

## SYSTEMATIC LITERATURE REVIEW: THE EFFECTIVENESS OF MATHEMATICS LEARNING AIDED BY CONCRETE MEDIA AND ARTIFICIAL INTELLIGENCE (AI) IN THE ERA OF NEW SOCIETY 5.0

Moh. Alwi Andiansyah Saputra<sup>1</sup>, Ahmad Nurul Huda<sup>2</sup>, Santika Lya Diah Pramesti<sup>3</sup>

*K.H. Abdurrahman Wahid State Islamic University*

[alwiandiansyah7@gmail.com](mailto:alwiandiansyah7@gmail.com), [ahmadnurulhuda160403@gmail.com](mailto:ahmadnurulhuda160403@gmail.com),  
[santikalyadiahpramesti@uingusdur.ac.id](mailto:santikalyadiahpramesti@uingusdur.ac.id)

### ABSTRAK

Dalam upaya mencapai tujuan pembelajaran matematika di era Masyarakat Baru 5.0, pendidik dihadapkan dengan tanggung jawab untuk lebih dinamis, inovatif dan kreatif. Tujuannya peserta didik memiliki 6 literasi dasar, diantaranya adalah literasi data, literasi digital dan literasi manusia. Integrasi teknologi pendidikan, khususnya media konkret dan media *artificial intelligence* (AI) menjadi salah satu aspek penting dalam upaya tersebut. Penelitian ini bertujuan untuk memahami efektivitas, kelebihan dan kekurangan penggunaan media konkret dan media AI dalam pembelajaran matematika. Peneliti menggunakan metode *Systematic Literature Review* untuk menggali temuan terbaru terkait penggunaan media konkret dan AI dalam pembelajaran matematika. *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)* digunakan dalam pengumpulan data. Data dikumpulkan dari 25 jurnal bereputasi nasional dan internasional yang diterbitkan antara tahun 2019 dan 2024 dari database *Scopus*, *Semantic Scholar*, dan *Google Scholar*. Hasil penelitian menunjukkan bahwa media konkret dan AI memiliki potensi untuk meningkatkan motivasi dan minat peserta didik, menciptakan lingkungan yang mendukung eksplorasi, dan memperdalam pemahaman matematis. Penelitian ini memberikan kontribusi penting dalam memahami peran media konkret dan AI dalam pembelajaran matematika di era Masyarakat Baru 5.0. Temuan penelitian ini dapat membantu pendidik dalam memilih dan menerapkan media yang tepat untuk meningkatkan kualitas pembelajaran matematika.

**Kata kunci** : Media Konkrit, Kecerdasan Buatan, Pembelajaran Matematika, Era Masyarakat Baru 5.0.

**ABSTRACT**

*In an effort to achieve the goals of learning mathematics in the era of the New Society 5.0, educators are faced with the responsibility to be more dynamic, innovative and creative. The goal is that students have 6 basic literacies, including data literacy, digital literacy and human literacy. The integration of educational technology, especially concrete media and artificial intelligence (AI) media is one important aspect in this effort. This study aims to understand the effectiveness, advantages and disadvantages of using concrete media and AI media in learning mathematics. The researcher used the Systematic Literature Review method to explore the latest findings related to the use of concrete media and AI in learning mathematics. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) was used in data collection. Data were collected from 25 national and international reputable journals published between 2017 and 2024 from Scopus, Semantic Scholar, and Google Scholar databases. The results showed that concrete media and AI have the potential to increase learners' motivation and interest, create an environment that supports exploration, and deepen mathematical understanding. This research makes an important contribution to understanding the role of concrete media and AI in mathematics learning in the New Society 5.0 era. The findings of this study can assist educators in selecting and applying appropriate media to improve mathematics learning.*

**Keywords** : Concrete Media, Artificial Intelligence (AI), Mathematics Learning, New Society 5.0 Era.

## INTRODUCTION

The rapid progress of information and communication technology (ICT) has brought drastic changes to people's lives. This drastic change changes digital transformation to create new values and becomes a pillar of industrial policy. Today we live in the era of New Society 5.0 when globalization and the rapid progress of digital technology, such as the Internet of Things (IOT), artificial intelligence or Artificial Intelligence (AI) bring changes to society that encompass increasingly diverse and complex values.

**Objective**The goal of Society 5.0 is to create a society that is close to humanity, where economic development and social mobility are increasingly advanced and people can enjoy a quality life. A society that responds in detail to various community needs and provides the necessary goods and services regardless of region, age, gender, language, etc. The main key to achieving social mobility is by combining the virtual world and the real world to produce high-quality data to create value and new social solutions to solve problems. The national vision planned by our country is to create a new society that is centered on humanity while solving various social problems.

