

**SYSTEMATIC LITERATURE REVIEW: STUDENTS' MATHEMATICAL REPRESENTATION ABILITY IN MATHEMATICS LEARNING****Youlanda L.Man<sup>1</sup>, Mohammad Asikin<sup>2</sup> Sugiman<sup>3</sup>**<sup>1,2,3</sup> Universitas Negeri SemarangEmail: [youlandalman@students.unnes.ac.id](mailto:youlandalman@students.unnes.ac.id)

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CC BY-NC-4.0 (<https://creativecommons.org/licenses/by-nc/4.0/>)**Abstract**

*The ability of mathematical representation in learning is very necessary, especially in learning mathematics. The purpose of this study was to examine the ability of students' mathematical representation in learning mathematics. Data is collected through related journals for review. The research method chosen in this study was to find the SRL (Systematic Literature Review) method. Data collection was carried out by documenting and reviewing all articles on mathematical representation abilities published in the period 2016-2021. The articles used in this study were 29 international journal articles indexed by Scopus and 31 nationally accredited which were obtained from the undergraduate google database using the publish or perish application. The ability of mathematical representation is very closely related to students, especially in learning mathematics, which is a form of interpretation of students' thoughts on problems that are used as tools to find solutions to mathematical problems. The results showed that the ability of mathematical representation in learning mathematics can be improved by providing innovations in learning and providing opportunities for students to develop mathematical representation skills by fulfilling the indicators of the mathematical representation itself. Thus the students' mathematical representation ability is no longer in the low category in solving mathematical problems.*

**Keywords:** Representasi Matematis; Systematic Literature Review.**INTRODUCTION**

Education is the main key in the process of forming more qualified and superior individuals so that they can help change and develop for the better (Županec et al. 2018) . Education is an important part that can make a difference between humans and other living things (Raggi et al. 2016) . As the function of education is a place for humans to broaden students' horizons so that they can apply mathematical concepts in everyday life (Castaneda, Aguilar, and Gómez-blancarte 2019) . Each student has a different mastery of mathematics at each certain level. Mathematics is one of the important sciences in everyday life and for the development of science and technology (Hussein and Nasir 2021) . Mastery of mathematics is very important, the subject matter provided is provision in order to develop attitudes and abilities as well as basic knowledge and skills, and as a tool to understand science and technology. NCTM recommends five main standard competencies, namely problem solving skills, communication skills, connection skills, reasoning skills, and mathematical representations.

Mathematical representation is something that always appears when someone studies mathematics at all levels of education, so it is seen that mathematical representation ability is a component that deserves serious attention (Fincham et al. 2019) . Student representations

allow students to select, apply, and translate mathematical representations to solve problems. For example, translating between mathematical problems and mathematical representations and translating mathematical representations themselves (Kusuma, Mathematics, and University 2020) . When students are faced with a math problem, students will try to solve it using ways that are known or understood. One part of the student's effort is to make a mathematical representation of the problem (Deswantari et al. 2020) . Thus, students must be able to think flexibly in various forms of representation. This implies that students must use mathematical representations to solve problems, because using representations more efficiently helps facilitate students when solving problems (Dari and Logis 2020) . Thus the mathematical representation needs to be emphasized and raised in the process of teaching mathematics in schools. Therefore, in learning mathematics, the ability to express and present mathematical ideas/ideas is something that must be done by everyone who is studying mathematics (Chronaki and Planas 2018) . For this reason, teachers must create learning that directs students to develop these abilities. The objectives mentioned above make it important to analyze students' representational abilities so that teachers know more about the potentials of their students (Education 2018) . The competence expected by the government in learning mathematics is the ability of students in understanding concepts, solving problems , and communicating ideas through symbols, tables, diagrams, or other media to clarify something circumstances .

The NCTM explains that mathematical representation standards for pre-kindergarten through grade 12 should: (1) create and use mathematical representations to organize, record, and communicate mathematical ideas; (2) selecting, applying and translating among mathematical representations to solve problems; (3) using representations to model and interpret physical, social and mathematical phenomena. The reality in the field shows that students' mathematical representation abilities are not yet optimal. Students who have difficulty working on math problems because they don't know where to start. This is related to the lack of mathematical representation ability. The initial step in the stage of working on math problems is to change an object from and to verbal form, symbols, tables or graphs, so that the process of changing this shape contains information that can help solve math problems (Kusumaningsih and Herman 2018) . To work on math problems, students are required to write down what information they know and what the questions are asked to do. This process requires sufficient mathematical representation skills (Moleko et al. 2021) .

The development of mathematical representation skills is one of the goals in learning mathematics (Suarsana 2021) . Mathematical representation involves the ways students use to communicate how they found the answer. To think mathematically and to communicate mathematical ideas, one needs to present them in various forms of representation (Dagan, Satianov, and Teicher 2021) .

