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Systematic Literature Review: Cooperative Learning Model On Students' Mathematical Representation Abilities At Middle School Level

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Abstract. The aim of this research is to determine research trends and describe relevant research results regarding cooperative learning models on the mathematical representation abilities of students at the junior high school/MTs level. The method used in this research is literature study or generally known as Systematic Literature Review (SLR) to answer the problem formulation in the research. This research consists of five stages, namely formulation of research questions (Research Question), literature search (Search Process), determination of inclusion criteria (Inclusion Criteria), assessment of literature sources (Quality Assessment), and data analysis (Data Analysis). The study literature search process was carried out by accessing Google Scholar, Publish or Perish, and Garuda. Data was obtained related to keywords and based on the inclusion criteria, namely 22 articles that met the criteria. The research results from reviewing the 22 articles show that the cooperative learning models most widely used to improve representation abilities are cooperative learning models with the STAD and TPS types. The most published articles regarding cooperative learning models on representational abilities were in 2019. The description of research results related to cooperative learning models on representational abilities is that they are able to improve the mathematical representational abilities of students at the SMP/MTs level and equivalent. The cooperative learning model can be combined with appropriate media, strategies and approaches so that it can improve students' mathematical representation abilities.

Keywords: Cooperative Model, Representation Ability, SMP/MTs.

INTRODUCTION

One thing humans need is education in order to improve their quality. Even for a country, education is very important to continue national development and achieve progress. This is in line with Law of the Republic of Indonesia Number 20 of 2003 which explains that education is a deliberate and planned effort to create a learning atmosphere and learning process so that students actively develop their potential in spiritual aspects, self-control, personality, intelligence, morality and skills needed by himself, society, nation and state. The aim of national education is to develop abilities and form noble character and civilization in order to educate the life of the nation which focuses on developing the potential of students so that they become individuals who believe, are devoted to God Almighty, have noble character, are healthy, knowledgeable, independent, and can become democratic and responsible citizens. One of the sciences needed to improve the quality of every human being is mathematics. With civilization changing rapidly, mathematics continues to be relevant and

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supports change. This is because mathematics is widely applied in various areas of life. Based on the NCTM quoted by (Pancasilawati et al., 2020) in their research article, it is revealed that in mathematics learning there are five standard processes that must be mastered by students, namely problem solving, reasoning and proof, communication, connection, and representation.

Representation is an ability that cannot be separated from mathematics. Representation skills in problem solving and mathematical communication are important because representation skills are needed in creating mathematical models and interpreting solutions (Syafri, 2017). Mathematical representation ability is the ability to express mathematical ideas to solve mathematical problems (Nasruddin et al., 2023). Representation ability is one of the abilities students need to discover and express mathematics so that they can easily accept and understand mathematical concepts according to (Pancasilawati et al., 2020). Therefore, it is hoped that the representational skills possessed by students can make mathematical ideas more concrete and can help students in solving problems that are considered complex to become simpler so that they have a good impact on the ability to understand mathematical concepts. From NCTM in 2000, quoted by (Suwanti & Maryati, 2021), representation is the center of mathematics, so students will be able to use concepts and connect the concepts they already have by making representations to solve a problem.

However, the PISA results in 2018 stated that the representation ability of students in Indonesia was still low. This is because Indonesia received a lower score compared to the OECD average, where the average score was 76%, reaching level 2, namely being able to interpret and recognize a situation that can be represented. This is supported by several studies revealing that students' mathematical representation abilities are still lacking. Based on research conducted (Sofiarum et al., 2020), there are still many students who have difficulty communicating symbols or notation in mathematics. In his research he wrote that one of the reasons learning mathematics is considered difficult by students is that learning activities are carried out only by teachers who tend to be active and students only sit neatly listening and taking notes. Supported by the results of research conducted by (Tamba et al., 2021) based on the results of observations that many students experienced difficulty in answering mathematics questions. They revealed that students had difficulty in changing an object from and to verbal form, symbols, tables, or graphics from the information known in mathematics story problems to help solve the problem. Likewise, according to the results of an interview (Astriani & Dhana, 2020) with one of the junior high school teachers, there are

still many students who have difficulty translating or presenting mathematical ideas in visual form, so they still have difficulty determining the solution model.

