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A Systematic Literature Review: Effectiveness of Learning Media to Encourage Students' Problem-Solving Skills in Mathematics Learning

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ABSTRACT

This research is based on the lack of students in understanding mathematics through problem-solving skills. Various kinds of learning models that can be used to achieve the goal should be to improve problem-solving skills. This study aimed to determine the effectiveness of learning media in improving problem-solving skills. The method applied by the researcher is the Systematic Literature Review (SLR) method with a sample of 20 articles related to this research. The research method used a Systematic Literature review. Data collection was carried out by exploring related topics in the 2015 to 2024 time period through an electronic database with the help of Publish or Perish. The results of the journal will be reviewed based on the year of publication, education level, publication media, type of research, and research results. The results show that most publications are in 2023, participants dominate in senior high school, publication media in Sinta 2 national journals, most types of research are quantitative and the results of the literature conducted using several relevant articles and have met the selection process can be concluded that learning media are effective and able to support problem-solving skills in learning mathematics.

Keywords: Learning Media, Problem Solving, Systematic Literature Review

INTRODUCTION

Mathematics is one of the general sciences where mathematics is the basis for various developments in modern technology and science that can develop human thinking (Judijanto, 2024). Of the several subjects taught at every level of education, one of them is mathematics. The importance of math in life is to be able to equip students to solve problems that occur every day. In addition, mathematics is the basis for other fields of science and is the foundation for the development of modern technology (Medyasari et al., 2022). Mathematics is also important in other fields such as science and technology by facilitating everything (Li & Schoenfeld, 2019). Thus, appropriate aspects are needed, namely being able to think logically, critically, and creatively and work well together (Rianti & Dermawan, 2022). With low mathematical ability, learning needs to be considered so that students can apply it well orally or in writing (Anggraeni et al., 2023). According to (Anggraeni et al., 2023), mathematics learning must be able to create an internationally competitive generation. According to Permendikbud, the purpose of learning mathematics is that students can solve problems, including those in understanding the problem, designing models, solving, and interpreting solutions (Anggraeni et al., 2023). In learning mathematics, learning strategies are needed that can support the mathematical development of students from the cognitive aspect. According to the National Council of Teachers of Mathematics (NCTM, 2014), students must be able to master: 1) problem-solving; 2) reasoning and proof; 3) connection; 4) communication; and 5) representation. From this statement, learning mathematics is closely related to the ability to solve a problem (problem-solving). Therefore, problem-solving skills are important for students to master in learning mathematics.

Problem-solving is a process of facing difficulty to achieve the expected goal (Anggraeni et al., 2023). This is in line with the opinion of Arta et al (2020) which states that problem-solving ability is an effort to obtain the right solution after applying knowledge, understanding, and ability to solve a problem by prioritizing the right strategies and steps. This statement shows that problem-solving is at the heart of mathematics. With the provision of problem-solving skills, learning mathematics is more memorable because students will feel that they have the ability to face a problem, especially in making decisions in everyday life (Sinurat and Surya, 2020). So, problem-solving skills can be used by students both in learning and in life. Although considered important, some data and facts show that the ability to solve math problems of students in Indonesia is still low. The results of the TIMSS survey in 2015

stated that students' ability in the field of mathematics was ranked 44th, with an average score of 397 out of a standard score of 500 (Lestari Pratiwi & Akbar, 2022). The data is reinforced by the PISA (Program for International Student Assessment) study in 2018. Indonesia scored an average math score of 379 below the average of the accumulated scores of all participating countries, which was 489 (OECD, 2019). Several studies have reported that students' problem-solving skills are still low and require innovation in improving these skills. This shows that the problem-solving ability of Indonesian students is still below the standard. Therefore, the problem-solving ability of students in Indonesia needs to be considered and developed in mathematics learning.

It is necessary to maximize pupils' cognitive development when learning mathematics, specifically with regard to their capacity for problem-solving. The availability of media that facilitates learning is necessary to assist mathematics education. An essential component of teaching and learning is the use of learning media. One tool for providing information to pupils in their learning is learning media (T. T. Kusumaningrum et al., 2022). The process of learning can also be impacted by improper use of educational material. Interesting learning materials have the power to arouse emotions, ideas, focus, and a desire to learn. Media has a positive impact on learning because it helps students and teachers communicate, which makes learning activities more successful and efficient (Nalurita et al, 2019). Various types of learning media can be used in the teaching and learning process. Therefore, choosing the right type of learning media is very important to use in learning according to the learning needs of students.