The increasingly rapid and modern development of science and technology brings changes that influence the dynamics of human life, especially in the field of education (Jannah & Oktaviani, 2022). The background of rapidly developing science and technology cannot be separated from human efforts to overcome life's problems which increasingly seem difficult (Syarif et al., 2022). Therefore, innovation and thinking are needed to address and overcome collective problems. One of the latest technological developments that is currently popular is the application of artificial intelligence (Artificial Intelligence) as a form of innovation designed to make human tasks easier in carrying out daily activities (Munadiyal Khairi et al., 2022).

Artificial intelligence or Artificial Intelligence is a computer system that can perform tasks that usually require human intelligence (Sufyan & Ghofur, 2022).

Artificial intelligence is also an information system that refers to capturing, modeling and preserving human intelligence in an information technology system

so that the system has intelligence like humans (Prayogo & Lestari, 2022). Systems in artificial intelligence are designed to solve problems that are usually solved by human intellectual activity, such as improving the performance of computer-based information systems (Agustira & Rahmi, 2022). Artificial Intelligence is also known as a system that makes machines as intelligent as humans, comparing the cognitive systems that humans have, such as humans thinking, solving problems, remembering, perceiving stimuli, recognizing decisions, reacting and acting (Rachma & Hisban, 2022).

Since the emergence of the concept of Artificial Intelligence, it has become a source of inspiration for some people, technology and large technology companies in the world since its emergence (Zahroh, 2022). The same thing was also explained by Anggraeni et al in Rio Christiawan explaining that it was a development that had only begun to be felt on a large scale in the last few years, but before the development of the internet had an impact on every aspect of society, Artificial Intelligence said that History had proven that this had already become a problem. the subject of research by previous experts (Sufyan & Ghofur, 2022). In the last few decades, advances in computer and internet technology have increased the relevance of Artificial Intelligence, making it possible to freely apply it in various fields such as automotive, health, finance, government and education (Marini, 2022). Basically, in mathematics learning before Artificial Intelligence was discovered, concrete learning media were used to help students' understanding.

Education is a field that is closely related to daily life and education is needed to improve human resources and become intelligent and superior humans (Annur & Sari, 2022). Mathematics education plays a very important role in building a living civilization where mathematics makes quality education to produce intelligent and logical people. Mathematics education can be achieved if the quality of education is good with a more modern education system, one of which utilizes artificial intelligence (Artificial Intelligent). ) in mathematics education.

Susanto said that mathematics is an abstract concept that involves symbols, so it is necessary to understand the concept of mathematics before manipulating these symbols. Mathematics learning is a teaching and learning process that involves two types of activities that cannot be separated from learning and teaching,

these two aspects are integrated in an activity when there is interaction between students and teachers, students and students, and students and the environment when mathematics learning takes place in an integrated manner. Together. Teachers as a concept play an important role in creating a conducive and comfortable learning environment to guide students to achieve optimal goals and must be able to act dynamically and flexibly as agents of change, organizers and evaluators to form innovative learning activities for students.

Order teacherIf you are successful in presenting mathematics material well, you need to pay attention to knowing and preparing the mathematics learning material that will be taught. Teachers must also study and develop learning methods, mathematics learning models, and the use of various types of mathematics learning media.

This research uses a Systematic Literature Review (SLR) approach to thoroughly analyze relevant research on data from various studies. SLR by Liberti et al. (2019) and Synder (2019) described as a rigorous research process with the aim of identifying all empirical evidence that meets the inclusion criteria to answer the research questions. Khan, Kunz, Kleijnen, and Antes (2003) identified five stages in implementing SLR, namely: (1) formulating research questions; (2) conduct an article search; (3) evaluate articles; (4) summarize the article; and (5) interpreting article findings (Xiao & Watson, 2019).

The search process for research articles and textbooks was carried out by considering the following aspects: (1) use of mathematics learning media in the new society 5.0 era; (2) effectiveness, strengths and weaknesses of digital mathematics learning media; (3) effectiveness, strengths and weaknesses of concrete mathematics learning media. Literature searches were carried out through several databases such as Scopus, Semantic Scholar, and Google Scholar. Key words used in the literature search include: concrete mathematics learning media, artificial intelligence mathematics learning media, learning media in the new society 5.0 era, physical math manipulatives, and artificial intelligence math manipulatives.

