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SYSTEMATICS LITERATURE REVIEW: THE USE OF LEARNING MEDIA TO IMPROVE STUDENTS' MATHEMATICAL CREATIVE THINKING SKILLS IN 21st CENTURY LEARNING

SYSTEMATICS LITERATURE REVIEW: PENGGUNAAN MEDIA PEMBELAJARAN TERHADAP PENINGKATAN KEMAMPUAN BERPIKIR KREATIF MATEMATIS SISWA PADA PEMBELAJARAN ABAD-21

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[1]Fitri Qoriaturrosyidah, [1]Friska Yanti Simanjuntak, [1]Dina Mawaddah, [1]Carlos Bettran Daniel Marpaung, [1,2,*] Yudhi Hanggara, [1]Ismarti Ismarti, [1,2]Suryo Hartanto, [1]Hermansah

[1]Mathematics Education, Universitas of Riau Islands, Batam, Indonesia
[1.2]Teacher Professional Education Study Program, Universitas of Riau Islands, Batam, Indonesia

*Corresponding author: yudhi@fkip.unrika.ac.id

ABSTRACT

This research aims to review the literature related to the use of learning media in enhancing mathematical creative thinking skills. The method applied in this research is the Systematic Literature Review (SLR). As many as 20 articles were used as data sources in this study. Data were collected by reviewing all articles obtained from the period 2018 to 2023. To complete this research, various journal articles were collected through Google Scholar with the help of the Harzing's Publish or Perish application. The keywords in this article are "learning media and mathematical creative thinking skills." The research results show that the R&D (Research and Development) research method is used more frequently, accounting for 55%, compared to other research methods, with the topic of using electronic learning media to enhance students' mathematical creative thinking skills. Furthermore, the use of electronic learning media, such as e-comics, e-modules, learning videos, educational games, mobile learning, edutainment games, visual videos, Adobe Flash Professional, Go-Metra board games on geometry transformation material, Articulate Storyline 3, and e-learning, is effective in improving students' mathematical creative thinking skills. It is hoped that the results of this research can provide useful information for other researchers and assist educators in applying learning media to enhance students' mathematical creative thinking skills in the 21st-century learning era.

Keywords: Learning 21st Century, Learning Medium, Mathematical Creative Thinking Ability

ABSTRAK

Penelitian ini bertujuan untuk mengkaji literatur terkait penggunaan media pembelajaran dalam meningkatkan kemampuan berpikir kreatif matematis. Metode yang diterapkan dalam penelitian ini adalah Systematic Literature Review (SLR). Sebanyak 20 artikel digunakan sebagai sumber data dalam penelitian ini. Data dikumpulkan dengan menelaah semua artikel yang diperoleh dari periode 2018 hingga 2023. Untuk menyelesaikan penelitian ini, berbagai artikel jurnal dikumpulkan melalui Google Scholar dengan bantuan aplikasi Harzing's Publish or Perish. Kata kunci dalam artikel ini adalah "media pembelajaran dan kemampuan berpikir kreatif matematis". Hasil penelitian menunjukkan bahwa metode penelitian R & D (Research and Development) lebih banyak digunakan sebanyak 55% dibanding dengan metode penelitian lainnya dengan topik penggunaan media pembelajaran elektronik sebagai peningkatan kemampuan berpikir kreatif matematis siswa. Kemudian, penggunaan media pembelajaran elektronik, seperti e-comics, e-modules, learning videos, educational games, mobile learning, edutainment games, visual videos, Adobe Flash Professional, Go-Metra board games on geometry transformation material, Articulate Storyline 3, and e-learning, efektif dalam meningkatkan keterampilan berpikir kreatif matematis siswa. Diharapkan hasil penelitian ini dapat

memberikan informasi yang berguna bagi peneliti lain dan membantu pendidik dalam menerapkan media pembelajaran untuk meningkatkan kemampuan berpikir kreatif matematis siswa di era pembelajaran abad ke-21.