This research focusses on performing a literature review on students' problem-solving abilities when learning mathematics with the aid of learning media, as indicated by the preceding description. Review of the literature: A lot of studies has been done on using learning models to improve problem-solving abilities. The use of learning media as an aid to the mathematics learning process to enhance the process of developing students' problem-solving abilities is the originality that this study aims to demonstrate.

RESEARCH METHODS

According to (Kitchenham Stuart, 2007), a Systematic Literature Review is a literature review method that identifies, evaluates, and interprets all findings related to a research topic to answer predetermined research questions. This research aims to identify, review, and make conclusions from the literature relevant to students' problem-solving skills through learning mathematics with the help of learning media. A systematic literature review will carry out the process of identifying, evaluating, and interpreting all existing research results in such a way as to answer a series of research questions (Wahyu and Firmansyah, 2018). The stages of a systematic literature review are planning, implementation, and reporting.

A. Planning

Planning is the initial and fundamental stage in the SLR method. This Systematic Literature Review refers to a research question (RQ) that is made based on the topic discussed in the research. RQ aims to facilitate the search for topics and examine the literature in depth to be oriented to the object of research objectives (Kurniawan and Agoestanto, 2023).

Research Question

1. What is the diversity of the selected literature based on publication year, Sinta level, education level, and research method in 2015 - 2024?
2. How is the problem-solving ability of students through learning media in learning mathematics in the range of 2015 - 2024?

B. Conducting

At this point, the topic of problem-solving skills through learning mathematics with the aid of learning media was the focus of a literature search. The study results on pertinent subjects that were found by conducting keyword searches served as secondary data for this investigation. The initial step is to identify keywords, which are media learning, problem-solving skills, and mathematical learning. Using digital libraries such as Google Scholar and the Publish or Perish program, the second step of the research process involves locating the source. The third phase of the research process involves the selection of literature. This is done by choosing to acquire literature through search activities that address subjects that satisfy the inclusion criteria (Ariati

and Juandi, 2022), thus literature that does not meet the inclusion criteria as set out in the exclusion criteria, the literature is not included in this literature review process. The following inclusion and exclusion criteria are presented in Table 1 below:

Table 1. Inclusion and Exclusion Criteria

Inclusion	Exclusion
Literature from national journals relevant to the research topic	Literature from national journals that are not relevant to the research topic.
Literature published between 2015-2024.	Literature published before 2015
Literature with research targets from primary to tertiary education.	Literature targeting general research and early childhood education.

The fourth stage is quality assessment, by evaluating the literature based on the assessment criteria or Quality Assessment (QA), including (QA1) Was the literature published in 2015-2024?; (QA2) Does the literature describe the objectives, methods, and research design?; (QA3) Does the literature present information related to students' problem-solving skills through learning mathematics assisted by learning media? The fifth stage is data extraction, through the process of reading research results and drawing research conclusions, then the data collected and used at this stage is primary data (Rianti and Dermawan, 2022). The literature relevant to problem-solving skills through learning mathematics assisted by learning media was obtained as much as 79 literature, then in the screening process 12 literature in the field of non-mathematics education so that the number of literature became 67 literature. After that, seen from the inclusion category, 23 articles were obtained that were not Sinta. The remaining literature has been reclassified there are the same titles and the highest indexed article from each of the same titles. Then 20 articles were selected according to the topic of discussion.

C. Reporting

Reporting is the stage of writing the SLR results to be published in the form of a written paper for the preparation of the Review. The SLR writing structure consists of 3 major sections: Introduction, Main Body, and Conclusion.

RESULTS AND DISCUSSION

Result

The results of this study are in the form of a summary and analysis of 20 selected literature obtained by following the research stages, and then classified based on the table of the number of studies from several criteria. So it can be seen that there is heterogeneity in research related to problem-solving skills through learning mathematics assisted by learning media. Table 2 presents the grouping of the number of studies based on criteria.

