (2023)	*"Development of Animated Video-based Mathematics Learning on The Three-dimensional Material of Class* XII SMA *to Improve Mathematical Literacy"*	Adobe *After Effects*	Senior High School	This animated video media has been proven to be highly valid, practical, and effective in significantly improving students' mathematical literacy, as confirmed by statistical tests ($p < 0.05$).
Susanta et al. (2023)	*"Mathematical Literacy Skills for Elementary School Students: A Comparative Study Between Interactive* STEM *Learning and Paper-and-Pencil* STEM *Learning"*	E-*Worksheets*	Junior High School	The meta-analysis study concluded that the RME approach had a very significant effect on the mathematical literacy of junior high school students (effect size 1.385), especially in grade VIII.
Nuri, Zikriana, & Iqbal (2023)	*"Effectiveness of Desmos Application Integrated with PjBL in Multimedia Mathematics Learning in Terms of Mathematical Literacy Skills"*	Desmos	Senior High School	The results confirm the effectiveness of this model with a classical completeness of 93% and a significant difference in average mathematical literacy compared to the control class (Sig. 0.002).
Juliani & Pratini (2023)	"Pengembangan Lembar Kerja Peserta Didik (LKPD) Berbasis Asesmen Kompetensi Minimum Untuk Meningkatkan Kemampuan Literasi Matematis Dan Pemahaman Konsep Peserta Didik SMP"	LKPD	Junior High School	Expert validation concluded that the product is classified as 'Suitable' with an average score of 78.28%, which includes assessments of format, content, language, and benefits.
Ulum et al. (2024)	"Pengembangan Media Pembelajaran Matematika RIMath Materi Himpunan Terintegrasi Al-Quran Untuk Memfasilitasi Literasi Matematis Siswa"	*Smart Apps Creator*	Junior High School	The RIMath application has been proven to be feasible (78.28%) and effective in significantly improving mathematical literacy, as indicated by the average student learning achievement of 70.83%.
Wahyuni & Rusnilawati (2024)	"Pendekatan STEAM dengan Model *Inquiry Learning* Berbantuan *Liveworksheet* untuk Meningkatkan Literasi Matematis Siswa SD Kelas V"	*Liveworksheet*	Elementary School	The application of the Liveworksheet-assisted STEAM approach proved to be effective in significantly improving mathematical literacy, with scores jumping from 49.54% (pre-cycle) to 86.45% (Cycle II).
Cahyono et al. (2025)	*"An exploratory study on STEM education through math trails with digital*	Platform berbasis web & GPS	Junior High School	The STEM Trails program has been proven effective in significantly improving

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Author & Year	Article Title	Application Interactive	Subject Research	Key Findings
	technology to promote mathematical literacy"			mathematical literacy ($p<0.001$), as demonstrated by the experimental group's average score of 88.4 and a very high effect size (1.84).
Miftah, Kurniawati, & Musa (2024)	*"Development of Prospective Teacher Student Worksheets Through Interactive Case-Based Learning Model Assisted by Cublend App to Improve Mathematical Literacy Skills"*	Cublend	University	The ICBL-based LKPD assisted by Cublend proved to be feasible, practical, and effective in significantly improving mathematical literacy (Sig. 0.000), with an effect size of 0.696.
Hamidah et al. (2025)	*"Developing a Mathematical Literacy Learning Environment for Students through Educational Game Assistance"*	*Role-Playing Game* (RPG)	Junior High School	The RPG-based learning environment has been proven to be valid, practical, and effective, marked by the 100% success rate of students in applying mathematical literacy to solve algebraic problems.
Nasution & Hidayati (2025)	"Rancang Bangun Game Edukasi Matheduquest Berbasis Unity 6 Sebagai Inovasi Teknologi Adaptif Untuk Meningkatkan Literasi Matematika Siswa SMP"	Unity 6	Junior High School	MathEduQuest has been proven to be highly valid (score of 3.58) and effective as adaptive technology that significantly improves students' mathematical literacy, motivation, and engagement.
Dewi & Rusmining (2025)	*"Development of Mathematics Learning Media Based on Google Sites Contains Mathematical Literacy for Eighth Grade Junior High School Students"*	Google *Sites*	Junior High School	This Google Sites-based media has been proven to be valid and practical, with very positive student responses (score of 101.15), as well as effective in facilitating conceptual understanding and mathematical literacy.
Majid et al. (2025)	*"Development of SAC3-Assisted Digital Learning Media to Enhance Students' Mathematical Literacy in Matrix Topics"*	Smart Apps Creator 3	Senior High School	MatriXplore has been proven to be highly valid, practical, with positive responses from teachers (94%), and effective in improving students' mathematical literacy with an N-gain of 0.38 (moderate category).
Shofia & Setiaji (2025)	"Efektivitas Model *Discovery Learning* dengan Media Wordwall untuk Meningkatkan Kemampuan Literasi dan Kemandirian Belajar Siswa"	Wordwall	Junior High School	The integration of discovery learning and Wordwall proved effective in significantly improving independence (sig. 0.001) and mathematical literacy with an N-Gain of 76.5% (effective category).