Kata kunci: *Kemampuan Berpikir Kreatif Matematis, Media Pembelajaran, Pembelajaran Abad 21*

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INTRODUCTION

In 21st-century learning, education is one of the things that can build students' abilities and development in learning. According to Hamzah et al. (2024), 21st-century learning is learning that emphasizes students' critical thinking skills, problem-solving tendencies, communication skills, creativity, collaboration, and innovation. These skills must be mastered by students in order to equip them to face the development of the modern era. Of the several abilities that are emphasized, this creative thinking ability is very important for students to have in the 21st century. Creative thinking ability is an ability that is categorized as a high-order thinking (HOT) ability (Faturohman & Afriansyah, 2020). This ability is needed to help students face the changing world in the development of the modern era (Faroh et al., 2022). Thus, creative thinking skills are needed during the learning process to solve a problem and in facing the world of work to develop an agency to be more advanced and modern.

Creative thinking skills can be used in solving problems, especially in mathematics learning. Creative thinking skills in mathematics learning are often called mathematical creative thinking skills. According to Mulyaningsih & Ratu (2018), by teaching students mathematical creative thinking ability, they are better able to solve problems in mathematics learning. Students' mathematical reasoning ability is also influenced by their creative thinking ability (Sudiantini & Shinta, 2018). Mathematical creative thinking skills are very important for students to have in order to think more complexly and more critically when solving mathematical problems (Hanipah et al., 2018; Syahara & Astutik, 2021).

However, there are still some students who have low mathematical creative thinking skills (Ismara et al., 2017). The results of the Trends in International Mathematics and Science Study (TIMSS) show that only 2% of students in Indonesia can work on high and advanced category questions that require creative thinking to solve them. This shows that the level of mathematical creative ability of students in Indonesia is low (Septi et al., 2019). Meanwhile, one of the factors that causes students not to have mathematical creative thinking skills when learning mathematics is an unoptimal learning process (Faturohman & Afriansyah, 2020). In addition, the process of students' mathematical creative thinking ability can be hampered due to their own stage of thinking (Hidayah et al., 2021). Therefore, there needs to be an effort to take action so that students' mathematical creative thinking skills are not hampered and can develop properly.

In accordance with these conditions, there must be innovation in the learning process in order to improve students' mathematical creative thinking skills. One of the efforts to improve students' mathematical creative thinking skills is by using learning media during the learning process. Learning media is designed to stimulate students' thoughts, feelings, and desires, resulting in an effective teaching and learning process (Daniyati et al., 2023). According to Heswari & Patri (2022), the use of Android-based learning media in learning has a positive effect on students' mathematical creative thinking skills. Then, there is also a positive effect on mathematical creative thinking skills when using learning media in the form of multimedia (Khoiri et al, 2013). Based on research conducted by Tazkiyatunnisa et al (2018), pop-up learning media is considered more effective for teaching students mathematical creative thinking in flat-sided space-building material. Therefore, from the description above, it can be concluded that this learning media can be used to improve and hone students' mathematical creative thinking skills.

Based on the above issues, this research will discuss various articles related to the use of learning media to systematically enhance students' mathematical creative thinking abilities. The objective of this research is to identify the research methods used by other researchers regarding the comprehensive use of learning media, both in electronic and non-electronic forms, as well as to analyze the use of learning media that can improve students' mathematical creative thinking abilities. This research is expected to provide information related to the use of learning media for other researchers and to assist educators in applying learning media to enhance students' mathematical creative thinking abilities.

MATERIAL AND METHODS

The research method used is the Systematic Literature Review (SLR) method. This Systematic Literature Review (SLR) is carried out by identifying, reviewing, evaluating, and interpreting all available research. The SLR method is used as a reference to certain research and development methods to collect and evaluate relevant research on a particular topic. With this method, researchers systematically review and identify journals by following established procedures (Triandini et al., 2019). From the above understanding, the researcher raised the title "*Systematics Literature Review: The Use of Learning Media to Improve Students' Mathematical Creative Thinking Ability in 21st Century Learning*" to describe the extent to which the use of learning media developed as an increase in mathematical creative thinking ability and can find out how the important role of learning media in meaningful learning for students. The SLR stages, according to Zawacki-Richter et al. (2020), include:

1. Developing a research question

Questions that are tailored to the needs of this research topic, namely:

1) What type of research method is most often used in articles related to the use of learning media to improve students' mathematical creative thinking skills?
2) What are the results of the effectiveness of learning media in improving students' mathematical creative thinking skills in the use of learning media, and what are the types of electronic and non-electronic-based learning media?

