Qalamuna - Jurnal Pendidikan, Sosial, dan Agama | Vol. 14 No. 2 (2022)
455-470

SCAFFOLDING IN MATHEMATICS LEARNING SOCIAL ARITHMETIC MATERIAL TO IMPROVE STUDENTS' MATHEMATICAL THINKING

Ni Ketut Wedastuti [1], Sunismi [1], Suryasari Faradiba [1]

[1] Postgraduate Masters in Mathematics Education, Islamic University of Malang, Indonesia
**Corresponding Address*: *ketutweda81@gmail.com*

Received: 20 October 2022 | Approved: 21 November 2022 | Published: 29 December 2022

Abstract: This study aims to describe the scaffolding process in learning social arithmetic to improve students' mathematical thinking skills. The ability to think mathematically is an important skill for students because evaluating information systematically is very useful in solving a problem. This research method uses descriptive research methods with a qualitative approach. This research was conducted in class VII SMP 6 Singosari Malang. The instrument used is Higher Order Thinking Skill (HOTS) questions in social arithmetic math problems. The subjects in this study consisted of two people with high and low levels of mathematical thinking. The results of this study indicate that the scaffolding technique can improve students' mathematical thinking. After receiving scaffolding, Students with high mathematical thinking skills can improve mathematical thinking from the reproduction and connection stages to the analysis stage. In contrast, students with low mathematical abilities can improve mathematical thinking from the reproduction stage to the connection stage after being given scaffolding.

Keywords: Scaffolding, HOTS, Think Mathematically, Social Arithmetic

INTRODUCTION

Education is a learning that aims to sustain human life. In today's life, humans are in the era of globalization, in which a global change has befallen the world. This greatly affects people's economic, political, social, technological, cultural, environmental, etc. This greatly affects people's lives in almost all fields (Wahyudi & Sukmasari, 2018). In facing this era of globalization, humans must continue developing their abilities, one of which is through education. Education is a place to produce quality generations of the nation (Indah Wahyuni, 2022). In education, there are fields of study that play an important role in the era of globalization, one of which is the field of mathematics (Rahmah, 2013).

The aim of teaching mathematics in schools is to train students to think critically and logically and to deduce information deductively and inductively. Thinking is an important cognitive skill in acquiring knowledge (Sastrawati et al., in Winarso, 2014). (Layyina, 2018; Wahyuni et al., 2019) states that the ability to think mathematically is a dynamic process involving developing understanding and applying various mathematical skills such as estimation, induction, deduction, specification, generalization, analogy, reasoning, and verification. In addition, according to (Mason et al., n.d.), mathematical thinking is a process that continues to develop, and the more complex thoughts it can deal with, the more our understanding increases. Based on these various definitions, it can be concluded that the ability to think mathematically is a process that involves collecting information by deductive and inductive methods, analyzing information, and making generalizations to develop understanding and acquire new knowledge. Shafer & Foster (1997) states that there are criteria for thinking mathematically, namely the reproduction stage, the connection stage, and the analysis stage.

Until now, many students have faced difficulties in learning social arithmetic material. (Amam, 2017; Netriwati, 2016; Pebianto et al., 2018; Suryani et al., 2020) states that "questions related to numbers are not so difficult for students, but questions that use sentences are very difficult for students who cannot count. The obstacles students face are not solely due to their limited ability to perform calculations but rather because they do not understand the problems they face.

In the learning process, it is normal for students to encounter difficulties in understanding a concept. This shows that students are actively thinking. They seek to integrate new information into the knowledge they already have in mind. (K. Hamidah & Suherman, 2016; Sidik, 2016) says, "Thinking is a process that starts from finding information (from outside or from the student), processing, storing and recalling that information from the student's memory."

Students often experience difficulties in applying mathematical concepts in real contexts. Several SMP 6 Singosari Malang grade VII students often experience difficulties solving a problem and finding a solution due to limited analytical abilities. They have difficulty solving complex problems or finding patterns in data. The difficulties experienced by these students can be influenced by the level of mathematical thinking skills possessed by students. Therefore, efforts are needed to improve students' mathematical thinking skills, especially in class VII SMP 6 Singosari Malang.