After completing the search, the researcher evaluated the literature found. The literature was filtered using certain criteria to find articles that were relevant to this research. The evaluation criteria used are: (1) relevance of the literature to the

aspects studied; (2) type of literature which includes journal articles and textbooks published between 2017 and 2024; and (3) availability of full access by the public or is the result of proceedings in a journal article.

## **DISCUSSION**

The initial stage in this research is formulating research questions. At this stage, researchers conducted observations of the mathematics learning process in two high schools in Pekalongan Regency, Central Java, in 2024. Based on the results of interviews with mathematics teachers in the two schools, it was found that students had difficulty understanding and applying the concepts. mathematical concepts in solving problems in several learning materials. To overcome this problem, teachers apply differentiated learning innovations. One of the innovations used is the use of learning media supported by artificial intelligence and concrete media.

Apart from conducting observations in the field, researchers also reviewed various literature and research regarding the use of concrete learning media and artificial intelligence in the New Society 5.0 era. Based on the results of this study, the researcher formulated the research questions as follows:

1. How is learning media applied in the field of mathematics studies in the New Society 5.0 era?
2. What are the effectiveness, advantages and disadvantages of concrete learning media in the context of the field of mathematics study?
3. What are the effectiveness, advantages and disadvantages of artificial intelligence learning media in the context of the field of mathematics study?

After formulating research questions, researchers conducted a literature search in the form of research articles and texts according to predetermined criteria, using relevant databases and keywords. Next, an evaluation of the results of the literature search was carried out. A total of 25 articles were found that were considered to answer the research questions in depth. The search results are summarized in Table 1.

Table 1. Table and figure titles are written sequentially. (center aligned and single spaced)

No.	Keyword	Jumlah Artikel
1	learning media in the era of new society 5.0 ( <i>media pembelajaran di era new society 5.0</i> )	7
2	physical math manipulatives ( <i>media pembelajaran matematika konkret</i> )	10
3	AI math manipulatives ( <i>media pembelajaran matematika AI</i> )	8

In the fourth and fifth stages, researchers summarized and interpreted the 25 articles selected in the previous stage. The results of the summary and interpretation were then analyzed further. The following is a brief explanation of the summary results and interpretation of the literature found.

#### **Penggunaan Media Pembelajaran Matematika di Era New Society 5.0**

New Society 5.0, or often referred to as Society 5.0, is a concept of society that places humans at the center, but is based on technology (Anggreini & Priyojadmiko, 2022). This creates priority collaboration between humans and machines/technology to increase efficiency and effectiveness in various fields (Saputra et al., 2023). This concept is a continued development from the previous era, namely Society 1.0 to 4.0 (Asih et al., 2022), to overcome social challenges and problems by utilizing various technological innovations that were born in the Industrial Revolution 4.0 era, such as the Internet of Things (IoT), artificial intelligence, Big Data, and robots (Kahar et al., 2021).

Dalam era saat ini, penerapan pembelajaran matematika dalam dunia pendidikan sangatlah relevan. Teknologi memiliki potensi besar untuk memfasilitasi dan meningkatkan berbagai aktivitas manusia. Oleh karena itu, kebutuhan akan teknologi menjadi sangat penting, dan penggunaan teknologi modern menjadi kunci dalam mengadopsi pembelajaran di era Society 5.0.

The application of technology in mathematics learning in the Society 5.0 era can be done in various ways, including (Saputra et al., 2023).

1. Use of special applications. Various applications such as GeoGebra, Cabri, Wingeom, and Matlab are designed to support mathematics learning in schools. These applications help students understand complex mathematical concepts such as geometry, analysis, and mathematical problem solving.
2. Utilization of interactive technology. Tablets, smartphones and smartboards are interactive technologies that can increase student learning motivation and interaction between teachers and students. With this technology, the learning experience in class becomes more varied, interesting and fun.
3. Use of game-based technology. Game-based learning technology can increase students' interest and enthusiasm for learning, especially in understanding difficult mathematics material. Game-based learning provides a different and fun learning experience for students.
4. Utilization of real-time based technology. This technology allows teachers to provide fast and accurate feedback to students, improving students' learning experience. Apart from that, this technology also helps teachers evaluate mathematics learning effectively and on time.

### **Effectiveness, Strengths and Weaknesses of Concrete Mathematics Learning Media**

According to Mutoharoh (2018), concrete media is a tool used by teachers as an intermediary or introduction of information to students. This media uses objects that are truly real, so that they can be seen, touched, influenced and used directly by students. Concrete media provides opportunities for students to be actively involved in the learning process. The use of concrete media as a tool or support allows students to easily understand the concepts being taught. This is because concrete media allows students to directly interact with physical objects around them. By messing with objects directly, students can develop a deeper understanding and strengthen their skills in understanding abstract concepts. Apart from that, the use of concrete media can also increase students' motivation and interest in learning, because they can see and experience for themselves the application of what they have learned in a real context.(Narayani, 2019).