2. Developing a search strategy

The SLR method is often used by researchers as a review process and identifies journals related to the research title. To complete the research, researchers can use Harzing's Publish or Perish application as a collection of several articles in various journals from the Google Scholar database. The keywords used in this research are mathematical creative thinking skills and learning media. The limitation of searching for articles in the publication range is from 2018 to 2023.

3. Selection of the criteria

The collected articles were categorized based on the inclusion and exclusion criteria. Table 1 describes the inclusion and exclusion criteria.

Table 1. The Inclusion and Exclusion Criteria

Criteria	***Inclusion Criteria***	***Exclusion Criteria***
Specific Journal	Relevant national articles related to the use of learning media to improve students' mathematical creative thinking skills.	Irrelevant national articles related to the use of learning media to improve students' mathematical creative thinking skills.
year of publication	Publication in journals/proceedings from 2018 - 2023.	Journal/proceedings publications before 2018 and after 2023.
Language	Using Indonesian and English	Besides using Indonesian and English
Publication Type	Articles obtained from Google Scholar through the Publish or Perish application.	Articles obtained other than from Google Scholar through the Publish or Perish application.

4. The article selection process

After collecting various articles, the next step was to select relevant articles. The selection of articles was done by reviewing them to ensure their relevance and suitability to the predetermined selection criteria. Articles that do not meet the criteria will be screened out and not continued for the next stage.

5. Appraising the quality of articles

The articles analyzed must meet the required criteria based on the questions presented, including:

1) Does the article discuss mathematical creative thinking skills and learning media?
2) Does the article have any relevance to 21st-century learning?

6. Synthesis of the results

The researcher recorded the results of the analysis of each article in a table. Furthermore, this study concludes how the use of learning media affects the improvement of students' mathematical creative thinking skills and compares the effectiveness of electronic and non-electronic media based on the results of the analysis that has been done.

Researchers chose this research method because it makes it easier for other researchers to obtain various information from relevant literature. The collected literature can be used as a basis for thinking to build and improve a scientific work.

RESULT AND DISCUSSION

Result

Based on the search for articles in journals by entering keywords, namely "*mathematical creative thinking ability and learning media*," on Harzing's Publish or Perish application from the Google Scholar database, 200 articles were obtained. Then, article selection was carried out based on the inclusion criteria with a time range from 2018-2023. Analysis of articles on mathematical creative thinking skills and learning media, a total of 20 articles. So, it was found that the most articles published in 2020 were 8 articles, and the least were in 2018 and 2022, with 2 articles each. The following graph shows the number of article publications per year.

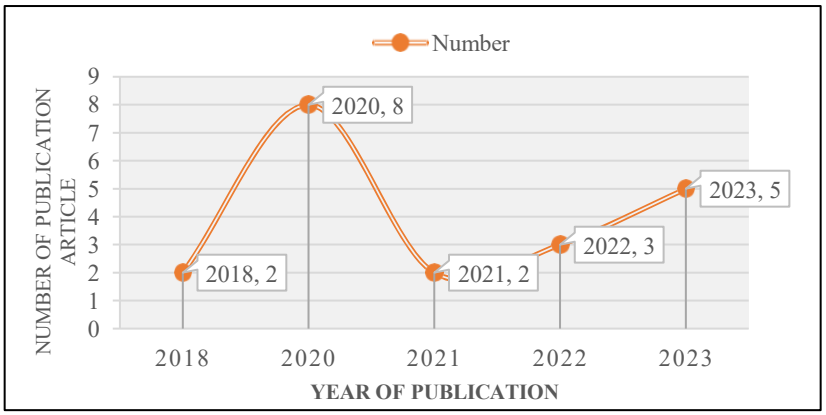

Figure 1. Number of articles published each year

After finding 20 selected articles from 2018 to 2022, the next step is to classify the articles into several sections, such as determining the journal name, authors and year, and research methods. From the classification of the article literature, researchers have summarized the research methods that are often used in the 20 articles obtained. Among the most widely used research methods related to the use of learning media to improve mathematical creative thinking skills from 2018-2023 is the R&D (Research and Development) research method. Based on the results of data analysis, it is known that the R&D research method is used in 11 articles, with a percentage of 55%. The experimental and quantitative