In addition, teachers also need to understand individual differences in students so that they can organize education according to the needs of each student. Each student will experience different developments according to their abilities. They also have different developmental tempos, so the teacher must give lessons by paying attention to the individual developmental tempo of each student. These individual differences affect the way of learning and student learning outcomes. Therefore, teachers must pay attention to these individual differences in learning efforts.

Teachers often do not realize that the lack of attention, understanding and the teacher's role in the learning process impacts students' difficulties. In addition, it is not uncommon for the assistance or intervention provided by the teacher to not pay attention to the source of student difficulties. Sometimes, teachers assist when students are already capable, and this can annoy students. Meanwhile, when students feel they need help, they are ignored. One theory that discusses the level of student difficulty and the concept of providing assistance is Vygotsky's theory of constructivism. Amam (2017), Chairani (2015), Dewi (Nino Adhi) et al. (2020), H. Hamidah et al. (2022), Sari et al. (2022) explain that two important things need to be considered in applying Vygotsky theory. Namely, learning must be prospective and collaborative. Prospective means that students' potential must be able to increase from one meeting to the next. Collaborative means interaction between students and their environment, where students get help from teachers or peers with more abilities in the material. The role of the teacher or peer in collaboration is not only to provide structured instructions to help student performance but to focus more on talking, exploring, and other uses of social media to assist students in controlling their learning. Vygotsky called this type of support dynamic support or scaffolding.

The provision of scaffolding by teachers has been widely applied in the learning process. However, giving scaffolding is often not well planned, so a clear picture of students' mindsets is not obtained when they receive scaffolding during learning. It is important to look closely at this description of the student's mindset because this information can be a reference for making improvements in the planning and implementation of subsequent learning. Several learning techniques can be applied by teachers, one of which is the scaffolding learning technique. The

scaffolding learning technique is a learning technique that encourages student learning interest (Novita Sari, 2017). This technique assists in the form of instructions for solving a problem, provides a brief explanation for solving problems, and provides examples and encouragement in solving a problem (Sa'adah et al., 2021). Based on this background, researchers are interested in obtaining an overview of scaffolding in learning mathematics on social arithmetic material to improve mathematical thinking.

METHODS

Descriptive research with a qualitative approach is the method used for this research. The research subjects were class VII students of SMPN 6 Singosari Malang using a purposive method. The subject taking technique used by giving tests of social arithmetic questions is then categorized using a purposive technique: students with high and low mathematical thinking abilities. So, the number of subjects used in this study was two students. One student has high mathematical thinking ability, and one has low mathematical ability. The data collection techniques used were tests, observations, and interviews, in which students were given social arithmetic questions with the HOTS type of questions. At that time, the researchers used scaffolding techniques and made observations. The interview was conducted when the students had answered the questions. The validity of the data using triangulation techniques. The data analysis technique used is the concept (Layyina, 2018; Yusmin, 2017) Miles and Huberman, namely data reduction, data presentation, and conclusion. The characteristics of mathematical thinking in this study refer to the characteristics discovered by Shafer and Foster (1997), namely the reproduction stage, the connection stage, and the analysis stage.

Table 1. Characteristics of mathematical thinking by Shafelr and Fostelr (1997).

