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Students' Mathematical Literacy in GeoGebra-Assisted Mathematics Learning: A Systematic Literature Review

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Abstract: *Educational developments in the 21st century emphasize the importance of mathematics learning that can improve students' mathematical literacy. This study aims to systematically examine research trends related to students' mathematical literacy in GeoGebra-assisted mathematics learning. The method used is a Systematic Literature Review (SLR) of 12 articles published in the 2020–2025 period and obtained through the Google Scholar and Crossref database with the help of the Publish or Perish application using the keywords mathematical literacy and GeoGebra. The results of the study show that the use of GeoGebra in the last five years has been increasingly researched, with a focus on strengthening mathematical literacy through various innovative learning models, including Problem-Based Learning, Project-Based Learning, Discovery Learning, Realistic Mathematics Education, Think-Talk-Write, and the Missouri Mathematics Project. In conclusion, GeoGebra-assisted mathematics learning can improve students' mathematical literacy sustainably and in accordance with the context of 21st-century learning.*

Keywords*: geogebra, mathematical literacy, systematic literature review*

INTRODUCTION

Mathematical literacy is one of the important competencies in 21st-century mathematics learning. Mathematics learning activities aim to foster various thinking skills in students, such as creativity, critical thinking, effectiveness, systematic thinking, logic, accuracy, and efficiency in solving mathematical problems (Aprilyani & Hakim, 2020). These thinking skills form an important foundation for developing students' mathematical literacy, which refers to the ability to understand, apply, and analyze mathematical information in various situations. However, students' mathematical literacy skills are still relatively low in solving contextual mathematical problems.

In the 21st century, mathematics learning objectives require students to possess the 4Cs: critical thinking, collaboration, communication, and creativity. This is in line with the NCTM (2017), as cited in Meika et al. (2021), which identifies five mathematical competency standards to achieve these objectives: problem-solving, reasoning and proof, communication, connection, and representation. The low performance of students is evident in Indonesia's ranking on the PISA (Programme for International Student Assessment) tests. PISA is an internationally standardized assessment targeting 15-year-old school students in an education program developed by participating countries (Habibi & Prahmana, 2022). Indonesia ranks among the 10 lowest countries in terms of mathematical literacy. In 2018, Indonesia scored 379, ranking 72nd out of 78 countries. This achievement is certainly still below the average PISA assessment score of 500 (Kurniawan & Khotimah, 2022). In addition, the TIMSS (Trends in Mathematics and Science Study) 2015 study, Indonesian educators' mathematics achievement ranked 46th out of 51 countries with a score of 397, which is considered low considering the international average score is 500 (Amalia et al., 2024).

Mathematical literacy is the ability of students to understand, apply, and analyze mathematical information in various situations. There are seven indicators of mathematical literacy in the 2018 PISA (OECD, 2019): 1) communication; 2) mathematizing; 3) using symbolic, formal, and technical language and operations; 4) reasoning and argument; 5) representation; 6) using mathematical tools; and 7) devising strategies for solving problems. In this study, the indicators of mathematical literacy refer to the PISA 2018 framework developed by OECD (2019). These indicators require students to actively explore mathematical concepts through visualization, representation, and interactive problem-solving activities. Therefore, innovative and technology-based learning media are needed to support the development of students' mathematical literacy skills.

One of the digital learning media that can support mathematical literacy is GeoGebra. GeoGebra is a dynamic mathematics software that enables students to visualize mathematical concepts, explore multiple representations, and interactively solve mathematical problems. The use of GeoGebra in mathematics learning can support students in understanding concepts more meaningfully through visual and interactive exploration (Novitasari et al., 2021). In addition, GeoGebra can facilitate students in developing reasoning, representation, and problem-solving skills, which are important aspects of mathematical literacy. Using GeoGebra in learning can maximize students' mathematical literacy by encouraging them to develop their own thinking to solve problems (Kusumawati et al., 2024).

Several studies have discussed the use of GeoGebra in mathematics learning to improve students' mathematical literacy through various learning models and educational levels. However, these studies are still scattered and have not been systematically reviewed, especially regarding research trends, learning models, educational levels, and findings related to mathematical literacy in GeoGebra-assisted mathematics learning during the 2020–2025 period. Therefore, this study is important to provide a comprehensive overview of the development of research in this field.

Based on the background of the problem above, the objectives of this study are (1) to describe research trends in 2020-2025 regarding students' mathematical literacy in GeoGebra-assisted mathematics learning and (2) to analyze findings related to students' mathematical literacy in GeoGebra-assisted mathematics learning. This literature review also identifies various learning models integrated with GeoGebra and maps the educational levels that are most frequently investigated in previous studies. Through these findings, this study is expected to provide recommendations for future research related to the development of GeoGebra-assisted mathematics learning in improving students' mathematical literacy.

METHOD

This research used the Systematic Literature Review (SLR) method. A systematic literature review is a method used to identify, evaluate, and interpret all research findings to answer predetermined questions (Rachmawati et al., 2021). The purpose of applying the SLR method in this research is to identify and draw conclusions from various previous research findings discussing mathematical literacy and GeoGebra. The identification and review process was carried out following the SLR stages proposed by Triandini et al. (2019).

The first step is to determine the Research Question (RQ) or research questions formulated based on the needs of the specified research topic. The RQs in this study are: (RQ1) What are the research trends from 2020 to 2025 regarding students' mathematical literacy in GeoGebra-assisted mathematics learning? (RQ2) What is the description of students' mathematical literacy in GeoGebra-assisted mathematics learning? The second step is the Search Process. The Search

Process is the step of finding relevant data sources to use in answering the RQ. Researchers searched for relevant data sources through the Google Scholar and Crossref database using the Publish or Perish application. The keywords used were "mathematical literacy and GeoGebra" for the years 2020–2025.