data were 3 articles with a percentage of 15%, the qualitative data were 2 articles with a percentage of 10%, and the literature study data were 1 article with a percentage of 5%. The classification of research methods from the obtained article is presented in Figure 2.

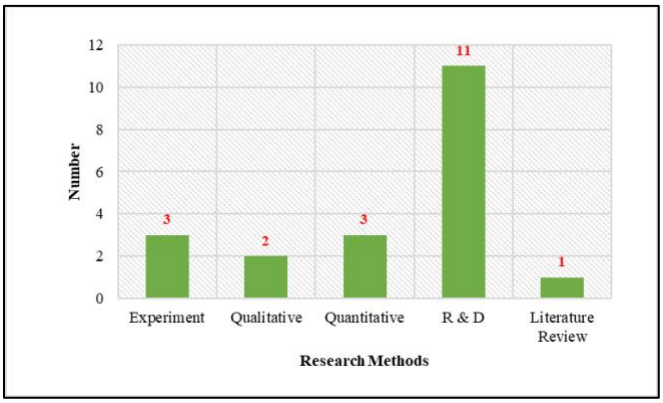

Figure 2. Classification of the research methods from the obtained article

The next step is to determine the research data results. The research data included in this literature review are analyses of articles discussing the use of learning media to enhance students' mathematical creative thinking and the differences between electronic (E) and non-electronic (NE) learning media. The analyzed research results are presented in Table 2.

Table 2. Classification of Research Results and Types of Learning Media

No	Authors and year	Research results	Types of learning media	
			E	NE
1.	Arumsarie et al., 2018	The research results state that the use of Mobile Learning applications is better compared to conventional learning methods. Therefore, in this study, it can be concluded that the Mobile Learning application as a learning medium can be effective in enhancing students' creative thinking skills in Trigonometry. The comparison of the average N-Gain scores in the experimental class was higher than in the control class, which was conducted to improve students' creative thinking abilities.	✔	
2.	Trilaksono & Murtafiah, 2018	The results of the study indicate the development of competency-based learning media using Adobe Flash Professional conducted on Class XI Banking Competency students at Cendekia Madiun to enhance students' creativity in mathematics. This media has proven to be effective and suitable for use in the learning process. The research results show that the learning media meet the requirements of relevance, practicality, and effectiveness.	✔	
3.	Anawati & Isnaningrum, 2020	The research results show that manipulative learning media have a positive influence on the improvement of students' mathematical creative thinking abilities because manipulative media are used to explain mathematical concepts in a tangible form. Therefore, it can be concluded that the use of manipulative media in mathematics learning, especially the concept of spatial shapes, can enhance students' abilities to think creatively in mathematics.		✔
4.	Mahfi et al., 2020	The research results show that the developed edutainment game is valid, effective, and practical in enhancing students' creative thinking abilities. Students' perceptions of this game are also positive, indicating a high level of support. The research results show that the edutainment game as a learning medium is effective, as evidenced by the pre-test and post-test results of students' mathematical creative thinking abilities, with a score of 0.65, which falls under the moderate improvement category.	✔	
5.	Mawanto et al., 2020	This research uses illustrated story media for teaching fractions in second-grade elementary school. The results of the study indicate that the illustrated media can be used in the learning process because	✔	

		it meets the criteria of being valid, practical, and effective. Furthermore, after being tested on a small group, there was a positive change of 80% during the trial phase and 85% during the implementation phase.	