Author & Year	Article Title	Application Interactive	Subject Research	Key Findings
Pramesti & Wahyudi (2025)	*"Development of Culture-Based Interactive Comic Media to Improve Mathematical Literacy in Primary Schools"*	Canva	Elementary School	Interactive comic media based on local culture has proven to be highly valid, practical, and effective in significantly improving mathematical literacy, as evidenced by an increase in average scores from 31.10 to 65.50.
Afrilia et al. (2025)	"Studi Komparatif Penggunaan Kahoot Dan Wordwall Dengan Model TGT Terhadap Literasi Matematis Siswa SMP"	Kahoot! dan Wordwall	Junior High School	The integration of TGT with Wordwall proved to be significantly more effective (sig. 0.042) in improving mathematical literacy than Kahoot, with an average score of 84.96.
Setyaningsih & Sugiman (2025)	*"The Effectiveness of the Problem Based Learning Model Assisted by* GeoGebra *Classroom to Improve the Mathematical Literacy Ability of Deaf Students"*	GeoGebra *Classroom*	Special Needs School	PBL assisted by GeoGebra proved to be effective in significantly improving the mathematical literacy of deaf students (0% overlap), with score increases of 11-26 points and very positive student responses.
Wathoni (2025)	*"Utilizing the Youtube Platform to Familiarize Students with Mathematics Literacy in Elementary School"*	YouTube	Elementary School	YouTube has proven to be effective in developing affective, cognitive, and psychomotor mathematical literacy skills as a source of independent learning, with the caveat that its success depends on students' ability to select educational content.
Sulthoni & Hakim (2025)	*"The Effect of Linktree-Based Learning Media on Mathematical Literacy Skills in Junior High School"*	Linktree	Junior High School	Linktree-based media has been proven to have a positive and significant effect on mathematical literacy ($p< 0.05$), with an influence contribution of 44.5%.
Telussa et al. (2025)	*"Educational Innovation Through Audiovisual Media: Enhancing Student Motivation And Mathematical Literacy"*	Audiovisual	Junior High School	Audiovisual media has been proven to have a significant positive effect on learning motivation, whereas mathematical literacy does not, with the simultaneous contribution of both variables reaching 92.3%.
Nurmala et al. (2025)	*"The Effectiveness of PBL Assisted by H5P Interactive Video in Improving Mathematics Literacy of Junior High School Students"*	HTML5	Junior High School	The integration of H5P interactive videos in PBL proved to be effective in significantly improving mathematical literacy ($p<0.05$) with an N-gain of 0.71, surpassing the control class which only achieved 0.38.