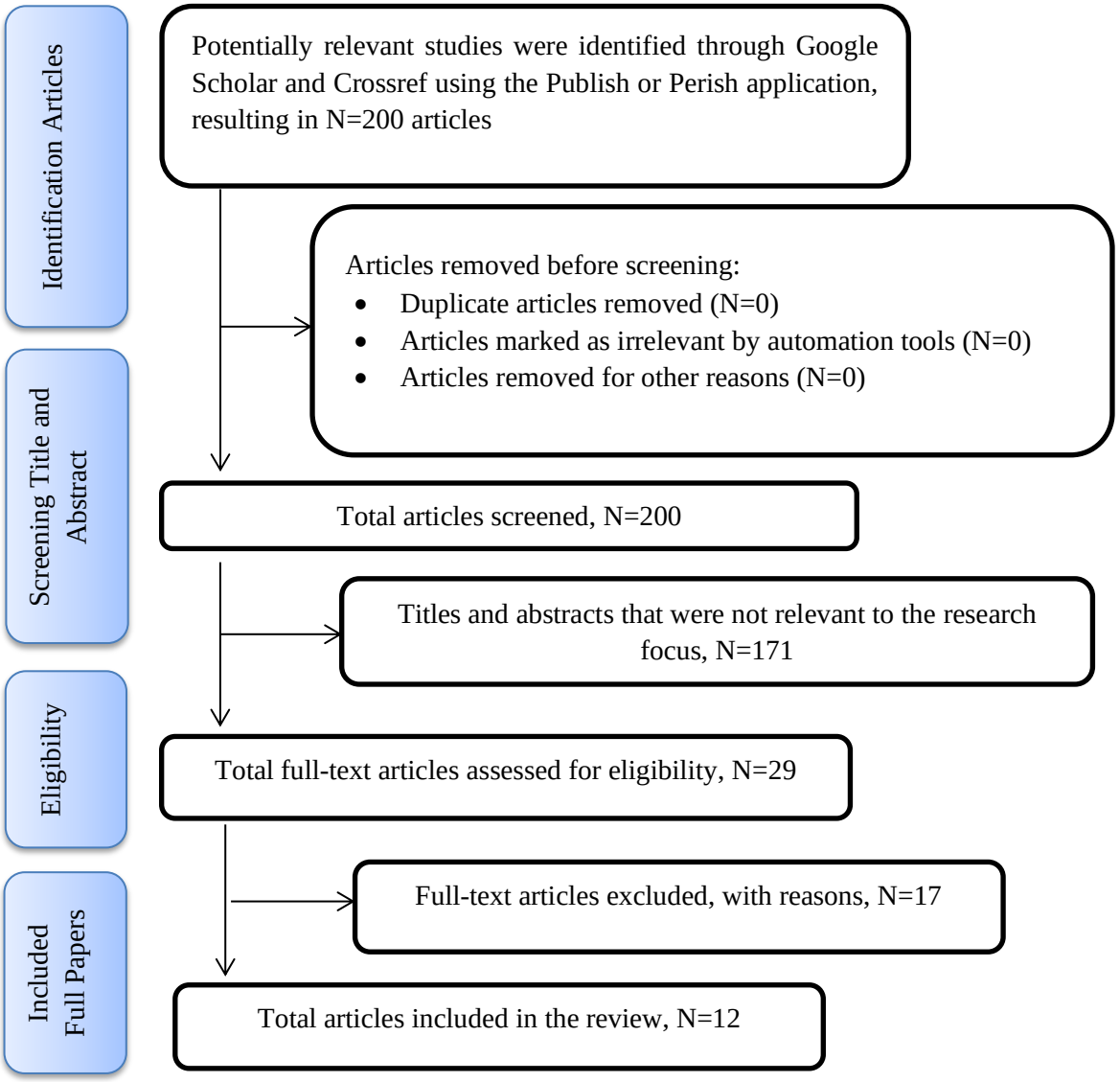


Figure 1. PRISMA Flow Diagram

The third step was Inclusion and Exclusion Criteria. This step was carried out to determine whether the obtained literature was suitable for use in the research. The eligibility criteria for this study are presented in Table 1.

Table 1. Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Literature in the form of journal articles or conference proceedings.	Literature not in the form of journal articles or conference proceedings.
The publication year of the literature is 2020–2025.	The publication year of the literature is before 2020.

International and national literature related to students' mathematical literacy in GeoGebra-assisted mathematics learning.	International and national literature not related to students' mathematical literacy in GeoGebra-assisted mathematics learning.
Literature obtained from Google Scholar and Crossref.	Literature obtained from sources other than Google Scholar and Crossref.
Research participants are students.	Research participants are not students.

The fourth step is Quality Assessment (QA). This step is carried out to evaluate the obtained literature based on QA criteria. In this study, the QA criteria determined include (QA1) Is the literature a journal article or conference proceedings?; (QA2) Was the literature published between 2020–2025?; (QA3) Does the international and national literature discuss students' mathematical literacy in GeoGebra-assisted mathematics learning?; (QA4) Is the literature obtained from Google Scholar and Crossref?; (QA5) Are the research participants students?; (QA6) Are the objectives of the study clearly stated in the article?; (QA7) Does the research method support the investigation of students' mathematical literacy?; (QA8) Does the article clearly describe the characteristics and educational levels of the research participants?. The existence of established QA makes literature that meets all of these criteria worthy of being used as a reference in this study. The fifth step is Data Collection. This step is carried out by researchers to collect literature that will be used in research based on established QA. The sixth step is Data Analysis. After obtaining the literature, the next step is to analyze the data obtained to answer the established RQ. The seventh step is Deviation from Protocol. Correcting word equivalents to be adjusted based on keywords in the database.