Table 2. Continued

6.	Rachmawati et al., 2020	The research results show that website-assisted learning media can have a positive impact of 98% and is effective for use in mathematics learning for all eighth-grade students at SMP Negeri 3 Mranggen.	✔
7.	Rachmawati et al., 2020	The research results indicate that web-based interactive learning can influence the improvement of creative thinking abilities in eighth-grade junior high school students and is effective in developing their skills. The research results show that the use of web-assisted interactive learning media is effective, with an average student response rate of 88.36%, falling into the very good category.	✔
8.	Rochmad & Ulinnuha, 2020	The research results indicate that blended learning with Gnomio shows better mathematical creative thinking abilities compared to students who receive face-to-face learning. Additionally, the use of blended learning with Gnomio results in a moderate improvement in students' mathematical creative thinking abilities. The use of Gnomio as a learning media can also be combined with the blended learning model as an effort to enhance the mathematical creative thinking abilities of middle school students.	✔
9.	Sanusi et al., 2020	The research results show that students in the experimental and control classes have better mathematical creative thinking skills than students in the control class. They also have comparable initial abilities. This shows that using Android-assisted educational games enhances students' mathematical creative thinking abilities. The research results indicate that the use of Android-assisted educational games can improve students' mathematical creative thinking abilities compared to conventional learning media.	✔
10.	Widiyasari et al., 2020	The findings of this research indicate that the development of mathematics learning tools with the aid of e-learning media has been successfully implemented to enhance students' creative thinking abilities and self-concept, which include the syllabus, lesson plans, student worksheets, and student books. Therefore, it can be concluded that the development of mathematics learning tools with the aid of e-learning media has proven effective in improving students' creative thinking abilities and self-concept in eighth-grade geometry material.	✔
11.	Priangga, 2021	This research develops learning media based on smartphone applications conducted at MAN 1 Pekalongan City. The research results indicate that there is a difference in the average analysis of mathematical creative thinking abilities. The analysis of the experimental class students obtained an average of 71.18, higher than the average of the control class.	✔
12.	Tsani et al., 2021	The research results show that the developed learning media meets the criteria of being very valid with an average score of 4.43, very practical with a final score of 4.45, and effective with an average score of 4.82. This indicates that there is an improvement in mathematical creative thinking skills in the geometry transformation material through the development and use of the Go-Metra board game learning media.	✔
13.	Heswari & Patri, 2022	The research results show that Android-based learning media are effective in enhancing students' creative thinking skills based on the perceptions of eighth-grade students, with an average score of 85.33%.	✔
14.	Mustika, 2022	The research results include product testing with a limited sample of 25 students to gather feedback, conducting group discussions and research, analyzing the effectiveness and practicality of the PjBL-based math e-module, and verifying with experts who have tested it on students. Thus, it can be concluded that the PjBL-based math learning media E-Module is proven to be effective, practical, and efficient in enhancing students' creative thinking abilities, particularly	✔

		in the field of spatial architecture material.	

Table 2. Continued

15.	Noptario & Prastowo, 2022	The research results show that the use of audio-visual media in elementary school mathematics learning can make the lessons less monotonous and more diverse, as well as stimulate students' creativity. These results are also supported by two research sources that state that students are more enthusiastic in the lessons.	✔
16.	Agus & Sholahudin, 2023	The research results show that there is a significant improvement in students' mathematical creative thinking abilities through Android-based learning media, and it has a positive effect. However, the media was less effective when used in mathematics learning in the experimental and control classes X MIPA at SMA 1 Cinangka. The average N-Gain Score calculation results for the experimental class were 53.1499 or 53.2%, and for the control class, it was 30.0204 or 30.02%.	✔
17.	Cahyono et al., 2023	The research results show that the e-comic learning media based on ethnomathematics and creative thinking is effective for geometry material. The research results show that 95% of practical test participants stated that the media can be used in the learning process with an average expert validity score of 3.38, indicating that it is very valid for use. E-comics are very effective in increasing students' learning motivation with an n-gain score of 0.363 and show that the use of e-comics at a moderate level can enhance students' creative thinking abilities.	✔
18.	Nadeak et al., 2023	This research develops video learning media on the topic of sets. The results of this study indicate that the use of educational video media has an impact on mathematical creative thinking abilities, with the average score of the experimental class being higher than that of the control class (82.6667 > 71.2667).	✔
19.	Ranila et al., 2023	The research results show that the Android-based educational game "Titungan" is valid, practical, and effective because it achieves a high level of validity, practicality, and effectiveness in testing with students. It can be concluded that the game can enhance students' mathematical and creative thinking abilities.	✔
20.	Ridwan et al., 2023	The research results show that the use of Articulate Storyline 3 media based on tangrams has a significant positive impact on the creative thinking abilities of fourth-grade elementary school students at SDN Karangantu in flat shape material. Tangram media, based on Articulate Storyline 3, is better used than conventional learning. These results can be obtained from the processing of post-test data, which showed that t-count = 4.811 and t-table 0.05 = 2.000, thus t-count > t-table (4.8 > 2.0).	✔