A model is a pattern or form that is used as a reference for implementation by a person or group of people in acting. The application of learning models, strategies and approaches must be prepared well and optimally, so that they can have an impact on future learning development. According to (Ardiansyah et al., 2022), in his quote, quality learning means designing meaningful learning, which must use approaches, strategies, methods, techniques and models that involve a lot of student activity and are varied. Therefore, the cooperative learning model was chosen.

A quote from Eggen and Kauchak (Harefa et al., 2022) states that cooperative learning is group learning or a learning strategy that involves students in collaborating or working together to achieve a common goal. According to (Hasanah & Himami, 2021) cooperative learning provides students with the opportunity to learn with peers in structured tasks so that students can become a learning resource for other students and reveal several characteristics of cooperative learning as follows:

1. Team learning. Therefore, learning success is determined by the success of the team.
2. Based on cooperative management. Implementation is in accordance with the 4 management functions, namely planning function, organizational function, implementation function and control function.
3. Ability to work together. Because it is team learning, success is determined by the team's ability to work together to help and complement each other.
4. Skills to work together. This learning encourages students to be able to develop collaboration skills so they want to mingle, interact and communicate with other members.

There are many types of cooperative learning models used in implementing mathematics learning activities at the SMP/MTs level. Therefore, based on the background description above, this research was carried out with the aim of finding out trends in cooperative learning models on students' mathematical representation abilities and descriptions of research results on cooperative learning models on students' mathematical representation abilities at the SMP/MTs level in the last five years, namely in 2019. -2023.

METHODE

The method used in this research is literature study or generally known as Systematic Literature Review (SLR) to answer the problem formulation in research based on relevant previous research. This research consists of several stages, namely the formulation of research questions (Research Question), literature search (Search Process), determination of inclusion criteria (Inclusion Criteria), assessment of literature sources (Quality Assessment), and data analysis (Data Analysis).

The first step is to determine the research question. In this research there are several questions that will be answered. Researchers will ask the following questions:

1. What is the trend in research on cooperative learning models on the mathematical representation abilities of junior high school students in terms of type of cooperative learning model, year of publication, and class?
2. What is the description of the research results related to improving students' mathematical representations based on the cooperative learning model?

The second step is literature search. The study literature search process was carried out by accessing the Google Scholar, Publish or Perish, and Garuda databases. The search was carried out using the keywords "mathematical representation ability", "cooperative learning model", "representation ability and cooperative models", and "cooperative learning for representation ability". The third step determines the inclusion criteria and exclusion criteria for the articles used. The following are the inclusion criteria:

1. Research focus on cooperative learning models with various types of mathematical representation abilities
2. Publications in the form of journals/proceedings
3. Publications in the last 5 years, namely 2019-2023.
4. Research was conducted at the SMP/MTs and equivalent level.
5. Not in the form of research on device development in implementing cooperative learning models on mathematical representation abilities.

The fourth step is selecting the results of the literature search. The literature obtained was selected and analyzed based on inclusion criteria. There were 23 articles that matched the keywords and were based on the inclusion criteria. In the fifth stage, the researcher collected data and then analyzed the article into a table. At the end of the research, the researcher presents the results of the article review and provides conclusions.

RESULT AND DISCUSSION

After several articles were selected based on inclusion criteria, the articles were grouped based on studies, namely the type of cooperative model used, year of publication, study class at junior high school level, and the material tested was grouped by domain in accordance with the independent curriculum. Based on the search results, there are more than 200 articles, but the research focus is on "cooperative learning models on students' representational abilities at the SMP/MTs level". After selection and analysis, 22 articles were obtained that conducted research on cooperative learning models on representative abilities at the junior high school level. Below are presented answers based on the research questions in this article.

1. **Trends in research on cooperative learning models on the mathematical representation abilities of junior high school students**

The results of the study collected 22 articles that were suitable for analysis. From the relevant data, the number of articles published from 2019 to 2023 can be seen in the pictures below.