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Author & Year	Article Title	Application Interactive	Subject Research	Key Findings
Agusdianita (2025)	"Pendampingan Penerapan Literasi Matematika dengan Konteks Budaya Tabut pada Pembelajaran Konsep Geometri dan Pengukuran"	Modul	Elementary School	The Tabut culture-based ethnomathematics approach has proven effective in significantly improving student learning outcomes (average score increased to 92.25) and optimizing teacher skills.
Putri, Syaf, & Widiastuti (2025)	*"Developing STEAM-Based Interactive E-Modules with Religious Integration to Enhance Students' Mathematical Literacy"*	Canva, iSpring Suite, & Website 2 APK Builder	MA	This religious STEAM e-module has been proven to be highly valid, practical, and effective in improving mathematical literacy with a high effect size (1.2) in large-scale testing.
Putri, Rafianti, & Setiani (2025)	"Efektivitas Model Team Games Tournament Berbantuan Permainan Tic Tac Toe Terhadap Kemampuan Literasi Matematis Siswa SMP"	Educandy	Junior High School	Modification of TGT with the digital game Tic Tac Toe proved to be effective in significantly improving mathematical literacy ($p<0.05$) with a learning completeness rate of 94.11%.
Leton et al. (2025)	*"Integrating local wisdoms for improving students' mathematical literacy: The promising context in learning whole numbers"*	Modul	Junior High School	This teaching material has been proven to be highly valid, practical, and effective in significantly improving learning outcomes with an N-Gain of 0.76 (high) and student mastery reaching 100%.

III. RESULT AND DISCUSSION

The initial literature search on Google Scholar and Scopus indices yielded 202 articles. Through a rigorous selection process that included the application of inclusion-exclusion criteria and quality evaluation, the number was narrowed down to 28 final articles that were valid for this study. The main characteristics and data extraction from the 28 articles are summarized in Table 2.

RQ1. What interactive applications are most commonly developed to improve mathematical literacy from 2020 to 2025?

An analysis of 28 selected scientific articles from the period 2022–2025 shows that the ecosystem for developing learning media for mathematical literacy is very diverse, in terms of platforms, types of devices, and pedagogical design. However, in aggregate, the landscape is dominated by general-purpose multimedia tools and gamification platforms rather than specialized mathematics software. As seen in Figure 2, researchers and developers' preferences significantly skew toward design-based/no-code media (67.86%) and gamification (25.00%), while math-specific tools only occupy a minority share (7.14%). Apps like Smart Apps Creator (SAC), Canva,

and Wordwall are key exemplars of this trend, each contributing the highest frequency of use in this study.

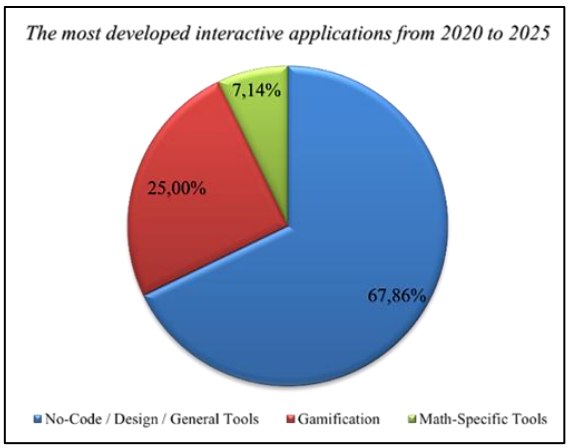

Figure 2. The most developed interactive applications from 2020 to 2025.