RESULTS AND DISCUSSION

The results obtained from a literature search through the Google Scholar and Crossref database using the Publish or Perish application using the keywords "Mathematical Literacy" and "GeoGebra" for the period 2020-2025 yielded 200 literatures obtained based on inclusion and exclusion criteria starting from the title, abstract, and similarity of titles. The final results were 12 literatures derived from journal articles. The obtained data were then classified and presented in Table 2 as follows.

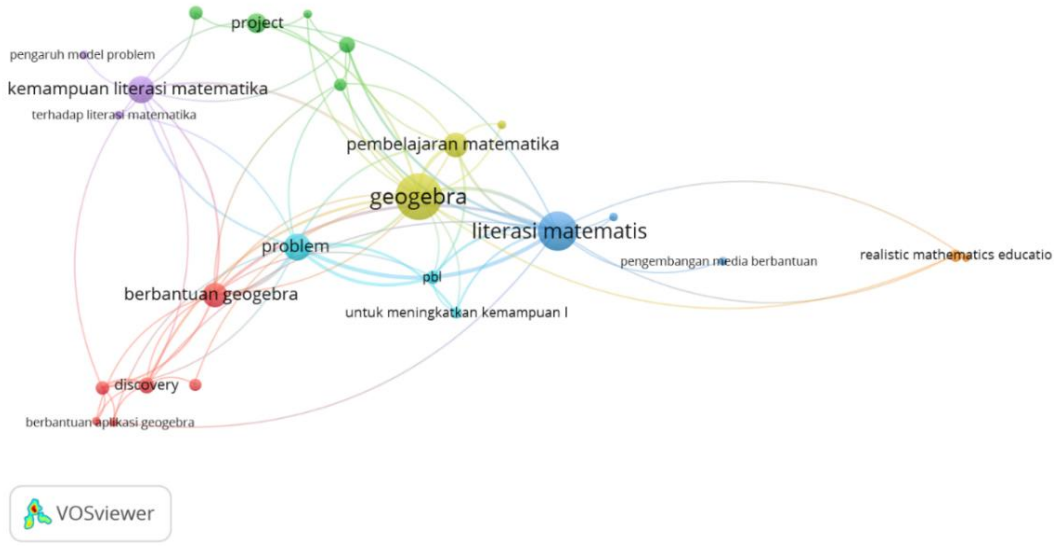
Table 2. Classification of Selected Literature

Author and Year of Publication	Publisher	Learning Model	Participants	Research Results
Al Fitriani, N. A., Darta, D., & Kandaga, T. (2023).	*Symmetry: Pasundan Journal of Research in Mathematics Learning and Education*	Problem-Based Learning (PBL)	High School Students	Based on the research results and discussion, it can be concluded that the increase in mathematical literacy skills of students who received the GeoGebra-assisted PBL model was higher than students who received the regular learning model. In this study, GeoGebra functioned as an interactive visualization tool to support problem-solving activities.
Azizah, F. N., Waluya, S. B., & Masduki, L. R. (2023).	*Journal of Syntax Literate*	Think-Talk-Write (TTW)	Elementary School Students	The GeoGebra-assisted Think-Talk-Write (TTW) learning model showed good quality in supporting students' mathematical literacy skills as viewed from students' self-efficacy. GeoGebra was used to support mathematical

				communication and representation during the learning process.
Fitriani, I. (2023).	*Jurnal Al-Ilmu: Jurnal Penelitian dan Pendidikan Madrasah Ibtidaiyah,*	Project Based Learning (PjBL)	Elementary School Students	Based on the results and discussion, the study identified that the GeoGebra-assisted PjBL learning model can be used as an innovation to support students' mathematical literacy skills. GeoGebra also functioned as a digital learning medium in project-based mathematics learning activities.
Nasution, D. J., Simamora, Y., & Maharani, I. (2023).	*Jurnal Pembelajaran Dan Matematika Sigma (JPMS),*	Missouri Mathematics Project (MMP)	MA Students	Based on the results of data analysis and discussion, it can be concluded that there is a positive influence of the Missouri Mathematics Project learning model on mathematical literacy skills implemented in schools. GeoGebra was utilized to support interactive and contextual mathematics learning.
Rahim, S. W., Ridlo, M. R. Y., & Syaifuddin, M. W. S. (2023).	*WIDYA DIDAKTIKA-Jurnal Ilmiah Kependidikan*	Project Based Learning (PjBL)	High School Students	Based on the research results, it can be concluded that in this study, the application of the GeoGebra-assisted PjBL learning model in mathematics learning was able to improve the literacy skills and activeness of class XG students of SMA N 1 Jatinom in the 2022/2023 academic year. GeoGebra supported students in visualizing and presenting mathematical project results.
Tambunan, T. D. A., & Mukhtar, M. (2023).	*Journal Of Student Research,*	Problem-Based Learning (PBL)	High School Students	The application of the problem based learning model assisted by GeoGebra can improve the mathematical literacy skills of class X MIPA 1 students at SMA Negeri 4 Medan. GeoGebra functioned as a problem-solving and visualization tool during mathematics learning.
Kusumawati, W., Purwosetiyono, F. D., & Handayani, S. H. R. (2024).	*JagoMIPA: Jurnal Pendidikan Matematika dan IPA*	Problem-Based Learning (PBL)	High School Students	Learning with the Problem Based Learning (PBL) model assisted by GeoGebra is effective and has an influence on students' mathematical literacy abilities. GeoGebra was used as an interactive mathematics learning medium to support conceptual understanding.
Liunesi, D. T., Nenohai, J. M., & Halim, F. A. (2024).	*Jurnal Pendidikan Matematika Malikussaleh,*	Discovery Learning (DL)	Middle School Students	Based on the results and discussion, it can be concluded that the application of the GeoGebra-assisted discovery learning model can improve the mathematical literacy skills of class VIII D students of SMP Negeri 3 Kupang on the Two-Variable Linear Equation System (SPLDV) material. GeoGebra helped students explore mathematical concepts and relationships visually.
Agustina, R., & Sukestiyarno, Y. L. (2025).	*Jurnal Ilmiah*	Problem-Based	Middle School Students	Based on the research results, it can be concluded that the Problem-Based Learning (PBL) model with a realistic