Relevant research has proven that the use of concrete learning media in understanding mathematical concepts has a positive impact on students. Based on



research conducted by Setyawan (2020), there are several advantages to using concrete learning media. The first advantage is that the use of concrete learning media can increase students' enthusiasm during mathematics learning. This is caused by the variations provided in learning through the use of concrete learning media. Students become more interested and actively involved in operating the media. Apart from that, the use of concrete learning media also helps students connect abstract mathematical concepts with concrete examples that are relevant to their daily lives. This builds students' self-confidence, so they are braver to express their opinions during learning.

One of the second advantages of using concrete learning media in mathematics learning is increasing student learning outcomes or mathematics achievement. Research conducted by Ekajana and Sujana (2017), Hidayah, Dwijanto, and Istiandaru (2018), Leonita and Budiyo (2020), Parmiti and Arnawa (2017), Setyawan (2020), Suartini (2020), Sutarti and Wibawa (2018) have proven this.

The increase in student mathematics achievement is caused by students' ability to understand and remember mathematical concepts with the help of concrete learning media (Suciati et al., 2019). A good understanding of concepts is very important to help students solve mathematical problems. Therefore, the use of concrete learning media can also improve students' problem solving skills, as shown by research conducted by Rokhmaniyah (2019). Apart from that, the use of concrete learning media also has other advantages, namely increasing students' creative thinking abilities (Faridah, Jihan Wahidin Hendriana, 2019) and visual thinking abilities or basic spatial thinking abilities in mathematics (Kania, 2017). Research conducted by Shoimah (2020) found that the use of concrete media helped students visualize abstract concepts in Mathematics material.

Mathematics consists of concepts that are abstract and arranged in stages and sequentially. To understand each mathematical concept, special proofs are needed. Therefore, in studying mathematics, mastery of previous concepts is an important prerequisite for being able to proceed to more advanced concepts. A deep understanding of basic concepts is really needed so that students can properly study and master mathematics comprehensively. (Narayani, 2019). This makes students

feel more familiar and helped in learning Mathematics. Thus, these studies have proven that the use of concrete media can increase interest in learning Mathematics. Interest in learning has a significant influence on students' activeness in learning.

### **Effectiveness, Strengths and Weaknesses of Artificial Intelligence Mathematics Learning Media**

Recently, large language models such as Chat-GPT have begun to enter our lives, and students often refer to these bots. Chat-GPT is perhaps one of the most famous examples of large language models. Devlin (2023) does not consider the GPT (Generative Pre-trained Transformer) system to be a threat to mathematics education; instead, computer artificial intelligence systems can be seen as a useful type of AI. He emphasized that artificial intelligence is different from human intelligence, and machine learning is different from human learning, just as driving a car is different from walking or riding a horse. AI technology is something different and should not be compared to existing technologies; we need to learn how to use this technology in a safe and appropriate way.

Effectiveness in mathematics learning can be seen based on research by Graham (2023) which outlines various uses of AI in mathematics education, such as AI-based visualization and interactive simulations to explain complex concepts; increase learner engagement through personalized math games and challenges; as well as providing AI-assisted remediation and support for students experiencing difficulties. By recognizing the challenges students face in learning mathematics, artificial intelligence (AI) platforms can dynamically adapt instruction by providing additional explanations, visual aids, or exercises tailored to students' unique learning styles (Graham, 2023).

Recently, a book edited by Richard and his colleagues (2023) focused on the contribution of artificial intelligence (AI) in the context of mathematics education. The book provides concrete examples obtained through dynamic international collaboration, and discusses the interaction between humans and machines in mathematics education. The system is able to analyze the steps taken by students, identify possible misconceptions, and provide appropriate hints or explanations, thereby providing personalized assistance and contributing to deeper understanding. Other uses of AI include automated grading, data analysis and

learning, virtual simulations, and visualization, and adaptive testing, where AI algorithms design tests that dynamically adjust difficulty and content based on learner performance.

Van Vaerenbergh and Pérez-Suay (2022) provide a general overview of the various AI systems that can be used in mathematics education, clarifying the current possibilities of AI technology, what is still out of reach, and what can be expected in the near future. The advantages of these AI tools include: (1) personalized learning, where AI tools can personalize education and meet the needs of each learner by providing appropriate content; (2) accurate feedback, which provides precise assessments of student performance and immediate feedback, thereby improving learning; (3) increasing engagement, with educational games and interactive activities that attract student interest and increase student participation.