The popularity of these three applications illustrates a shift in trends from the use of complex programming-based software to no-code development platforms (NCDP) and authoring tools that are oriented towards visual interfaces. The dominance of SAC usage indicates that educators and researchers prioritize design efficiency, flexibility in integrating text, images, audio, and video, as well as ease of distribution to Android devices without requiring high coding skills (Kurniasih et al., 2025; Rukoyah & Bektiningsih, 2024). In line with this, Canva is widely chosen because it provides an intuitive drag-and-drop interface and a wealth of templates, making it easy to transform abstract mathematical concepts into infographics, slides, or visual worksheets that are more accessible to elementary school students (Asmi & Wijayanto, 2025; Janah et al., 2023; SIHOMBING et al., 2024). These findings are consistent with interactive multimedia studies that confirm that SAC- and Canva-based media effectively support science and mathematics literacy when designed with explicit learning objectives and a step-by-step task flow (Komang Sri Purniasih & I Gusti Ayu Tri Agustiana, 2024).

Beyond the visual aspect, he contribution of the gamification category, which reached 25%, is represented by the distribution of the use of Wordwall and various other educational game applications (for example, RPG-based games or game engines), confirming the strong current of gamification in mathematical literacy interventions. A series of experimental studies show that Wordwall educational games can increase students' motivation to learn and improve their mathematics learning outcomes at various levels (Walidah et al., 2022). Furthermore, the development of Wordwall-based interactive media is explicitly aimed at reducing math anxiety and creating a more enjoyable learning environment, with findings showing a decrease in math anxiety levels from high to moderate after learning interventions and improvements in students' math learning outcomes at various levels (Agrullina et al., 2023). Other studies confirm that integrating game elements such as points, leaderboards, and time challenges into mathematics assessment can strengthen students' intrinsic motivation and emotional engagement (Qomaria et al., 2024).

Interestingly, dynamic mathematics software such as GeoGebra and Desmos appeared relatively infrequently in this corpus (total 7,14 %), even though various studies show that both are very powerful in supporting graph visualization, modeling, and conceptual understanding. GeoGebra,

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for example, has been shown to be effective in improving mathematical literacy and self-directed learning when integrated into Realistic Mathematics Education-based learning and problem-based learning (Al-Fitriani et al., 2023; Purbaningrum & Mahmudi, 2024). Similarly, the use of Desmos has been reported to strengthen students' understanding of quadratic functions and engagement through interactive classroom activities and dynamic visualizations (Lubis et al., 2024). The limited emergence of Dynamic Mathematics Software (DMS) in studies on the development of mathematics literacy media shows that, in the last five years, the dimensions of accessibility (user-friendliness), flexibility of use across topics, and the potential for affective engagement through gamification have often been the main considerations for technology adoption by researchers and education practitioners, surpassing considerations of mathematical computational sophistication alone.

RQ2. What level of education is most often targeted for the implementation of interactive learning media?

The results of mapping 28 articles analyzed show that the educational level most targeted for the implementation of interactive learning media is junior high school (SMP), accounting for 50% of all studies. This percentage is followed by senior high school/equivalent (25%) and elementary school (SD) (17.86%), as shown in Figure 3. This distribution pattern indicates that junior high school is implicitly positioned by researchers as a "critical period" in the formation and strengthening of mathematical literacy in Indonesia.

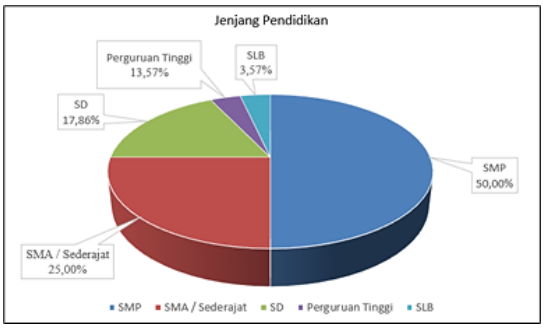

Figure 3. Educational levels that implement MPI.