## **METHODS**

The method used in this study is the SRL (Systematic Literature Review) method. This SRL researchers do by identifying, reviewing, evaluating and interpreting all available research. With this research method, the researcher reviews and identifies journals systematically which in each process follows the steps that have been set (Utami and Murtianto 2020) . Based on the stages above, to support this research, the researchers collected journal articles on the Google Scholar database with the help of the Publish Or Perish application. The keywords are mathematical representation and *systematic literature review* . The articles collected are only

articles published in the 2016-2021 timeframe. From various articles, the researcher selected 51 articles related to the keywords used.

## RESULT AND DISCUSSION

### Result

The results of the research data included in this literature review are tabulations of documented article data related to mathematical representation abilities as many as 15 articles. For more details see from table below:

**Table 1 . Research Related to Mathematical Representation**

<b>Name and Year</b>	<b>Journal</b>	<b>Research result</b>
(Bhesh Mainali, 2021)	International Journal of Education in Mathematics, Science and Technology	This research is a <i>Systematic Literature Review</i> . Representation is an important skill that needs to be developed so that students are more proficient in learning mathematics. In recent decades, the role of representation in mathematics education has increased but requires more research studies to explore various aspects of representation.
(Dwi Priyo, & Dita Latifatu, 2021)	International Journal of Education in Mathematics, Science and Technology	This research is a qualitative descriptive study with the conclusion that students who have high, medium, and low representations have differences in results. High ability students carry out symbolic representation processes at the level of understanding, students with high abilities are carrying out symbolic representation processes at the problem solving stage, while those with low abilities write what they understand and are asked about the problem.
(Princess Yuanita, 2018)	Plos One	This research is a quasi-experimental which finds that mathematical representation plays an important role, namely as a mediator between mathematical beliefs and solving arithmetic problems.
(Andrzej Sokolowski, 2018)	IAFOR Journal of Education	The current study provides a meta-analysis of global research on the use of representations to support mathematics learning in Pre-kindergarten through Grade 5. Representations provide strong support for their use in Pre-kindergarten through Grade 5 in mathematics and highlight the importance of providing students with opportunities to construct and explore transitions between different forms of representation.
(Heribertus, 2021)	iJIM	This research is a research and development (R&D) using 4D Model development. The

		result of this research is that CAKA can improve the mathematical representation and critical thinking skills of class X SMA students.
(Michael A Hebert, 2016)	Springer	This study analyzes the mathematics-writing intervention, to see how students write mathematics and use writing features to convey mathematical knowledge. The findings show that students use different writing features across the norm-reference measures of their essay writing and math writing. Students also use mathematical vocabulary and representations with varying degrees of success.
(Mustangin, 2020)	International Journal of Scientific & Technology Research	This research is an exploratory qualitative descriptive research. Students who have high representation will be able to solve algebra through verbal representation, symbolism, imagination, and formal notation. Thus, enabling students to successfully solve mathematical problems ranging from analyzing, understanding, to concluding to obtain the correct results.
(Mathilde Kjær Pedersen, 2021)	Mathematics	This research is a <i>systematic literature review</i> . Representations are essential for any mathematical activity, both for students and skilled mathematicians. The results show that there is a clear relationship between the mathematical topics covered and the type of representation used, and further indicates that certain aspects of competency representation are outsourced when DT is used.
(Fitrianingrum, 2020)	Vygotsky: Journal of Mathematics and Mathematics Education	This research is a descriptive analysis with data collection techniques in the form of tests and documentation. In this study, it can be seen that the importance of mathematical representation skills and needed by students in understanding the material given and solving problems, if the mathematical representation ability is lacking, it causes a lack of understanding of students in the material provided so that students find it difficult to understand and work on the questions provided.
(Muhammad Sidiq Nur, 2020)	Variable	This research is a quantitative research with experimental method. The research design used in this study was a quasi-experimental research design with a Two Group Pretest-Posttest Design. In general, it can be

			concluded that the 7E Learning Cycle and Problem Based Learning models can improve the mathematical representation ability of junior high school students in statistical material.
(Siti Ruqyah, 2020)	EduSains: Journal of Science & Mathematics Education		This research is a quasi-experimental research. The effect obtained in this study is that the DMR learning model assisted by sparkol videoscribe is as good as the DMR learning model on mathematical representation abilities, the DMR learning model is better than conventional learning models on mathematical representation abilities and DMR learning models are better than conventional learning models on representation abilities. mathematical.
(Yoni Sunaryo, 2020)	JNPM (National Journal of Mathematics Education)		This research is a quasi-experimental research. The results of data analysis concluded that students who used a problem-based learning model assisted by tungsten mathematica software had an increase in mathematical representation abilities that were better than those using conventional learning.
(Emerged Yuwono, 2021)	JNPM (National Journal of Mathematics Education)		This research is a descriptive qualitative research. Overall, the ability of mathematical representation in solving problems of visual indicators, written texts, and mathematical expressions at 4 stages of Polya is classified as capable and can be done well. Even though in the representation of mathematical expressions, there are several steps that tend to not be able to be done, namely the constraint function, the optimum function, and the optimum value.
(Naila Kurnia Restu, 2020)	Collase: Journal of Elementary Education		This research is a qualitative descriptive study. Third grade elementary school students have difficulty in completing tasks of mathematical representation of fractions. This is due to the low understanding of students towards the commands contained in the questions or the low ability of students to understand the tables presented.
(Sri Rizki Hardianti, 2021)	JPMI: Journal of Innovative Mathematics Learning		This research is a qualitative descriptive study. Students who have high mathematical representation skills have been able to solve symbolic representation indicator questions very well, for visual representation indicators and verbal representations students can complete but there are few errors. Students

with moderate category representation skills can solve visual representation indicator questions, symbolic representations and verbal representations, but there are some errors. While students in the low category cannot solve the three mathematical representation problems properly