Table 2. Percentage of Research Samples

Category	Variations	Quantity
Year of Research	2015	0
	2016	2
	2017	1
	2018	0
	2019	3
	2020	2
	2021	1
	2022	5
	2023	5
	2024	2
Participant Education Level	Elementary School	3
	Junior High School	7
	Senior High School	10
	Higher Education	0
Publication Media	Sinta 1	2
	Sinta 2	8
	Sinta 3	6
	Sinta 4	3
	Sinta 5	1

	Sinta 6	0
Type of Research	Qualitative	2
	Quantitative	18
	Mixed-Methods	0

DISCUSSION

RQ 1: What is the diversity of the selected literature based on publication year, Sinta level, education level, and research method in 2015 - 2024?

Based on the results of the identification of literature related to the year of publication, journal level, level of education, and Research Methods in 2015-2024, the diversity of literature will be described in the form of diagrams to facilitate exposure. The literature published in the range of 2015-2024 can be seen in the image in the form of a bar chart in Figure 1.

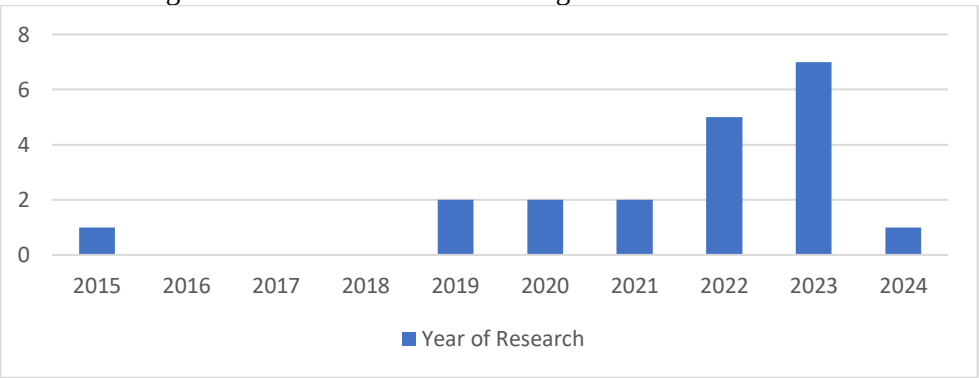

Fig 1. Research Databased on Publication Year

Figure 1. shows that much of the literature on the topic of learning media-assisted problem-solving skills published in 2015-2024 tends to stabilize in 2019-2021 and continue to increase until 2023 and decrease again in 2024. In the literature obtained, based on the Sinta level in journals from 2015-2024, it is described in Figure 2 in the form of the following line diagram:

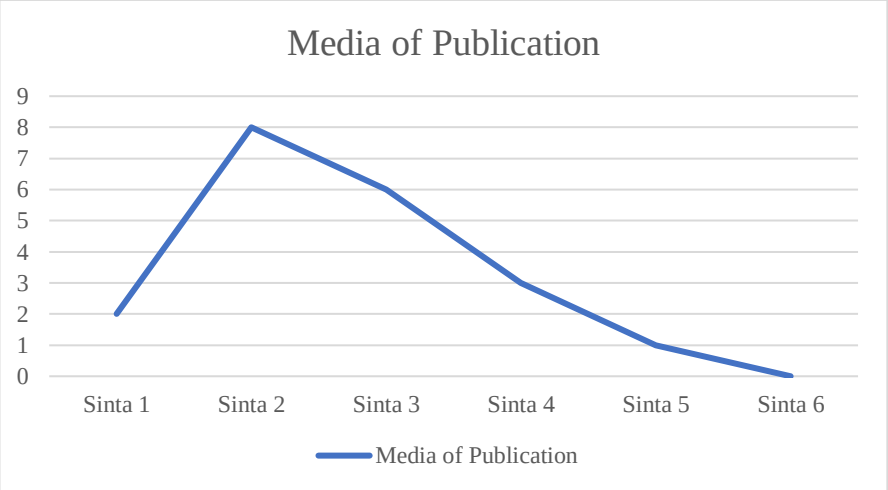

Fig 2. Research Databased on Media of Publication

Based on Figure 2, it is known that the selected literature from national journals is also in the moderately high to low category, this is based on the acquisition of sinta journal levels, namely in S1, S2, S3, S4, and S5 and S6 with the most literature levels in S2. Furthermore, the acquisition literature will be reviewed based on the level of education that refers to the inclusion criteria, namely from Elementary School to Higher Education in the 2018-2023 time span. The diversity of literature based on education level can be seen in Figure 3.