	Multidisipl in,	Learning (PBL)		mathematics approach assisted by GeoGebra is effective in improving students' mathematical literacy. GeoGebra supported contextual and interactive mathematics learning activities.
Amri, K., Armanto, D., & Surya, E. (2025).	*Mandalika Mathematics and Educations Journal*	Problem-Based Learning (PBL)	Elementary School Students	Based on the research results, the interactive media based on the PBL model using the GeoGebra application was categorized as valid based on expert validation results to support literacy learning. The study emphasized the development of GeoGebra-assisted interactive learning media.
Setyaningsih, N. A., & Sugiman, S. (2025).	*Hayati: Journal of Education*	Problem-Based Learning (PBL)	High School Students	Based on the research results, it shows that the Problem Based Learning model assisted by GeoGebra Classroom was effective in improving students' mathematical literacy skills. GeoGebra Classroom facilitated interactive learning and students' active participation.
Situmeang, J. C. (2025).	*Jurnal Kajian Teori dan Praktik Pendidikan*	Realistic Mathematics Education (RME)	Middle School Students	Based on the research results, it can be concluded that the implementation of GeoGebra-assisted RME learning was not only positively received by students, but was also able to provide a real influence on improving their numeracy literacy skills. GeoGebra was used to connect contextual situations with mathematical concepts visually.

(RQ1) What are the research trends in 2020–2025 regarding students' mathematical literacy in GeoGebra-assisted mathematics learning?

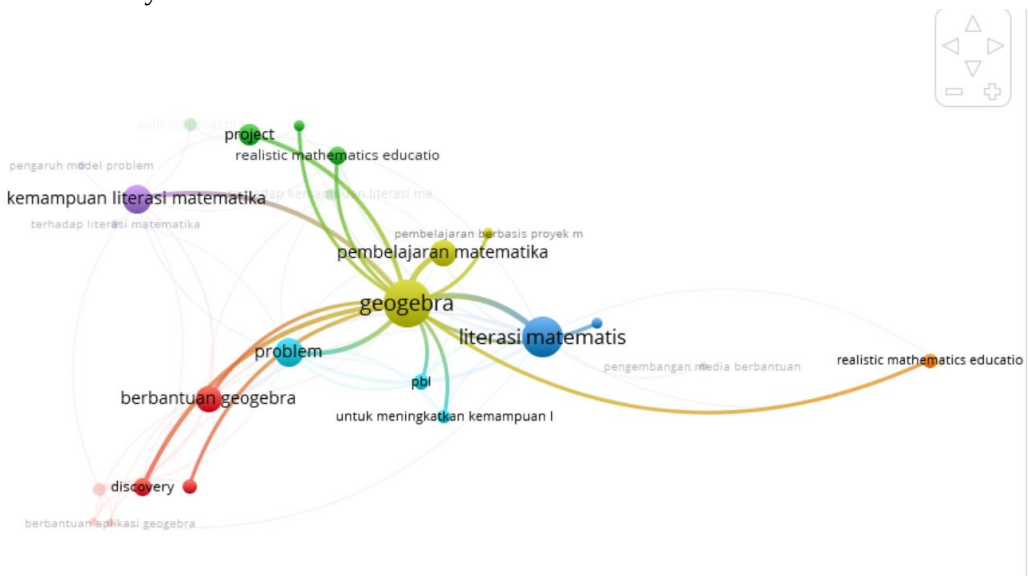


Picture 1. Visualization of the Relationship Between Keywords

The network visualization results in the picture 1 show the relationships between keywords frequently appearing in research related to students' mathematical literacy in GeoGebra-assisted mathematics learning. Figure 1 shows seven different colors. These different colors represent seven clusters. The circles, which vary in size, indicate that the larger the circle, the more discussion of that keyword. The connecting lines between the circles indicate the relationships between keywords. The keywords "GeoGebra" and "Mathematical Literacy" dominate the network, indicating that much research is focused on strengthening students' mathematical literacy in GeoGebra-assisted mathematics learning. The identified clusters include themes related to problem-based learning, project-based learning, realistic mathematics education, discovery learning, mathematics learning, mathematical literacy, and GeoGebra, indicating that previous studies commonly integrated GeoGebra with various student-centered learning approaches to support students' mathematical literacy skills.

Strong relationships with the keywords "mathematical literacy," "problem-based learning," "project-based learning," and "learning model" indicate that many studies focus on improving students' mathematical literacy skills through the implementation of various learning models. The close association with keywords such as "GeoGebra" also indicates that this study emphasizes contextual and interactive mathematics learning.

The strong connection between the keywords "GeoGebra," "mathematical literacy," and "mathematics learning" indicates that the research topic focuses largely on the use of GeoGebra as a medium to improve students' mathematical literacy skills. The close association with keywords such as "problem," "project," and "PBL" (problem-based learning) indicates that problem-based and project-based learning approaches are often used in conjunction with GeoGebra to develop problem-solving skills and a deeper understanding of mathematical concepts. The association with "realistic mathematics education" also indicates a research direction that emphasizes contextual and meaningful learning in developing students' mathematical literacy.