E: Electronic Media, NE: non-electronic Media

From the results of the previous research, it is evident that the most dominant learning media that can improve students' mathematical creative thinking skills is electronic learning media. There are 95% of electronic learning media that are more effective to use than non-electronic learning media by 5%. This can be a reference for a teacher to develop more electronic learning media to increase students' mathematical creative thinking skills in 21st-century learning. According to Mulyati and Evendi (2020), the learning process becomes fun and can foster enthusiasm and motivation for students if teachers can create interesting learning media to use. The use of interesting and innovative learning media in learning can have a positive effect on students. With that, students are motivated to learn mathematics, become more active and enthusiastic in finding problems, and can improve student achievement.

From the data analysis on the 20 selected articles, it can be said that the use of learning media is not only beneficial for students in improving mathematical creative thinking skills but can also provide significant support for teachers in the learning process. With a variety of learning media available, teachers can choose the most appropriate method to facilitate interactive and interesting learning for students. Collaboration between the use of innovative learning media and the role of creative teachers

can create a learning environment that blends technology and pedagogical expertise to achieve optimal learning objectives. Therefore, the application of innovative and diverse learning media is expected to be one of the effective strategies in improving the quality of mathematics learning in the 21st-century education era.

Discussion

The use of electronic learning media in the learning process shows an increase in students' mathematical creative thinking abilities. Electronic-based learning media can advance education in Indonesia. According to Pajrin et al. (2024), with electronic learning media, students can actively participate during the learning process, thereby enhancing their Mathematical Creative Thinking skills. According to Latifah and Auliya's (2025) perspective, the results of using learning media in the form of Problem-Based Learning-based E-LKPD Mathematics can be declared valid and effective, thereby enhancing students' creative thinking abilities. Rachmawati et al. (2020) stated that web-assisted interactive learning media have the advantage of being able to develop creative thinking skills. Based on research from several experts, there is an increase in students' mathematical creative thinking abilities when using electronic learning media in the learning process.

Electronic learning media are different from non-electronic learning media. The presence of electronic learning media can change the way students think and learn in the classroom. The media can create a more interactive, engaging, enjoyable, and memorable classroom atmosphere in learning, including in mathematics. In this 21st-century education era, electronic learning media is the most important platform in the world of education to assist in the learning process of students, especially in Indonesia. Student engagement during the learning process can enhance their interest in studying. Not only that, electronic learning media can foster students' interest in increasingly advanced technology and enhance their creative thinking abilities. With the presence of electronic learning media, it can serve as an inspiration for teachers and students when learning for the future.

CONCLUSION

Based on the analysis conducted on 20 relevant articles from 2018 to 2023, it can be concluded that the R&D (Research and Development) research method is more widely used, accounting for 55%, compared to other research methods, with the topic of using electronic learning media to enhance students' mathematical creative thinking abilities. The electronic learning media used by previous researchers have proven effective in improving students' mathematical creative thinking abilities, such as e-comics, e-modules, learning videos, educational games, mobile learning, edutainment games, visual videos, Adobe Flash Professional, Go-Metra board games on geometry transformation material, Articulate Storyline 3, and e-learning. From the various electronic learning media, it can provide innovation for mathematics teachers to prepare better, more engaging, and memorable lessons. Thus, the use of electronic learning media can contribute positively to mathematics education and the development of students' creative thinking skills.

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