Stage	Indicator	Penjewelds
Reproduction	a. Know the Basic Facts	Able to understand the questions well and be able to compose complete answers, including information already known and questions asked in the questions
	b. Implementing the Algorithm	Able to convert everyday sentences contained in the problem into symbols in mathematics correctly and correctly
	c. Develop Technical Skills	Able to change the data or information obtained from the problem into a suitable solution to solve the problem
Connection	a. Integrating Information	Able to understand the problem in the problem well and understand its characteristics in depth
	b. Make connections within and between domains of mathematics	Able to decipher the sentence in the problem and use rules or rules related to the information contained in the problem to find the right solution
	c. Define formulas (tools) that will be used to solve the problem	Able to analyze new situations using previous rules or rules to determine the appropriate formula to solve problems
	d. Solve non-routine problems	Solve problems by leveraging more than one knowledge

Analysis	a. Social Mathematization	Able to flex the most appropriate and appropriate steps to solve the situation in the problem
	b. Perform Analysis	Able to analyze the information needed to answer the questions in the problem so that it can find the right solution
	c. Perform Interpretation	Able to solve problems properly until they find answers that match the questions in the problem
	d. Develop own models and strategies	Able to develop own solutions or solutions
	e. Developing Mathematical Arguments	Able to explain properly and precisely how the settlement is done, both in oral and written form
	f. Generalize	Able to generalize the results obtained from a problem

In this study, the instrument used was the Higher Order Thinking Skill (HOTS) type questions on Social Arithmetic material, with question categories based on the level of mathematical thinking. The following questions were given to students to collect research data: Nita will shop at the Sumber Kasih store to buy blankets and bed sheets. Nita found a blanket that she liked for Rp. 350,000, previously, she already had a voucher worth Rp. 85,000, the voucher can be used with a minimum purchase of Rp. 300,000, then she goes to another section to find bed linen. Nita wants to buy Rp a blue bed sheet with a Doraemon pattern. 200,000, which says 20% discount. According to shop rules, Nita can only use one type of cut, not both. If you were Nita, what type of cut would you take?

Data processing was discussed with research group friends to be more efficient in data processing. So that the results of the data processing obtained are valid. From the results of data processing, the percentage of each category was formed.

RESULTS AND DISCUSSIONS

The Mathematical Thinking Process of High Ability Students in Solving Social Arithmetic Problems

1. The mathematical thinking process of students with high abilities in solving social arithmetic problems before giving scaffolding techniques.

The subject RA is a category of students with high mathematical thinking who can reach the stages of reproduction and connection. In the following, the answers and interview results are presented regarding the process of thinking mathematically in solving social arithmetic problems with the help of HOTS questions.

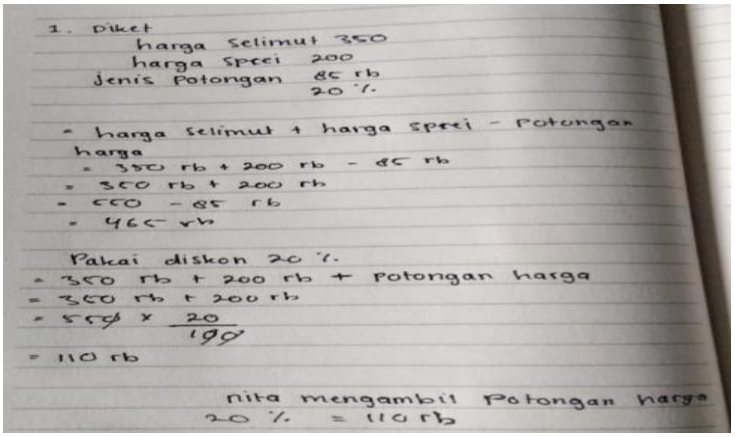

Figure 1. RA answer

RA's mathematical thinking process data can be seen in the interview excerpts below.

Interview (1)

Q : "Can you explain your steps in answering this question?"

RA : “Yes, sis, so I read the questions first. After that, I wrote down everything I knew in the questions. Then my first answer was adding up the prices for blankets and sheets minus the discounted prices for sheets. So 350 + 200 – 85 = 465 thousand. Then my second answer uses a 20% discount, so 350 + 200 + 20% = 110 thousand. Of the two ways, it turns out that the cheapest price is 110 thousand using a 20% discount.

Q : "What do you understand in this matter?"

RA : "What is asked from the question determines which price is the cheapest."

Q : "Then what strategy did you use to answer this question?"