Picture 2. GeoGebra Keyword Relationships

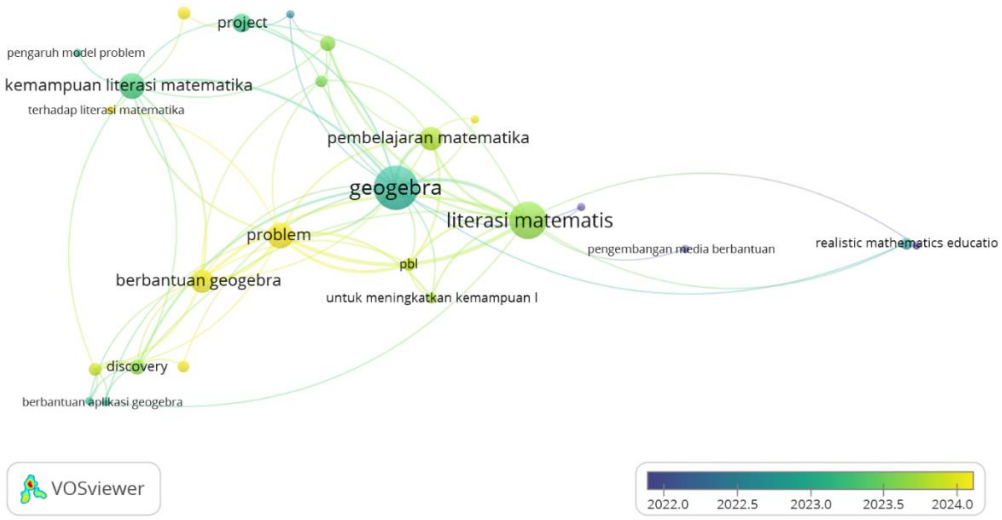
Based on picture 2, the keyword relationship analysis shows that the term "GeoGebra" occupies a central position in the network, with the strongest connections to various other keywords. This node (circle) is closely connected to keywords such as "mathematical literacy,"

"mathematics learning," and "problem," indicating that research on GeoGebra is largely directed at improving students' mathematical literacy skills through the application of various problem-based learning models. This relationship demonstrates that GeoGebra is positioned not only as a visualization tool but also as a medium that supports problem-solving and critical thinking-based learning.

Furthermore, the connection between GeoGebra and keywords such as "project," "PBL (problem-based learning)," and "GeoGebra-assisted" demonstrates that this research topic also focuses heavily on the use of GeoGebra in project-based learning and technology-assisted learning. The emergence of the keywords "discovery" and "media development" confirms the research trend toward digital media innovation and the application of discovery learning strategies to improve the effectiveness of mathematics learning.

Meanwhile, the correlation with the keyword "realistic mathematics education" indicates that studies on GeoGebra and mathematical literacy are also directed at the application of contextual learning approaches that emphasize the connection between mathematical concepts and real-world situations. This pattern indicates that the use of GeoGebra in learning is not only theoretical but also applied and oriented towards developing meaningful mathematical thinking skills.

Overall, this keyword network map confirms that GeoGebra plays a central role in mathematical literacy research, with problem-based learning, project-based learning, discovery learning, and realistic mathematics education being the approaches most frequently associated with it. These findings indicate a growing research focus on utilizing interactive technologies like GeoGebra to improve students' mathematical literacy and higher-order thinking skills through contextual and innovative learning.



Picture 3. Research Trends in 2020-2025

According to picture 3, research trends for 2020–2025 related to the use of GeoGebra to improve mathematical literacy and mathematics learning are shown in Figure 3 by color. The lighter the color, the more recent the research, while darker colors indicate older publications. The research on the topics shown on the map illustrates the direction of research developments on the use of GeoGebra and its relationship to mathematical literacy over time. Discussions on the use

of GeoGebra in mathematics learning demonstrate how research trends continue to evolve and adapt to the needs of 21st-century education.

Based on the overlay visualization, the dominant research trends appeared around 2022–2024. Earlier studies were more focused on the use of GeoGebra in mathematics learning and realistic mathematics education. Meanwhile, studies published in 2023–2024 increasingly emphasized the integration of GeoGebra with student-centered learning models such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), and discovery learning to support students' mathematical literacy skills. Several studies also applied other learning models, such as Think-Talk-Write (TTW) and the Missouri Mathematics Project (MMP), although these appeared less dominant in the keyword visualization. This trend indicates that research has developed from focusing on the use of GeoGebra as a learning medium toward emphasizing the development of mathematical literacy and higher-order thinking skills through interactive and contextual mathematics learning.

The overlay visualization results demonstrate research developments that align with the direction of this research topic. The blue circle indicates that earlier studies were primarily focused on utilizing GeoGebra as an interactive learning medium in mathematics education. Keywords such as "realistic mathematics education" and "media development" indicate that research in this phase is oriented towards the design and development of media that utilize GeoGebra to support the understanding of basic mathematical concepts visually.

The green circle indicates a shift in research direction toward improving mathematical literacy through GeoGebra-assisted learning. The emergence of keywords such as "mathematical literacy," "mathematics learning," and "project" indicates efforts to integrate GeoGebra into student-centered learning approaches aimed at developing critical thinking, problem-solving, and higher-order mathematical skills.

The yellow circle depicts the most recent research focusing on innovative project-based and discovery-based learning supported by GeoGebra. Keywords such as "problem," "PBL," "discovery," and "GeoGebra-assisted" demonstrate that GeoGebra's role has evolved into an interactive tool that not only facilitates visualization but also enhances students' independent learning, creativity, and higher-order thinking skills.

The overall results of the overlay visualization demonstrate that research trends for the 2020–2025 period have consistently progressed toward more innovative mathematics learning that is relevant to the needs of the 21st century. The use of GeoGebra has evolved from simply being a learning aid into a technology-based learning medium that supports students' mathematical literacy development. This development demonstrates significant potential for further research to develop technology-based learning models that can strengthen critical thinking and problem-solving skills in the context of modern mathematics learning.

(RQ2) How is students' mathematical literacy in GeoGebra-assisted mathematics learning?