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## **Discussion**

Representation is defined as an act of understanding what is obtained and interpreting the form of images in any model through words and being able to say whatever they want to say (Yenni 2020). Mathematical representation plays an important role, namely as a mediator between mathematical beliefs and solving arithmetic problems (Yuanita, Id, and Id 2018). The importance of mathematical representation skills and needed by students in understanding the material provided and solving problems, if the mathematical representation ability is lacking, it causes a lack of understanding of students in the material provided so that students find it difficult to understand and work on the questions provided (Fitrianingrum, Basir, and Article 2020).

The current study provides a meta-analysis of global research on the use of representations to support mathematics learning in Pre-kindergarten through Grade 5. Representations provide strong support for their use in Pre-kindergarten through Grade 5 in mathematics and highlight the importance of providing students with opportunities to construct and explores transitions between different forms of representation (Sokolowski 2018). Third grade elementary school students have difficulty in completing tasks of mathematical representation of fractions. This is due to the low understanding of students towards the commands in the questions or the low ability of students to understand the tables presented (Naila Kurnia Restu, Siti Ruqoyyah 2020). Students use different writing features across the norm-reference measures of their essay writing and math writing. Students also use mathematical vocabulary and representations with different levels of success (Hebert and Powell 2016).

There are several indicators of mathematical representation, including, (1) visual representation, which is presenting data or information in the form of images or diagrams, (2) mathematical equations or mathematical expressions (symbolic), namely solving problems involving mathematical expressions, (3) words or written text (verbal), namely Answering questions using words or written text (Setiawati et al. 2020). Overall, the ability of mathematical representation in solving problems of visual indicators, written texts, and mathematical expressions at 4 stages of Polya is classified as capable and can be done well. Even though in the representation of mathematical expressions, there are several completion steps that tend not to be carried out (Yuwono, Darmawan, and Suwanti 2021).

Students who have high, medium, and low representations have differences in results. High-ability students carry out symbolic representation processes at the level of understanding, capable students are carrying out symbolic representation processes at the problem-solving stage, while those with low abilities write what they understand and are asked about the problem (Dwi Priyo Utomo 2021). Students who have high representation will be able to solve algebra through verbal representation, symbolism, imagination, and formal notation. So, it allows students to successfully solve mathematical problems starting from analyzing, understanding, to concluding to obtain the correct results (Mustangin and Malang 2020). Students who have high mathematical representation skills have been able to solve symbolic representation indicator questions very well, for visual representation

indicators and verbal representations students can complete but there are few errors. Students with moderate category representation skills can solve visual representation indicator questions, symbolic representations and verbal representations, but there are some errors. Meanwhile, students in the low category could not complete the three mathematical representation problems well (Hardianti, Nia, and Effendi 2021) .

Representation is an important skill that needs to be developed so that students are more proficient in learning mathematics (Mainali and Representation 2021) . Several previous studies have obtained results on how to improve and develop this mathematical representation. Representations are essential for any mathematical activity, both for students and skilled mathematicians. There is a clear relationship between the mathematical topics covered and the types of representations used, and further suggests that certain aspects of competency representation are outsourced when DT is used (Pedersen et al. 2021) . The 7E Learning Cycle Model and Problem Based Learning can improve the mathematical representation ability of junior high school students on statistical material (Nur and Prihatiningtyas 2020) . The DMR learning model assisted by sparkol videoscribe is as good as the DMR learning model for mathematical representation abilities, the DMR learning model is better than conventional learning models for mathematical representation abilities and the DMR learning model is better than conventional learning models for mathematical representation abilities (Rukiyah et al. 2020 ) . Students who use a problem-based learning model assisted by tungsten mathematica software have a better mathematical representation ability than those who use Conventional Learning (Sunaryo 2020) . CAKA can improve the mathematical representation and critical thinking skills of class X SMA students (Kurniawan and Kuswanto 2021) . From various previous studies, there is still a need for serious attention to improving mathematical representation. In recent decades, the role of representation in mathematics education has increased but more research studies are needed to explore various aspects of representation.

## **CONCLUSIONS AND SUGGESTIONS**

Based on the results and discussion described above, it can be concluded that the ability of mathematical representation in learning mathematics can be improved by providing innovations in learning and providing opportunities for students to develop mathematical representation skills by fulfilling the indicators of the mathematical representation itself. Thus students' mathematical representation skills are no longer in the low category in solving mathematical problems. Teachers are expected to continue to innovate in learning mathematics in an effort to improve students' mathematical representation.

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