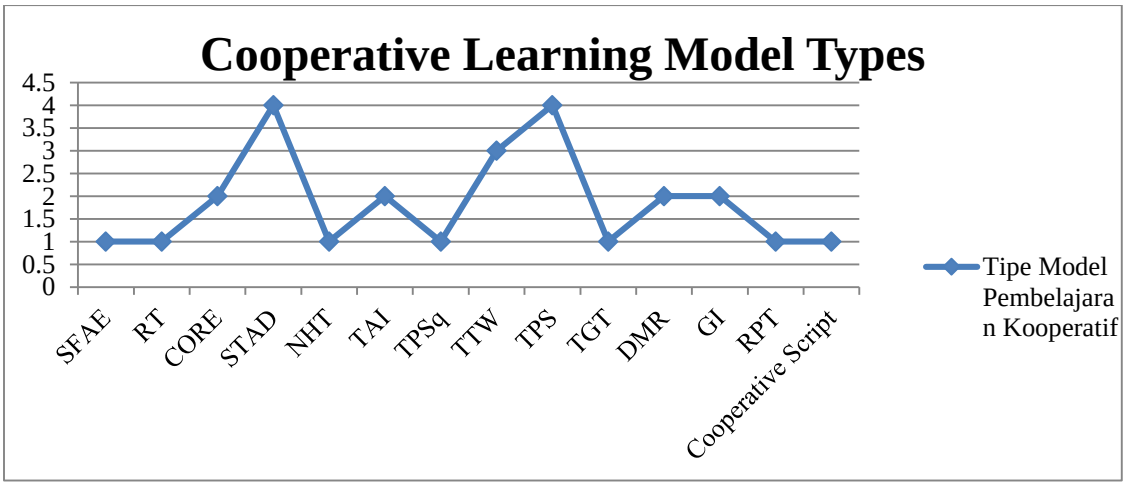

Figure 1. Research data based on cooperative learning model types

From **Figure 1.** it can be seen that there are many types of cooperative learning models that are applied in the world of education to facilitate (improve) students' mathematical representation abilities. From 2019 to 2023 there is the most research using STAD and TPS type cooperative learning models.

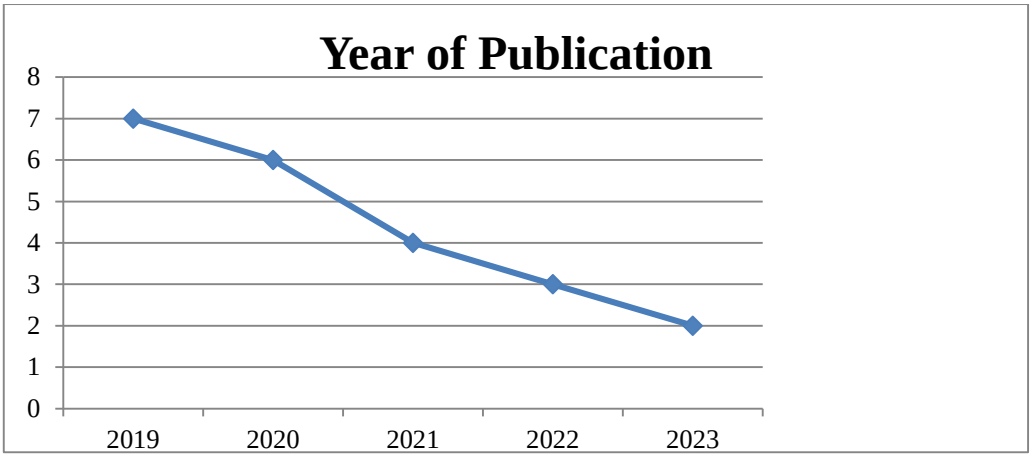

Figure 2. Research data based on year of publication

From Figure 2 above, it can be concluded that research related to representational abilities using cooperative learning models has decreased and has continued to stabilize since 2021. Most studies related to this research occurred in 2019. Of the 23 articles, 8 articles were published in 2019.

2. Description of research results related to the cooperative learning model for improving students' mathematical representation abilities

Documented article data related to students' mathematical representation abilities regarding learning styles, namely 22 articles, is presented in the following table.