Students' mathematical literacy in GeoGebra-assisted mathematics learning was analyzed based on 12 research articles that passed the selection process according to inclusion and exclusion criteria. The analysis was conducted by grouping the articles into two main aspects: (1) learning model and (2) educational level.

Learning Model

An analysis of 12 reviewed articles identified six learning models used in GeoGebra-assisted mathematics learning to support students' mathematical literacy, namely Problem-Based Learning (PBL), Project-Based Learning (PjBL), Discovery Learning (DL), Realistic

Mathematics Education (RME), Think-Talk-Write (TTW), and Missouri Mathematics Project (MMP). Among these models, PBL was the most frequently implemented model (6 studies), followed by PjBL (2 studies), while DL, RME, TTW, and MMP were each identified in one study. These models emphasize student-centered learning and utilize GeoGebra to facilitate mathematical exploration, visualization, communication, and problem-solving activities.

The findings from the reviewed articles indicate that GeoGebra-assisted learning generally contributes to improving students' mathematical literacy through visualization, exploration, mathematical communication, and contextual problem-solving activities. Across the reviewed studies, the integration of GeoGebra within various student-centered learning models was associated with the development of reasoning, representation, communication, and problem-solving skills. Meanwhile, Discovery Learning, RME, TTW, and MMP contributed to improving students' conceptual understanding, communication skills, and the ability to connect mathematics with real-life situations. Overall, the reviewed studies demonstrate a consistent pattern that the integration of GeoGebra with student-centered learning models supports the development of higher-order thinking skills and students' mathematical literacy.

The Problem-Based Learning (PBL) model has been implemented by Al Fitriani et al. (2023), Tambunan & Mukhtar (2023), Kusumawati et al. (2024), Agustina & Sukestiyarno (2025), Amri et al. (2025), and Setyaningsih & Sugiman (2025). Learning focuses on presenting contextual problems that challenge students to think critically, reason, and find solutions independently. The use of GeoGebra helps students visualize relationships between variables, test hypotheses, and dynamically confirm calculation results. This model not only strengthens conceptual understanding but also fosters curiosity, increases academic self-confidence, and fosters reflective skills regarding the concepts learned. This process supports mathematical literacy indicators such as reasoning and argument, representation, devising strategies for solving problems, and using mathematics tools.

The Project-Based Learning (PjBL) model was implemented by Fitriani (2023) and Rahim et al. (2023). This approach focuses on implementing contextual mathematical projects that require students' active involvement in designing, investigating, and presenting technology-based learning outcomes. GeoGebra is used to facilitate the visual exploration process and the creation of digital representations of students' mathematical ideas. This process trains students to collaborate, communicate, and think creatively when solving complex mathematical problems. Learning becomes more meaningful because students experience the direct application of mathematical concepts in real life, rather than simply memorizing procedures or formulas. It also supports communication, mathematizing, and devising strategies for solving problems as important components of mathematical literacy.

The Discovery Learning model was implemented by Liunesi et al. (2024). The learning process emphasizes independent discovery of mathematical concepts through exploratory activities. GeoGebra is used to help students discover patterns, relationships between geometric shapes, and interrelationships between variables. Students go through the stages of observing, asking questions, experimenting, and drawing conclusions, enabling them to understand concepts in depth and contextually. This model makes students more active, independent, and gives them a sense of ownership of their learning process, which has a positive impact on improving students' mathematical literacy abilities. This model strengthens representation, reasoning and argument, as well as the use of mathematics tools through exploratory activities.

The Realistic Mathematics Education (RME) approach was developed by Situmeang (2025). The learning focus is on connecting real-world contexts with mathematical concepts.

GeoGebra is used to bridge understanding from concrete models to more abstract, mathematical representations. Students are encouraged to interpret everyday situations into mathematical models that can be tested and solved. This approach helps build strong conceptual understanding and simultaneously strengthens numeracy and mathematical literacy skills. This approach helps students develop mathematizing and devising strategies for solving problems through contextual mathematical situations.

The Think-Talk-Write (TTW) model was studied by Azizah et al. (2023). The learning process takes place through three stages: individual thinking, peer discussion, and writing down the results of their thinking in mathematical writing. GeoGebra is used to dynamically illustrate mathematical ideas to facilitate students' communication of their ideas and findings. The TTW approach strengthens communication, representation, and reasoning and argument skills, which are essential components of mathematical literacy.

The Missouri Mathematics Project (MMP) model was developed by Nasution et al. (2023) by integrating elements of Malay culture. Learning is structured through systematic stages, starting from introduction, concept development, guided practice, and finally application of concepts in real-world contexts. GeoGebra serves as a tool to visualize concepts and reinforce understanding through interactive simulations. The integration of MMP and cultural context makes learning more relevant and meaningful for students and improves contextual mathematical literacy skills. The integration of GeoGebra in MMP supports representation and using symbolic, formal, and technical language and operations.

The reviewed studies indicate that Problem-Based Learning (PBL) is the most frequently implemented model in GeoGebra-assisted mathematics learning aimed at improving students' mathematical literacy, followed by Project-Based Learning (PjBL). Other models such as Discovery Learning, RME, TTW, and MMP also make important contributions to the development of higher-order thinking skills. The similarities between all these models lie in their emphasis on student-centered learning, the use of contextual problems, and the application of digital technology to strengthen conceptual understanding and enhance students' mathematical literacy ability.

Level of Education

A review of 12 articles shows that the use of GeoGebra in mathematics learning has been implemented across several educational levels, namely elementary school (SD/MI), junior high school (SMP), and senior high school/Islamic senior high school (SMA/MA). Fifty percent of the studies focused on the senior high school level (SMA/MA), while 25% focused on junior high school (SMP) and 25% on elementary school (SD/MI). This proportion indicates that most research has been conducted at the senior high school level, while studies at the elementary and junior high school levels are still relatively limited.