RA : "I use addition and subtraction if I take a discount of 85,000, and I add up all the prices using a 20% discount.”

Based on the answers and interview results above, it can be seen that at the reproduction stage, RA can understand the questions well and write down what is known in the questions, and at the connection stage, RA can understand the problem problems and their characteristics well, but RA cannot determine the appropriate steps according to the conditions. The question means that RA does not meet the analysis stage.

2. Mathematical thinking process of high ability students in solving social arithmetic problems assisted with HOTS questions after giving scaffolding techniques

Based on the incomplete achievement of RA students' mathematical thinking, it was known that RA could not carry out the stages of analysis. Hence, the researchers carried out a scaffolding

technique to improve and complete the stages of mathematical thinking of RA students optimally. Below is an excerpt from the researcher's interview with RA research subjects, which aims to improve RA's mathematical thinking processes in solving social arithmetic problems by applying scaffolding techniques. Interview (2)

P : "Now, identify what information is known on this problem?"

RA : "On the matter, it is known that the price of the blanket is 350,000, the price of the sheet is 200,000, the discount is 85,000, and the sheet discount is 20%.

Q : "Then what is asked in the question?"

RA : "Determining the lowest total price."

Based on the results of interviews (2), the researcher gave a scaffolding technique to identify what was known and asked about the problem given. This can be done to reach RA's reproduction and connection stages in solving social arithmetic problems. By providing RA scaffolding techniques, identifying information becomes simpler so that it is possible to make it easier to solve problems.

After RA reached the ability of the reproduction stage and the connection stage, the researcher again provided scaffolding techniques in the form of instructions, reminded them of some material related to the problem, and asked questions that could attract students to solve problems in the questions which can be seen in the following interviews: Interview (3)

P : "In your answer in calculating the total price, the first step is that you answer the price of the blanket + the price of the sheet - discount = 465,000, and the second step, you answer using the formula for the price of the blanket + the price of the sheet + discount (discount) = 110,000. What is your reason for answering questions with this formula?”

RA : "Yes, sis, because I understand that if you use a discount, the price is reduced, sis, but if you use a discount, it's added."

P : "For the first step, you are correct, but for the second step, isn't it that if we get a discount, the price is reduced?"

RA : "Oh yes, sis, my answer for the second step is wrong."

P : "Well then, what is the right way to calculate the total price when using discounts and vouchers?"

RA : "Yes, sis, I should have multiplied the price of the sheet with the discount first, then from the multiplication of the price of the sheet and the discount, I subtracted it from the initial price of the sheet (while correcting my answer)."

P : "(a few minutes after the RA made the repairs) If you have found the correct answer, what conclusions can be drawn from the answers you got?"

RA : "In conclusion, if I become Nita, I have to take a discount in the form of a voucher."

Based on the interview (3) above, the researcher provides questions that can attract the RA to make conclusions about the answers to the solutions that have been found. Through these questions, it appears that the RA can make the right conclusion by choosing a discount in the form of a voucher. Furthermore, after the ability to solve RA problems was raised, the researcher again provided a scaffolding technique in the form of questions that could attract students to think mathematically, which can be seen in the interview below: Interview (4)

P : "After I gave instructions and questions to you, now I ask you to explain what steps you can take to find solutions to the problems in the questions?"

RA : "The first step, I determine what is known and asked in the problem. Then in the second step, I answered the total price using the voucher with the voucher formula = (350,000 + 85,000) + 200,000 = 465,000. Then I answered the one using the discount with the discount formula = (200,000 x 20%) + 350,000 = 510,000. It turns out that the lowest total price is the total price using the voucher."

Based on interviews (4) above, the researcher provides questions that can attract RA explaining the steps in determining answers. With these questions, it can be seen that RA can describe how the stages of problem solving are carried out, from understanding the problem to finding the final answer. RA can explain what is known in the questions, what is asked in the questions, and the steps in determining the answers to make conclusions. Thus RA can reach the analysis stage. The following are the students' answers after being given the scaffolding technique.