Table 1. Results of Cooperative Learning Model Research on Representation Ability

Peneliti dan Tahun	Hasil Penelitian
(Siregar et al., 2022)	This research uses two cooperative learning models, namely the Reciprocal Teaching and Student Facilitator and Explaining models to compare their effectiveness in improving representation skills and self-confidence. Based on the research results, both have an impact, but the RT learning model can improve presentation skills and self-confidence. This is because this learning prioritizes independent learning in understanding, increasing creativity, collaboration, expanding students' self-confidence in communicating opinions.
(Eka et al., 2021)	Based on research conducted, it shows that there is an increase in students' overall mathematical representation ability. With CORE type cooperative model instructional activities, students actively ask and explain several questions given in the form of test instruments, concentrate more on learning and make it easier for students to understand the material being taught. So in this research it can be seen that the positive impact on the ability of mathematical representation has increased. Because it prioritizes how students learn actively through discussion. However, there are still students who think that the CORE model makes them feel tense and less concentrated.
(Arcat & Subchan, 2019)	Based on the research results, the average of the experimental class with the STAD cooperative learning model was higher than the control class. This is because there are steps that can encourage the ability of student representation, one of which is the Achievement or Rewards step. This step makes students motivated to understand the material and try as hard as possible to get the highest score. Therefore, students try to express mathematical ideas as outlined in the worksheet, such as making mathematical models in story problems, so that those who get the highest score will be averaged into the group's final score to determine the award.
(Sukma, 2022)	Based on the research results, there is a contribution from the Numbered Heads

	Together learning model to improving mathematical representation skills that are relevant to previous research. In the process teachers also overcome problems that occur in the field. With NHT, it can encourage students to interact and work together so that they can practice communication and more easily master and understand the material.
(Sofiarum et al., 2020)	Based on the results of research on 1 experimental class with CORE, 1 experimental class with Cooperative Script and 1 control class. From the research results, there was an increase in the two experimental classes in the use of the CORE and Cooperative Script learning models, showing an influence on increasing students' mathematical representation abilities.
(Witaheksantri et al., 2019)	Based on the research results, TPSq plays a more important role in mathematics learning to increase students' self-confidence. This is because students must be able to express opinions or knowledge arguments they have in working on representation questions (Think), then students combine their knowledge arguments with their classmates (Pair). Then students experience the learning process again with a larger group of friends, so that students gain more knowledge or information through question and answer activities with more friends. (Square).
(Zarina & Asnawati, 2019)	Based on research, there is an increase in mathematical representation abilities seen from the presentation of initial and final achievements in indicators of representation ability (representing data in graphical or tabular form, solving problems with mathematical expressions, and writing down solution steps). Learning outcomes with the TTW model regarding representation abilities are supported by the stages of the TTW model which result in students having to play an active role in discussion activities and representing the concepts they have acquired with their group.
(Agustina & Sumartini, 2021)	Based on the results of research comparing two cooperative learning models, namely the STAD model which is carried out in groups and TPS which is carried out in pairs. And both have significant differences but both show good interpretations. As for the advantages of each, for the STAD model, because it is carried out in groups, it can train social skills, while for the TPS model, students get more time to think and help each other.
(Pujianto, 2019)	Based on the research results, using the cooperative learning model and also using the smart number quiz strategy has a better average than the TGT model without the smart number quiz or the expository model.
(Rukiyah et al., 2020)	Based on the results of research conducted with 3 learning models, namely the DMR model assisted by Sparkol Videoscribe, the DMR model without Sparkol Videoscribe, and the conventional model. The results obtained were that the DMR model assisted by Sparkol Videoscribe and the DMR model without Sparkol Videoscribe were not significantly different but had significant differences. This is because students are facilitated to search for literary sources to solve problems independently. However, there is still an obstacle, namely that not all students are active in learning and time management.
(Suryadi & Simanjuntak, 2022)	Based on the research results, class VII-4 students at MTs Hifzil Quran are divided into 3 categories, namely students with moderate and low representation abilities. And it is still divided into the categories of visual, symbolic and verbal representation. With a diversity of representational abilities in presenting a problem, they try to answer every question given so that students are actively involved in gaining an understanding of the material related to the material.
(Waty & Setialesmana, 2019)	Based on the results of research comparing the GI type cooperative learning mode and the DL learning model, it can be concluded that there is a better increase in mathematical representation abilities with the GI model with a scientific approach compared to the DL model. Likewise with the ability to make mathematical connections and produce self-direction with good interpretation in learning using the GI model with a scientific approach.
(Sirad et al., 2020)	Based on the results of research regarding the application of the GI learning model with an open ended problem approach to achieve the goal of improving representation skills, it has been realized. Apart from that, this research also increases student activity in group discussions and teacher performance can be evaluated.
(Pancasilawati et al., 2020)	Based on the research results, there is an effect of learning using the Team Assisted Individualization type learning model with the help of teaching aids on students' mathematical representation abilities.