In their findings, bin Mohamed et al. (2022) show that robotics is the most popular approach for applying AI in mathematics education, especially to improve collaboration in elementary schools. Additionally, other AI-based educational technologies, such as tutoring systems and educational games, have been used in mathematics teaching to provide individualized feedback and support to students, which can improve their ability to solve problems (Mills, 2021). Another study by Qiu et al. (2022) highlighted the role of AI in the development of mathematics education through intelligent tutoring systems and Internet-based learning experiences, concluding that the application of this technology significantly increases students' learning capacity. In general, several studies show that AI can improve problem-solving abilities in mathematics by providing personalized learning experiences, adaptive feedback, and opportunities for collaborative learning. For example, Lee et al. (2022) developed an AI-based collaborative learning system that allows students to work together to solve problems and receive immediate feedback on their strategies. The results of this research show that the system can improve students' problem-solving abilities and encourage social learning through real-time feedback.

The same thing is proven by research conducted by Alissa and Hamadneh (2023) showing that the use of artificial intelligence applications by science and mathematics teachers is at a moderate level with an average of 3.49 and a standard

deviation of 0.79. The most frequently used item was the development of thinking skills (critical, creative, reflective, and imaginative) with artificial intelligence techniques, with a mean value of 4.09 and a standard deviation of 0.96, indicating a high level of use. Other frequently used applications include search engines, translation applications, and Internet of Things technology for interactive activities such as games and simulations. Respondents acknowledged that artificial intelligence stimulates creativity and innovative thinking. Successful experiences from other people also encourage students to use this technology (Alissa & Hamadneh, 2023).

The use of AI tools or applications in mathematics learning can improve students' understanding of mathematical concepts. Hoorn, Konijn, Buuren (2021) mention AI-based applications for mathematics learning, namely (1) online learning platforms such as ChatGPT-powered Tutor Eva, Brainquake, Khan Academy and Coursera which use artificial intelligence techniques to guide students and provide assessments accurate regarding student progress; (2) mobile applications that leverage AI to provide educational games and interactive activities that help students understand mathematics better; (3) learning design tools that help teachers adapt teaching materials and create educational experiences tailored to students' needs, using data analysis and automatic recommendations. (4) In mathematics education in particular, animated images and mathematical representations obtained using appropriate software can increase students' imagination (Voskoglou & Salem, 2020).

Apart from that, there are several weaknesses, including: (1) dependence on technology, which can be a problem in areas with inadequate infrastructure; (2) reduced social interaction, because excessive reliance on AI can reduce interaction between students and teachers; (3) privacy and security challenges, which need to be considered when using AI technology in Education (Wang et al., 2020). Even though AI can provide information to students, (1) AI cannot think for students, (2) AI cannot help students actually learn. As educators seek to increase interest in subjects and mastery of skills, students' use of AI often involves individual interactions with bots that "give instant answers" without forcing students to think or retaining students' knowledge. So teachers still have a crucial role in guiding

students' mathematical development with AI as a supporting tool to improve and assist mathematics learning. The same thing was also expressed by Frieder et al. (2023) compared ChatGPT's mathematical capabilities with other models, such as Minerva. The results show that ChatGPT's math skills are far below the average math graduate student. It's important to note that ChatGPT's training data only goes back to 2021, and lacks insight into recent developments.

## CONCLUSION

This research uses a Systematic Literature Review (SLR) approach to analyze relevant research related to the use of mathematics learning media in the New Society 5.0 era. The main aim of this research is to answer three key questions: (1) how is learning media applied in the field of mathematics studies in the New Society 5.0 era, (2) what are the effectiveness, strengths and weaknesses of concrete learning media in the context of mathematics, and (3) what are the effectiveness, strengths and weaknesses of artificial intelligence learning media in the context of mathematics. The literature search process was carried out through several leading databases using relevant keywords, and 25 articles were selected for further analysis.

The research results show that the use of mathematics learning media in the New Society 5.0 era must consider collaboration between humans and technology to increase the efficiency and effectiveness of learning. In addition, concrete learning media and artificial intelligence each have specific strengths, weaknesses and effectiveness in the context of mathematics learning. Overall, this research provides comprehensive insight into the use of mathematics learning media in the New Society 5.0 era and its implications for the effectiveness, strengths and weaknesses of concrete learning media and artificial intelligence.

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