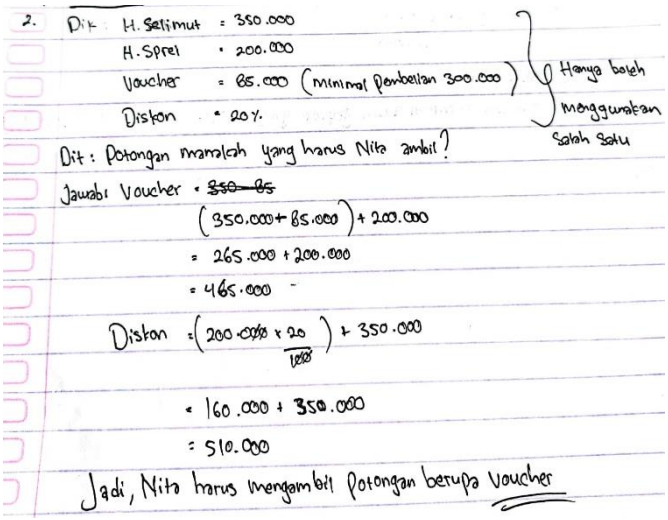

Figure 2. RA answer

The Students' Mathematical Thinking Processes have a Low Ability in Solving Social Arithmetic Problems.

1. The process of mathematical thinking of low ability students in solving social arithmetic problems before giving scaffolding techniques.

AJ is a category of low mathematical thinking students who have not yet reached the analysis stage. Still, AJ can know the basic factors and understand the information in the problem. The following presents the answers and interview results regarding thinking mathematically in solving social arithmetic problems.

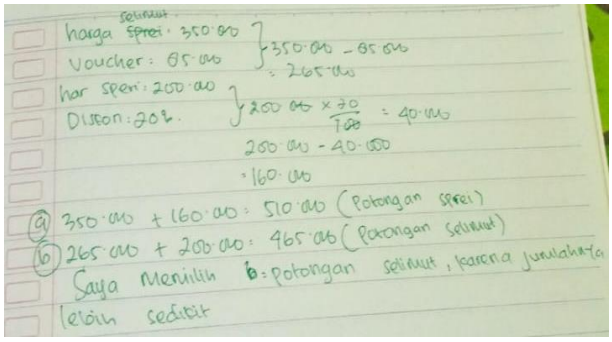

Figure 3. AJ answer

Data on AJ's mathematical thinking process can be seen in the interview excerpt below. Interview (1)

P : "Now try to explain how you determine the answer to the question?"

AJ : “Yes, sis, so I wrote down what I knew in the question, then I immediately answered by reducing the price of the blanket with the voucher, so 350,000 – 85,000 = 265,000. Then I calculated the price of the sheets multiplied by the 20% discount = 160,000. Then I answered 350,000 + 160,000 = 510,000 for the bed sheet, then 265,000 + 200,000 = 465,000 for the blanket. So from my answer, I chose the blanket pieces because there are less of them.”

Q : "Before that, what did you understand from the question?"

AJ : "What is being asked in the question, if I were Nita, which type of cut would I choose?"

Q : "What strategy do you use to answer the questions in the questions?"

AJ : “I calculated the total price with the voucher and also calculated the total price with the discount.”

Based on the answers and interview results above, it can be seen that at the stage of understanding the problem, AJ could decipher the information already known, namely the price of a blanket Rp. 350,000, a voucher of Rp. 85,000, a bed sheet price of Rp. 200,000 and a 20% discount.

This proves that AJ has fulfilled the reproduction stage by understanding the questions well and being able to write down what is known. Then AJ solves the problem in the problem, with the first step determining the total price if using a 20% discount with a result of Rp. 510,000, then the second step determines the total price using a discount of Rp. 85,000, with the result being Rp. 465,000. This can prove that AJ can go through the stages of understanding the problems in the questions and the characteristics of the questions well. The explanation above shows that AJ has not fulfilled the connection and analysis stage because AJ cannot determine the steps that best suit the conditions of the problem.