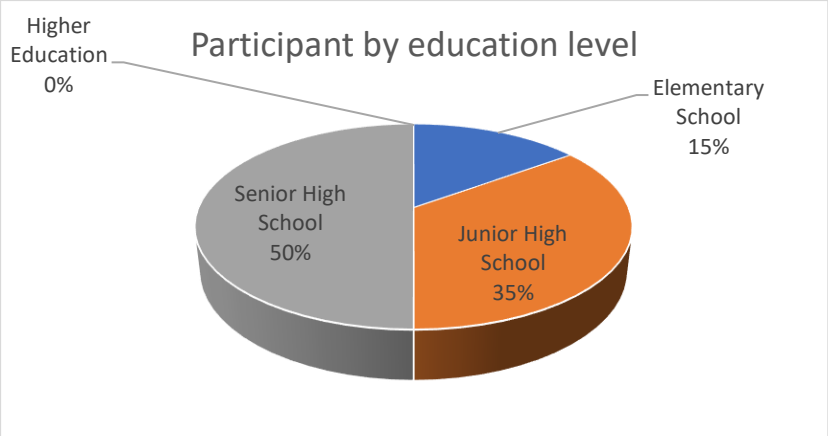

Fig 3. Research Databased by Education Level

In Figure 3 there is a description for the elementary school level represented in blue, the junior high school level represented in orange, and the senior high school level represented in gray. It can be seen that research on problem-solving skills through problem-based learning assisted by learning media is mostly carried out at the Senior High School level, namely 50%, while the least research is at the Higher Education level which is 0%.

The last one is based on research methods from the selected literature as shown in the diagram in Figure 4 below:

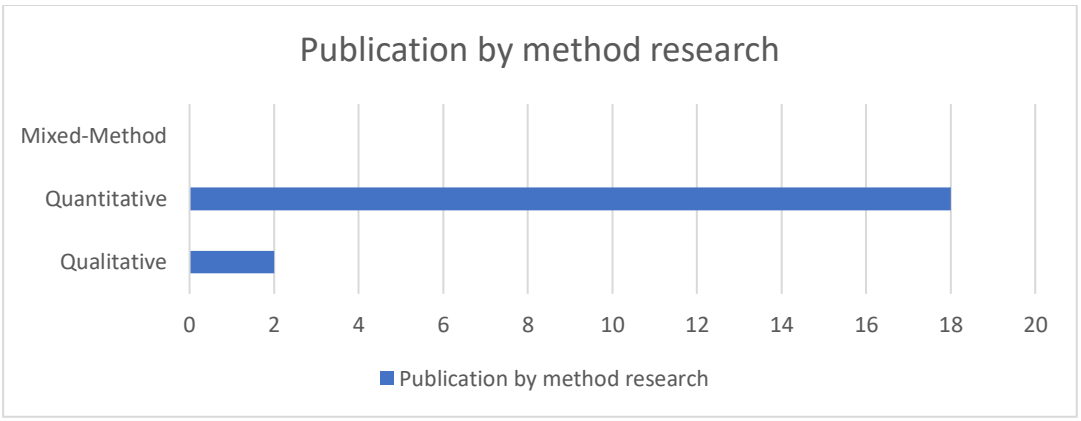

Fig 4. Publication by Method Research

From Figure 4. It is known that research with quantitative methods is most widely used, namely 18 literature, then qualitative methods are used as much as 2 literature while no literature uses mixed-method methods.

RQ2: How is the problem-solving ability of students through learning media in learning mathematics in the range of 2015 - 2024?