(Nasruddin et al., 2023)	Based on the results of research on learning effectiveness in this study, good effectiveness was achieved with the TAI learning model and conventional models. However, based on the results, the average increase in mathematical representation ability is higher in the TAI model with a constructivist approach than with the conventional model.
(Suryani & Mashuri, 2023)	Based on the results of research, mathematical representation abilities in cooperative learning of the Reciprocal Peer Tutoring type achieve classical completeness so that this learning is effective for mathematical representation abilities. There is a positive influence of learning style on the mathematical representation abilities of Reciprocal Peer Tutoring Cooperative Learning students.
(Soleha & Budiono, 2021)	Based on the research results, it was found that in the implementation of Cycle I and Cycle II. Because cycle I did not show an increase in representation abilities, continuing in cycle II using the TPS learning model was said to be successful because it could meet the indicators of successful implementation of class actions and could increase various representation abilities based on the Pythagorean theorem.
(Astriani & Dhana, 2020)	Based on the research results, it was found that there was an influence of the TPS learning model on the mathematical representation abilities of students in the experimental class compared to the representation abilities of students in the control class with the conventional model.
(Angraini & dkk, 2019)	Based on the research results, it was found that students' representational abilities were better if learning activities used the DMR learning model with the CBSA approach and were also influenced by each student's learning motivation.
(Khasanah et al., 2021)	Based on the research results, it was found that students' mathematical representation abilities using the TTW learning model with a scientific and open-ended approach had no difference and both achieved classical completeness, and were better than using conventional learning models.
(Putri et al., 2019)	Based on the results of this research, it was found that with the TTW learning model, student representation abilities and learning achievements were obtained that were better than learning using the TPS learning model.
(Zairisma et al., 2020)	Based on the research results, it was found that by combining the syntax of the MEA and STAD learning models you can obtain better mathematical representation abilities so that it is hoped that it can become an alternative learning model.

Based on the results of research on 22 relevant articles previously, it can be seen that there are many types of cooperative learning models that can be used to support the improvement of students' mathematical representation abilities at the junior high school/MTs level. Research articles in 2019-2023 regarding cooperative learning models on students' mathematical representation abilities at junior high school level have the same focus, namely whether there is an influence of cooperative learning models on improving students' mathematical representation abilities. There is a cooperative learning model with the Student Team Achievement Division (STAD) type on mathematical representation abilities (Arcat & Subchan, 2019), (Zairisma et al., 2020), and (Suryadi & Simanjuntak, 2022). Both research results show an increase in students' mathematical representation abilities. Each student tries to come up with ideas to present and solve a problem given by the teacher. This is because in the STAD learning model there are Achievement steps so that students are motivated and try to get this award by studying and understanding the material presented and conveying ideas to solve problems.

There is a cooperative learning model with the Numbered Heads Together (NHT) type (Sukma, 2022). Based on the results of the research, it shows that there is an increase in students' mathematical representation abilities after implementing the cooperative learning model with the NHT type. This is because in the NHT model each student in a group is given the opportunity to discuss their answers to the questions given together with their group. They are required to communicate and discuss with each other in the learning process so they can easily understand and master the material.

The implementation of the cooperative learning model with the Team Assisted Individualization (TAI) type was carried out by (Nasruddin et al., 2023) and (Pancasilawati et al., 2020). From the three articles regarding the cooperative learning model with the TAI type on mathematical representation abilities, it is said that there is an influence on increasing students' mathematical representation abilities. Based on analysis of research results, this learning model allows students to still have responsibility even though they are studying in groups.