This finding may indicate that research on GeoGebra-assisted mathematical literacy is more frequently conducted at the senior high school level because students at this stage tend to have higher cognitive abilities and are exposed to more abstract mathematical concepts, making the integration of GeoGebra and mathematical literacy more relevant. In contrast, research at the elementary and junior high school levels is still limited, possibly because students at these levels are still in the stage of developing basic mathematical understanding and reasoning skills.

The predominance of research at the senior high school level indicates that this level is considered one of the most relevant educational levels for the application of GeoGebra in the context of mathematical literacy. High school students are at a formal thinking stage, enabling them to understand abstract mathematical concepts such as functions, transformations, and

analytic geometry. GeoGebra serves as a visualization tool to help students interactively connect symbolic representations with graphical forms.

Research at the junior high school level accounted for 25% of the studies and indicates that GeoGebra use is increasingly being developed during the transition from concrete to abstract thinking. GeoGebra helps students understand concepts such as equations, graphs, and geometric shapes through dynamic visualizations. This has been shown to increase learning motivation, strengthen conceptual understanding, and develop logical thinking skills as a foundation for mathematical literacy.

Research at the elementary school level (25%) indicates that GeoGebra's implementation in elementary schools is also gaining attention. GeoGebra is used to introduce basic concepts such as geometric shapes, symmetry, and spatial relationships in a visual and engaging way. The use of technology-based media helps students learn through concrete experiences, fostering interest and curiosity in mathematics. GeoGebra can serve as an initial foundation for developing mathematical literacy based on conceptual understanding and visualization.

The distribution of educational levels across the articles shows that research on the use of GeoGebra for mathematical literacy is still focused on the senior high school level (SMA/MA). However, the increasing number of studies at the junior high and elementary school levels indicates growing interest in the broader implementation of GeoGebra-assisted mathematics learning. The use of GeoGebra shows significant potential in supporting the development of students' mathematical literacy at various levels of education.

CONCLUSION AND SUGGESTION

The results of the review of 12 selected articles indicate that research trends on GeoGebra-assisted mathematics learning in the 2020–2025 period show a shift toward more innovative, interactive, and student-centered learning. Earlier studies mainly focused on the use of GeoGebra as a mathematics learning medium, while more recent studies increasingly integrated GeoGebra with various learning models such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), Discovery Learning (DL), Realistic Mathematics Education (RME), Think-Talk-Write (TTW), and the Missouri Mathematics Project (MMP). Among these models, PBL was the most dominant learning model found in the reviewed articles. In terms of educational level, most studies were conducted at the senior high school (SMA/MA) level, followed by junior high school (SMP) and elementary school (SD/MI). The findings also indicate that GeoGebra contributes positively to students' mathematical literacy by supporting indicators such as communication, mathematizing, using symbolic, formal and technical language and operations, reasoning and argument, representation, using mathematics tools, and devising strategies for solving problems.

Based on these findings, educators are encouraged to optimize the use of GeoGebra through student-centered and problem-solving-oriented learning models to support the development of students' mathematical literacy. Future research is recommended to expand the implementation of GeoGebra at different educational levels and mathematical topics, as well as to explore its integration with other innovative learning models and digital technologies. Further studies are also needed to examine the influence of GeoGebra-assisted learning on other aspects such as higher-order thinking skills, motivation, self-efficacy, and students' engagement in mathematics learning.

REFERENCES

Agustina, R., & Sukestiyarno, Y. L. (2025). Literasi Matematika Ditinjau Dari Rasa Ingin Tahu Pada Model Problem-Based Learning Berpendekatan Matematika Realistik Berbantuan GeoGebra. *Jejak digital: Jurnal Ilmiah Multidisiplin, 1(5)*, 3390-3405.

Al Fitriani, N. A., Darta, D., & Kandaga, T. (2023). Penerapan Model Problem-Based Learning Berbantuan GeoGebra Untuk Meningkatkan Kemampuan Literasi Matematis Siswa SMA. *Symmetry: Pasundan Journal of Research in Mathematics Learning and Education, 8(1)*, 138-145.

Amalia, F. N., Ristiana, M. G., & Afrilianto, M. (2024). Pengembangan LKPD Berbasis Pendekatan Saintifik Berbantuan GeoGebra. *JPMI (Jurnal Pembelajaran Matematika Inovatif), 7(4)*, 611-624.

Amri, K., Armanto, D., & Surya, E. (2025). Validitas Media Interaktif Berbasis Model PBL Menggunakan Aplikasi GeoGebra Untuk Meningkatkan Kemampuan Literasi Numerasi. *Mandalika Mathematics and Educations Journal, 7(2)*, 420-436.

Aprilyani, N., & Hakim, A. R. (2020). Pengaruh Pembelajaran Assurance, Relevance, Interest, Assessment, Satisfaction Berbantuan Etnomatematika Terhadap Kemampuan Pemecahan Masalah. *JNPM (Jurnal Nasional Pendidikan Matematika), 4(1)*, 61-74.

Azizah, F. N., Waluya, S. B., & Masduki, L. R. (2023). Analisis Kemampuan Literasi Matematik Melalui Think-Talk-Write (TTW) Berbantuan GeoGebra Ditinjau Dari Self Efficacy Peserta Didik Kelas VI. *Journal of Syntax Literate, 8(2)*.

Fitriani, I. (2023). Telaah Model Project Based Learning Berbantuan GeoGebra Terhadap Kemampuan Literasi Matematika. *Jurnal Al-Ilmu: Jurnal Penelitian dan Pendidikan Madrasah Ibtidaiyah, 5(1)*, 33-40.