To find out how the problem-solving ability of students through learning mathematics assisted by learning media, it is necessary to review the results of research from selected literature. The following table presents a table related to the results of research on the application of mathematics learning assisted by learning media to students' problem-solving skills. **Table 3. Hasil Penelitian dari Literatur Terpilih**

Writer	Research Results
(Khairunnisa et al., 2022)	The study explores the effectiveness of a Problem-Based Learning (PBL) model combined with flashcard media in enhancing students' creative thinking skills within biology education, spesifically in the context of environmental pollution. Conducted in two Madrasah Aliyah in Banda Aceh, Indonesia, the quasi-experimental research involved 126 students and revealed significant improvements in creative thinking dimensions such as fluency, flexibility, originality, and elaboration. Notably, elaboration increased from 49% to 74% and originality from 44% to 72%, underscaring

	the role of real-life problem-solving in forestering creative thinking abilities among students.
(Adhelacahya et al., 2023)	The research investigates the effectiveness of a STEM-integrated Problem-Based Learning (PBL) electronics module on enhancing critical thinking skills among high school students in physics education. Conducted with 34 students at SMAN 1 Pacitan, the study employed a quasi-experimental design featuring pretest and posttest assessments. Results demonstrated a significant improvement in critical thinking skills, with an N-Gain score of 0.76, indicating a high level of enhancement. The findings suggest that integrating PBL and STEM approaches can effectively address the limitations of traditional teacher-centered methods and foster critical thinking among students.
(Tambunan & Khairuna, 2024)	The study investigates the development and validation of Problem-Based Learning (PBL) worksheets integrated with the Make A Match cooperative model to enhance critical thinking skills among biology students at MA Laboratorium Uinsu. Utilizing a 4-D model approach, the worksheets achieved high validation scores (99% for media and 91% for material), demonstrating their feasibility and effectiveness, as indicated by an N-Gain score of 0.7, categorized as "very effective." Practicality was affirmed through positive feedback from both students (90%) and teachers (91%), highlighting the worksheets' role in promoting active learning and addressing limitations of traditional teaching methods.
(Puspitasari et al., 2022)	The document discusses the implementation of Problem-Based Learning (PBL) in mathematics education, emphasizing the integration of various media and technology, such as GeoGebra and interactive comics, to enhance student motivation and learning outcomes. A literature review of numerous studies from 2013 to 2022, highlights the effectiveness of PBL in fostering mathematical literacy, critical thinking, and engagement by creating an active and enjoyable learning environment. The findings suggest that appropriate media selection plays a crucial role in improving the teaching and learning process, with some studies also incorporating local cultural contexts and disaster mitigation themes into the curriculum.
(Oktario et al., 2023)	The article explores the implementation of Problem Based Learning (PBL) using brochure media to improve learning outcomes in Integrated Social Studies for eighth-grade students at SMP Negeri 3 Sekampung. The study, conducted through classroom action research over two cycles, revealed a notable enhancement in student engagement and academic performance, with average scores increasing from 68.75 to 90 and the percentage of students achieving mastery rising from 53.12% to 87.5%. The findings suggest that incorporating varied teaching methods, such as brochures, can significantly boost student participation and understanding in the subject.
(Harefa & La'ia, 2021)	The impact of audio-visual learning media on students' mathematical problem-solving abilities. Utilizing a pre-experimental design with a one-group pretest-posttest approach, the study found a significant improvement in students' scores, with pretest and posttest averages of 58 and 65, respectively. The hypothesis testing revealed a correlation coefficient of 0.894 and a t-value of 4.516, indicating that the use of audio-visual media effectively enhances students' understanding and engagement in learning mathematics, particularly in a remote learning context. The findings suggest that such media not only aids comprehension but also allows students to revisit complex topics at their own pace, thus contributing positively to educational practices in mathematics.
(Amin et al., 2022)	The research paper focuses on the development of a web-based learning media utilizing a problem-solving approach for teaching the topic of Systems of Linear Equations in Three Variables (SPLTV) to tenth-grade students. The study identifies the need for effective online learning tools during the COVID-19 pandemic, as traditional methods were insufficient for enhancing students' problem-solving skills. The developed media was validated for its practicality and effectiveness, showing a high level of student engagement and a significant improvement in learning outcomes, with 93.33% of students achieving mastery. The findings suggest that web-based learning can effectively support mathematical problem-solving, and future research should explore enhancing critical thinking and collaboration skills through such media.
(Anwar et al., 2022)	The research paper investigates the impact of the Problem Based Learning (PBL) model and interactive media on students' interest in learning mathematics. It highlights that traditional teaching methods often lead to low student engagement and interest in