The results of research using a cooperative learning model with the Think Pair Share (TPS) type also show an increase in students' mathematical representation abilities (Soleha & Budiono, 2021), and (Astriani & Dhana, 2020). Based on the research results, it was found that it can improve students' mathematical representation abilities. This is because the TPS model can encourage students in learning activities to think, help each other, share and appreciate the differences in abilities possessed by other students, thereby increasing students' mathematical representation abilities. At each step of the TPS learning model the teacher places emphasis on various representational ability indicators, including using the information contained in the image, using symbols to write information on the image and making precise connections between images symbolically. Later, each student discusses with his group of friends and conveys the results of the discussion orally.

Meanwhile, the cooperative learning model with the Think Pair Square (TPSq) type (Witaheksantri et al., 2019) concluded that the final achievement of mathematical representation abilities was better and there was an increase in students' mathematical representation abilities. This is because in TPSq learning students get used to training their self-confidence by showing their independence in making decisions to solve problems (Think). Then students also have to communicate and adjust to differences of opinion in pair discussions. Then, from the results of the discussion, students form comprehensive answers by combining answers. The difference with the previous stage is that students experience it with more friends, so that more students ask each other questions and receive more

knowledge. Students are also trained to socialize and accept differences of opinion, so that students are able to collaborate to determine solutions to given mathematical problems (Square).

Implementation of a cooperative learning model with the Think Talk Write (TTW) type on mathematical representation abilities (Khasanah et al., 2021), (Zarina & Asnawati, 2019), (Putri et al., 2019), and (Khasanah et al., 2021). The results of the research show an increase in mathematical representation abilities according to the indicators (representing data in graphical or tabular form, solving problems with mathematical expressions, and writing down solution steps). There is also a difference in increasing mathematical representation skills with the TTW model compared to implementing learning with the conventional model. This is due to the application of the learning model where students are involved in thinking activities to deal with the problems given (think). Then students are asked to convey the results of their thinking to a group of friends (talk), then students must write down the results of their discussion with the group (write). At this stage it also shows which students are active because during the presentation there are many conflicting opinions or differences in presenting the results of discussions from various groups.

Cooperative learning model with Discourse Multy Representation (DMR) type (Rukiyah et al., 2020) and (Angraini & et al, 2019). These two studies show an increase in students' representational abilities in learning using the DMR model. According to (Rukiyah et al., 2020) the DMR model can improve representation capabilities better with the DMR model assisted by videoscribe than just using the DMR model. Meanwhile, according to (Angraini & et al, 2019) the DMR model makes students' representational abilities better by using the DMR learning model with the Cara Belajar Siswa Aktif (CBSA).

There is a cooperative learning model with the Group Investigation (GI) type with an open ended approach (Sirad et al., 2020). And a scientific approach (Waty & Setialesmana, 2019). According to both students' mathematical representation abilities can be improved with the GI learning model with approach. (Waty & Setialesmana, 2019) said that the GI learning model with a scientific approach is better at improving students' mathematical representation abilities compared to the Discovery Learning learning model. GI learning model with approach Meanwhile, according to (Sirad et al., 2020), the GI learning model with an open ended approach, apart from being able to improve mathematical representation skills, can also increase student activity in group discussions and make it easier to evaluate teacher performance.

According to (Suryani & Mashuri, 2023) the Reciprocal Peer Tutoring (RPT) learning model is effective for students' mathematical representation abilities based on learning styles. From his research, it was found that students with a visual learning style met 3 indicators of representation ability compared to auditory and kinesthetic learning styles which only met 2 indicators of mathematical representation ability.

The article written by (Pujianto, 2019) also examines the effectiveness of the Teams Games Tournament (TGT) type cooperative learning model with the Smart Numbers Quiz strategy. In his research, he compared the TGT learning model without the Smart Numbers Quiz strategy and the conventional learning model. The results obtained show that the TGT learning model can improve mathematical representation abilities more than conventional learning models. However, the increase in students' mathematical representation abilities is better based on average if they use the TGT learning model with the Smart Numbers Quiz strategy. The article written by (Eka et al., 2021) also examines the effectiveness of the CORE (Connecting, Organizing, Reflecting, Extending) cooperative learning model. The results of the research show that students are more active in asking and explaining the questions in the test instrument, making students more concentrated, resulting in students understanding more easily.