Habibi, H., & Prahmana, R. C. I. (2022). Kemampuan Literasi Matematika, Soal Model PISA, Dan Konteks Motif Batik Tulis Jahe Selawe. *Jurnal Varidika, 33(2)*, 116-128.

Indirwan, I., Suarni, W., & Priyatmo, D. (2021). Pentingnya Self-Efficacy Terhadap Prestasi Belajar Matematika. *Jurnal Sublimapsi, 2(1)*, 61.

Kurniawan, H. S., & Khotimah, R. P. (2022). Profil Kemampuan Literasi Matematis Siswa Dalam Menyelesaikan Soal High Order Thinking Skill. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 11(3)*, 1966-1977.

Kusumawati, W., Purwosetiyono, F. D., & Handayani, S. H. R. (2024). Efektivitas Model Problem Based Learning Berbantuan GeoGebra Terhadap Kemampuan Literasi Matematis Siswa Pada Materi Fungsi Kuadrat. *JagoMIPA: Jurnal Pendidikan Matematika dan IPA, 4(1)*, 156-166.

Liunesi, D. T., Nenohai, J. M., & Halim, F. A. (2024). Penerapan Model Pembelajaran Discovery Learning Berbantuan GeoGebra Untuk Meningkatkan Kemampuan Literasi Matematika Siswa Kelas VIII SMP Negeri 3 Kupang. *Jurnal Pendidikan Matematika Malikussaleh, 4(2)*, 133-144.

Meika, I., Ramadina, I., Sujana, A., & Mauladaniyati, R. (2021). Kemampuan Pemecahan Masalah Matematis Siswa Dengan Menggunakan Model Pembelajaran SSCS. *Jurnal Cendekia: Jurnal Pendidikan Matematika, 5(1)*, 383-390.

Nasution, D. J., Simamora, Y., & Maharani, I. (2023). Pengaruh Model Missouri Mathematics Project Berbantuan GeoGebra Dalam Budaya Melayu Untuk Meningkatkan Kemampuan Literasi Matematikasiswa MA Tahun Pembelajaran 2022-2023. *Jurnal Pembelajaran Dan Matematika Sigma (JPMS), 9(1)*, 38-45.

Novitasari, D., Trisnowali, A., Hamdani, D., Junaidi, J., & Arifin, S. (2021). Pengembangan LKPD Berbasis GeoGebra Untuk Meningkatkan Pemahaman Konsep Matematika. *Jurnal Edukasi dan Sains Matematika (JES-MAT), 7(1)*, 1-16.

OECD. (2019). PISA 2018 Assessment and Analytical Framework, PISA, OECD Publishing, Paris.

Paloloang, M. F. B., Juandi, D., Tamur, M., Paloloang, B., & Adem, A. M. (2020). Meta Analisis: Pengaruh Problem-Based Learning Terhadap Kemampuan Literasi Matematis Siswa Di Indonesia Tujuh Tahun Terakhir. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 9(4)*, 851-864.

Pamungkas, M. D., & Franita, Y. (2019). Keefektifan Problem Based Learning Untuk Meningkatkan Kemampuan Literasi Matematis Siswa. *JP3M (Jurnal Penelitian Pendidikan dan Pengajaran Matematika), 5(2)*, 75-80.

Rachmawati, T. D., Cahyono, D. C., & Nastiti, A. S. (2021). Systematic Literature Review: Efektivitas Sistem Informasi Akuntansi Koperasi Di Indonesia. *Jurnal Ekobis: Ekonomi Bisnis & Manajemen, 11(1)*, 40-54.

Rahim, S. W., Ridlo, M. R. Y., & Syaifuddin, M. W. S. (2023). Penerapan Model Pembelajaran PjBL Berbantuan GeoGebra Untuk Meningkatkan Kemampuan Literasi Numerasi Dan Keaktifan Peserta Didik: Penerapan Model Pembelajaran PjBL Berbantuan GeoGebra. *WIDYA DIDAKTIKA-Jurnal Ilmiah Kependidikan, 2(2)*, 52-61.

Rahmawati, A. A., Waluya, S. B., & Wardono, W. (2023). Systematic Literature Review: Literasi Matematika Ditinjau Dari Self-Confidence. *In SEMANTIK: Prosiding Seminar Nasional Pendidikan Matematika, 1(1)*, pp. 231-245.

Setyaningsih, N. A., & Sugiman, S. (2025). The Effectiveness Of The Problem Based Learning Model Assisted By GeoGebra Classroom To Improve The Mathematical Literacy Ability Of Deaf Students. *Hayati: Journal of Education, 1(1)*, 94-106.

Situmeang, J. C. (2025). Hubungan Antara Persepsi Siswa Terhadap Model Pembelajaran Realistic Mathematics Education (RME) Berbantuan GeoGebra Dengan Kemampuan Literasi Numerasi Siswa SMP. *Jurnal Kajian Teori dan Praktik Pendidikan, 6(3)*.

Tabun, H. M., Taneo, P. N., & Daniel, F. (2020). Kemampuan Literasi Matematis Siswa Pada Pembelajaran Model Problem Based Learning (PBL). *Edumatica: Jurnal Pendidikan Matematika, 10(01)*, 1-8.

Tambunan, T. D. A., & Mukhtar, M. (2023). Penerapan Model Pembelajaran Problem Based Learning Berbantuan GeoGebra Untuk Meningkatkan Kemampuan Literasi Matematis Siswa Kelas X SMA Negeri 4 Medan. *Journal Of Student Research, 1(3)*, 75-98.

Triandini, E., Jayanatha, S., Indrawan, A., Putra, G. W., & Iswara, B. (2019). Metode Systematic Literature Review Untuk Identifikasi Platform Dan Metode Pengembangan Sistem Informasi Di Indonesia. *Indonesian Journal of Information Systems, 1(2)*, 63-77.