	mathematics, necessitating innovative approaches like PBL, which encourages active problem-solving and collaboration among students. The findings indicate that the combination of PBL and interactive media significantly enhances students' motivation and engagement, resulting in improved learning outcomes and a more enjoyable learning experience. Overall, the study emphasizes the effectiveness of integrating modern teaching strategies and technology to foster a positive learning environment in mathematics education.
(Amanah et al., 2023)	The research investigates the effectiveness of PhET simulation-based learning models on students' problem-solving abilities. It highlights that students' problem-solving skills vary based on internal factors like interest and intelligence, as well as external factors such as teaching methods and learning environments. The study employs a nonequivalent control group design, contrasting the interactive PhET simulation approach with conventional teaching methods, revealing that the latter often leads to passive learning and lower engagement among students. The findings suggest that integrating simulation media can significantly enhance students' problem-solving capabilities, indicating a need for further exploration of innovative teaching strategies in educational settings.
(Theana Putri Permananda & Wahyudi, 2020)	The research investigates the effectiveness of board games as a learning medium to enhance problem-solving skills among elementary school students. The study employs a pretest-posttest design with 25 third-grade students, utilizing tests, observations, and interviews to gather data. Results indicate a significant improvement in students' problem-solving abilities, with average scores rising from 65% to 79% after the intervention, demonstrating that board games can create an engaging learning environment that fosters critical thinking and problem-solving skills. The findings suggest that integrating playful learning methods like board games can effectively address the challenges of traditional teaching approaches, although further research is needed to explore long-term impacts and applications in diverse educational settings.
(Ambarwati, 2019)	The research investigates the effectiveness of web-based game learning media in enhancing problem-solving skills among elementary school students. The study highlights that traditional teaching methods often fail to engage students in problem-solving activities, necessitating innovative approaches like web games that promote active learning. Results indicate a significant improvement in students' problem-solving abilities post-intervention, suggesting that such interactive media can effectively foster higher-order thinking skills essential for academic success. The paper emphasizes the importance of integrating technology in education and encourages further exploration of digital tools to enhance learning outcomes.
(Sari, 2016)	The research paper investigates the effectiveness of the Microsoft Math Solver (MMS) application as an Android-based learning media to enhance students' problem-solving skills and promote independent learning among high school students. The study highlights that while students frequently use smartphones, they often do not leverage them for educational purposes, leading to a lack of motivation and creativity in learning mathematics. By implementing MMS, the research demonstrates a significant improvement in students' mathematical problem-solving abilities and their independence in learning, suggesting that technology can play a crucial role in modern education
(Rizky & Marhaeni, 2023)	The research paper investigates the effectiveness of the MathApp learning application in enhancing students' mathematical problem-solving abilities at SMA Negeri 1 Pengasih. The study highlights that students face significant challenges in understanding mathematical concepts, particularly in solving linear equations with three variables, which the MathApp aims to address. Results from statistical tests, including the Wilcoxon Signed Rank Test and Mann-Whitney U Test, indicate that students using MathApp showed a greater improvement in problem-solving skills compared to those who did not use the application, suggesting its potential as an effective educational tool. The authors recommend further research with a larger sample size to validate these findings.
(Sumarti, 2019)	The research investigates the effectiveness of problem-based learning (PBL) in enhancing high school students' mathematical problem-solving abilities and engagement. The study reveals that implementing PBL significantly improved students' activities, such as working collaboratively on tasks and engaging in discussions, with a