There is an article that tries to compare two cooperative learning models on the mathematical representation abilities of junior high school students. As is done (Sofiarum et al., 2020). In his article the researcher compares two cooperative learning models of the CORE type (Connecting, Organizing, Reflecting, Extending) and the Cooperative Scriptsofi learning model. From the research results, there was an increase in the two experimental classes in the use of the CORE and Cooperative Script learning models, showing the significant role of each learning model in improving students' mathematical representation abilities. Another relevant article by (Agustina & Sumartini, 2021). The research was conducted by comparing two cooperative learning models, namely STAD and TPS. Based on the research results, the most visible difference is the STAD model which is carried out in groups and TPS which is carried out in pairs. Both have significant differences but both show good interpretation of mathematical representation capabilities. As for the advantages of each, for the STAD model, because it is carried out in groups, it can train social skills, while for the TPS model, students get more time to think and help each other. Cooperative learning model, Reciprocal Teaching and Student Facilitator and Explaining model (Siregar et al., 2022). The results obtained showed that both had an influence on increasing students' mathematical representation abilities. However, there are differences in results between the

RT and SFAE models. The RT learning model has a higher average than the SFAE model. This is because RT learning prioritizes independent learning in understanding, increasing creativity, collaboration, expanding students' self-confidence in communicating opinions.

According to several studies (Sukma, 2022), (Soleha & Budiono, 2021), and (Witaheksantri et al., 2019) regarding the obstacles faced by teachers in the learning process. Because the cooperative learning model is learning by working together so that when forming groups. This results in the implementation of learning not being in accordance with the time allocation. It is not uncommon for a group, when discussing the results of the discussion, to only rely on one or two people. There are even students who talk about other topics during discussion activities, so that not all group members can achieve the learning objectives. Therefore, teachers need to be firm in giving warnings to students who are less orderly. Apart from that, teachers must also help and accompany students if there are things that students do not understand.

Based on the brief descriptions of several articles above, it can be concluded that cooperative learning models of any type can improve mathematical representation abilities. Of course, there are still certain obstacles that can cause the implementation of a learning model to be unconducive. Therefore, apart from being able to implement the learning model, teachers also need to complete and know how the teacher acts in dealing with obstacles in the learning process. Teachers also need to pay attention to the suitability of the model to the material that will be taught to students. Apart from learning models, teachers can also combine learning models with learning media, selecting learning strategies or learning approaches. So, from the results of the review of 22 articles, many discussed that the cooperative learning model was able to improve the mathematical representation abilities of students at the SMP/MTs level and equivalent. Cooperative learning models can improve mathematical representation abilities by modifying them with appropriate media, strategies and approaches.

CONCLUSION

Based on the results described and the discussion above, it can be concluded that:

1. Based on research trends, it can be concluded that research is related to cooperative learning models on students' mathematical representation abilities at the junior high school/MTs level.
    a) Most research uses cooperative learning models with the STAD and TPS types.
    b) Most articles, journals or proceedings published in 2019.

2. From the results of the literature review it can be concluded that the cooperative learning model is a learning activity that involves the active role of students in working collaboratively with colleagues to achieve common goals. The goal is to learn by working together, to give students the opportunity to be active in discussion activities, determine problem solving, and connect problems with mathematical concepts. It turns out that there are various types of cooperative learning models that can have an influence on improving the mathematical representation abilities of students at the junior high school/MTs level. The cooperative learning model is combined with media and supportive learning approaches/strategies in order to obtain better results. However, there are obstacles faced by teachers in the learning process, so teachers must be able to be firm and continue to guide participants in learning activities.

SUGGESTION

As a suggestion for further research related to cooperative learning models on mathematical representation abilities, it is necessary to pay attention to cooperative learning materials and models that are appropriate to the duration of learning activities and plan activities and actions to minimize the risk of obstacles in learning activities. Second, teachers who will conduct research can modify the learning model with strategies or use technological media. In this way, further research can provide more in-depth information regarding learning activities.

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