The dominance of research focus on the junior high school level makes perfect sense when viewed from the perspective of Piaget's cognitive developmental psychology. Junior high school students, who are between the ages of 12 and 15, are in a transitional phase from the concrete operational stage to the formal operational stage, which is the phase when they begin to encounter abstract mathematical concepts such as algebra and functions, which are often a source of cognitive barriers. It is in this context that interactive learning media acts as scaffolding or a cognitive bridge that helps visualize these abstract objects in a more concrete way and allows them to be manipulated mentally. These findings are in line with research results showing that technology-based interventions at the junior high school level have been proven effective in improving mathematical literacy, particularly in bridging the gap between basic arithmetic and algebraic thinking (Nuri et al., 2023; Susanta et al., 2023).

At the high school/vocational school level, which accounts for 25% of the study sample, the use of interactive media is generally directed at strengthening Higher

Order Thinking Skills (HOTS) and the vocational readiness of students. Various studies indicate that technologies such as Learning Management Systems (LMS) and the Internet of Things (IoT) at this level are more widely used to support complex evaluations and real-world problem solving, in line with the requirements of the PISA framework (Supianti et al., 2022). Meanwhile, implementation at the elementary school level (17.86%) emphasizes a gamification approach through educational games such as Math Adventure to instill basic mathematical concepts in a fun and intuitive way (Rofiq & Rachmawati, 2022).

Although the proportion of research at the higher education and special education (SLB) levels is still relatively small (3.57% each), this general pattern reinforces the indication that researchers position junior high school as the most strategic "entry point" for national mathematics literacy improvement interventions. Strengthening mathematical literacy during this transitional phase is expected to have a long-term effect on students' cognitive readiness when dealing with more complex material at the high school/vocational school and university levels (Susanta et al., 2023).

RQ3. How did mathematical literacy skills improve after using these interactive media?

Data shows that teachers and researchers more often choose no-code tools like Canva and Smart Apps Creator (67.86%) than math-specific tools like GeoGebra (7.14%). This preference can be understood through three main considerations. First, teachers are required to produce content that is not only mathematically accurate but also visually and aesthetically appealing to spark students' interest in learning. Second, Canva and SAC are relatively easy to operate because they do not require programming skills, while GeoGebra requires a more intensive adaptation process and generally requires longer learning and training time. Third, from a practical standpoint, teachers tend to choose tools that can be used immediately without having to go through a lengthy learning process (Kurniasih et al., 2025; Asmi & Wijayanto, 2025).

However, an important question arises: will the use of static or semi-interactive Canva reduce the quality of mathematical exploration compared to the dynamic GeoGebra? Research findings suggest the answer is not that simple. Even though the learning ecosystem used is predominantly no-code and gamification, mathematical literacy outcomes remain positive and strong: the implementation of Math Trails and the STEAM e-module produced effect sizes of 1.84 and 1.2, respectively; learning with H5P (no-code) showed results equivalent to GeoGebra; and the Canva-assisted ethnomathematics approach increased literacy from 49.54% to 86.45% (Cahyono et al., 2025; Putri et al., 2025; Leton et al., 2025; Agusdianita et al., 2025).

These successes suggest that the determining factor is not solely the sophistication of the software, but rather the quality of the accompanying learning strategies. Three factors stand out: the relevance of the learning design to students' lives (ethnomathematics), the use of gamification to increase motivation

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(Wordwall reduces math anxiety; AR and games increase literacy), and Canva's ability to help visualize abstract concepts into more easily understood representations (Walidah et al., 2022; Nasution & Hidayati, 2025; Janah et al., 2023). However, it should be noted that while audiovisual media can increase motivation, high motivation does not automatically improve mathematical literacy; students still need in-depth conceptual practice (Telussa et al., 2025). Therefore, while Canva has been shown to be effective in improving mathematical literacy outcomes, its use alone has the potential to limit the scope for deeper mathematical exploration, which is generally more optimally facilitated by GeoGebra. Therefore, a more balanced strategy is to integrate the three: Canva and SAC are used to present problems in an interesting and easy to understand way, gamification such as Wordwall is used to strengthen learning motivation, while GeoGebra is applied purposefully when students need to investigate patterns or manipulate variables dynamically.