	notable increase in the percentage of students meeting the minimum competency criteria from 61.30% to 82.14%. The findings suggest that PBL not only fosters a more interactive learning environment but also enhances students' understanding and application of mathematical concepts, indicating its potential as an effective pedagogical approach in mathematics education.
(Yuningsih et al., 2024)	The research paper explores the effectiveness of the Problem Based Learning (PBL) model combined with interactive learning media in enhancing students' mathematical problem-solving skills and interest in learning. It highlights that PBL encourages students to engage with real-world problems, fostering critical thinking and collaboration, which are essential for developing problem-solving abilities. The study concludes that integrating interactive media not only makes learning more engaging but also significantly improves students' understanding and application of mathematical concepts, ultimately leading to better academic performance.
(Rachmawati et al., 2020)	The research investigates the effectiveness of web-assisted interactive learning media in enhancing students' creative thinking skills, which are essential for navigating the challenges of the industrial revolution. The study identifies key indicators of creative thinking, including fluency, flexibility, originality, and elaboration, which are crucial for problem-solving. The findings suggest that such interactive media significantly increases student engagement and facilitates the application of diverse strategies in learning, thereby contributing to the development of creative thinking abilities in mathematics education.
(Mutiarawati et al., 2019)	The research paper investigates the effectiveness of the Creative Problem Solving (CPS) model assisted by GeoGebra on students' mathematical problem-solving abilities. Utilizing a quasi-experimental design with cluster random sampling, the study compares an experimental group using CPS with a control group employing conventional teaching methods. Results indicate that students in the CPS group significantly outperformed their peers in the control group, achieving higher average scores and demonstrating improved engagement and creativity in problem-solving. The findings suggest that integrating innovative teaching models like CPS with supportive media can enhance educational outcomes in mathematics, highlighting the need for further exploration of such methodologies in diverse educational settings.
(D. Kusumaningrum, 2017)	This research paper investigates the effectiveness of media in guided discovery learning, particularly focusing on problem-solving abilities and attitudes among students. Utilizing GeoGebra as a mathematical aid, the study highlights how this tool enhances the learning experience and fosters a positive attitude towards mathematics. The findings suggest that integrating such media in guided discovery can significantly improve students' problem-solving skills, indicating a valuable contribution to educational practices in mathematics.
(Haryanto, 2016)	The research paper investigates the enhancement of problem-solving abilities in mathematics among students at SMK Negeri 1 Ngawen through the use of computer media. It highlights the necessity of integrating technology into education to improve learning outcomes, particularly in mathematics, which students often find challenging. The study employs a Classroom Action Research (CAR) methodology, implementing a cycle model that includes planning, action, observation, and reflection, leading to significant improvements in student engagement and understanding of three-dimensional geometry. Despite initial challenges with computer literacy and group dynamics, the findings indicate that interactive computer-based learning can effectively motivate students and enhance their academic performance in mathematics.
(Nisa et al., 2023)	The research paper investigates the effectiveness of the Realistic Mathematics Education (RME) model supported by the CerMath media on improving students' mathematical problem-solving abilities at SMA N 1 Gebog. Utilizing a quasi-experimental design, the study involved two classes, one receiving RME with CerMath and the other following conventional teaching methods. Results indicated that the experimental group showed significantly better performance in post-tests compared to the control group, highlighting the potential of RME and interactive media in enhancing mathematical understanding and problem-solving skills among students. The study suggests further exploration of RME applications in educational settings to benefit teachers and learners alike.

Based on the analysis of the literature reviewed in this study, researchers found that students' problem-solving skills can be improved with mathematic learning assisted by learning media. According to Ripai and Sutarna (2020), there are several stages in applying the problem-based learning model; problem orientation, organization, investigation guidance, development and presentation of results, analysis, and evaluation, where several stages involve learning media. This can train students to design new ideas using previously owned mathematical methods, or students can innovate mathematical concepts through the investigation phase in developing new concepts. The use of learning media in mathematic learning is supported by research conducted by Hayati et al (2023) that it can have a good effect on students' problem-solving skills. Therefore, the utilization of effective and efficient learning media used by students and teachers can improve students' problem-solving skills through the mathematics learning applied.

CONCLUSIONS

Mathematical learning activities at school place a strong emphasis on problem-solving abilities, which are critical for children to acquire. Of course, in order to enhance pupils' problem-solving abilities, an efficient substitute solution is required. This alternate approach can be used in the classroom with a non-boredom learning paradigm. The active participation of students in mathematics education is complemented by educational media that effectively fosters the development of students' problem-solving abilities. Based on the findings of the review of a subset of the literature, it is possible to draw the conclusion that learning mathematics with the aid of learning media is beneficial and enhances students' ability to solve mathematical problems. Additionally, learning mathematics with the aid of instructional media improves students' capacity to solve mathematical puzzles. This is due to the fact that studying mathematics with the use of learning media concentrates on real-world issues that can be represented in learning mathematics. Therefore, more study is required to evaluate students' proficiency in solving mathematical problems using a variety of models, mediums, techniques, technologies, and other strategies.

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