Overall, the data trends in Table 2 confirm that mathematical literacy grows most optimally when digital content is presented in a relevant context (contextual learning). The dramatic jump in scores from 49.54% to 86.45% and the success of the culture-based ethnomathematics approach reinforce the conclusion that adaptive, culture-based interactive media are a valid, practical, and highly effective instrument for improving mathematical literacy (Agusdianita et al., 2025; Wahyuni & Rusnilawati, 2024).

IV. CONCLUSION

Based on a review of 28 scientific articles published between 2020 and 2025, this study concludes that the development of mathematical literacy media is shifting away from relatively complex software and toward no-code and gamification-based platforms, such as Canva and Wordwall, due to their ease of use and greater efficiency in the development process. The findings also indicate that media implementation is most common at the junior high school level. This reinforces the role of technology as a scaffold to help students visualize and understand abstract mathematical concepts during the transition from concrete to formal thinking. In general, the interactive media studied were deemed valid and practical, and consistently had a moderate to high impact on improving mathematical literacy. This impact is particularly evident when the media is designed contextually and intentionally encourages students' cognitive engagement, for example through reasoning activities, modeling, and interpreting representations, rather than simply adding visual appeal.

This research's contribution lies in mapping the direction of mathematical literacy media trends for 2020–2025, strengthening arguments regarding the function of digital media as a learning support at the junior high school level, and affirming that media effectiveness is determined more by the quality of learning design than the sophistication of its application. However, this research has limitations because it only includes 28 articles spanning a specific year, uses

diverse methods and instruments so that results between studies cannot always be directly compared, and is still dominated by short-term impact measurements. The implication is that teachers and schools can utilize no-code platforms and gamification to increase the efficiency of media development while strengthening learning engagement. However, this still needs to be accompanied by activities that require in-depth mathematical concepts and reasoning. Thus, the recommended strategy is an integrative approach. Canva or SAC are used to present material and problems clearly and engagingly, gamification such as Wordwall is utilized to strengthen motivation and learning persistence, while GeoGebra is applied in a targeted manner when learning requires dynamic exploration, such as investigating patterns and manipulating variables. Moving forward, the research agenda should focus on longitudinal studies to assess the sustainability of impacts, comparative studies to examine the relative contribution of each platform type to different literacy components, expanded contexts to elementary and high school levels by considering access gaps, and implementation studies that highlight teacher readiness and institutional support for more consistent and sustainable media adoption.

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AUTHOR'S BIOGRAPHY

Irfan Purnomo, S.Pd.

Born in Bekasi, October 7, 1990. Teaching staff at SMP Negeri 3 Jatinunggal, Sumedang Regency. Bachelor's degree in Mathematics Education from Sebelas April University, Sumedang, graduated in 2013; Currently pursuing a Master's degree in Mathematics Education at Sebelas April University.

Dr. Yusfita Yusuf, M.Pd.

Born in Sumedang, March 17, 1987. Lecturer at the Mathematics Education Study Program, Faculty of Teacher Training and Education, Sebelas April University. Bachelor's degree in Mathematics Education from Sebelas April University, Sumedang, graduated in 2011; Master's degree in Mathematics Education from Indonesia University of Education, Bandung, graduated in 2014; and Doctorate in Mathematics Education from Semarang State University, Semarang, graduated in 2020.

Dr. Neneng Tita Rosita, M.Pd.

Born in Bandung on July 2, 1977. Bachelor's degree in Mathematics Education from Pasundan University, graduated in 1999. Master's degree in Mathematics Education from Indonesia University of Education, graduated in 2012, and Doctorate in Mathematics Education from Semarang State University, graduated in 2021. Has been a lecturer since 2012, teaching in the Bachelor's Degree Program in Mathematics Education at the Faculty of Teacher Training and Education, Sebelas Maret University. Currently also teaches in the Master's Degree Program in Mathematics Education at the same university.