2. The mathematical thinking process of low ability students solving social arithmetic problems after being given the scaffolding technique.

Based on the stages of mathematical thinking, AJ could only go through the stages of understanding the problems in the questions and the characteristics of the questions. Therefore the researcher provides scaffolding techniques to optimally form AJ's stages of mathematical thinking. The following results of the researcher's interview with AJ are presented to improve AJ's mathematical thinking process in solving mathematical problems through scaffolding techniques. Interview (2)

Q : "From your answer, I see you wrote down what was known in the question and immediately answered what was asked in the question, right?"

AJ : "Yes, sis."

Q : "How can you answer this question?"

AJ : "I understand the problem first, sis, then I write down what is known in the problem, then after I know the question, I immediately answer, sis."

Q : "How do you answer the question?"

AJ : "First, I look for the total price using the discount, sis, by adding the price of the sheets that have been discounted to the price of the blanket, so 350,000 + 160,000 = 510,000, then the second step, I find the total price using the voucher by adding the results of the price of the blanket when used voucher + bed sheet price, so 265,000 + 200,000 = 465,000.

P : "Well, I see the results of your answer are correct, but in writing down the steps in answering the question, you are not quite right."

AJ : "How do you do sis?"

P : "So, first, you have to write down what is known in the question, then write down what is asked in the question, and after that, you answer according to the steps the question wants.

There is a discount (voucher) worth IDR 85,000 and a 20% discount. So you have to calculate the price of the sheets if you use a discount first, then the next step is to find the total price if you don't use a discount and a voucher, then find the total price if you use a voucher and the total price if you use a discount.

AJ : "So it's like that, sis" (while reworking).

Based on the results of interviews (2), the researcher asked questions related to how to determine the steps in answering the questions. So that question made AJ think about describing the steps to answer the problem correctly. Then AJ wrote down the steps to answer the problem correctly. Then the researcher asks questions related to how to conclude the solutions that have been obtained. This is presented in the results of the researcher's interview with AJ below. Interview (3).

P : "Yes, from the results you have found, what can you conclude?"

AJ : "So, it turns out that the cheapest price is, of course, the one that will be chosen, sis, so the total price is the voucher."

P : "Yes, that's true. The conclusion is written at the end after you answer the question."

AJ : "Okay, sis."

Based on the results of interviews (3), the researcher posed questions that could bring up AJ's ideas in making a conclusion on the solution to the problem. From the results of the three interviews, one can see AJ's answers after being given the scaffolding technique below.

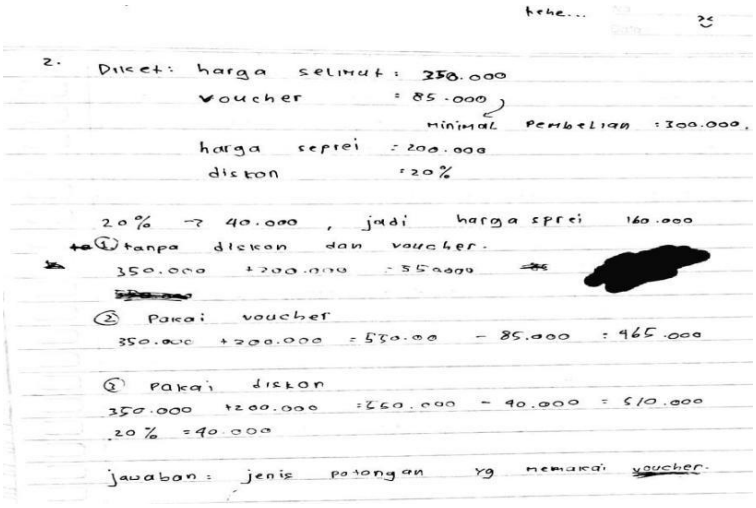

Figure 4. AJ answer

Based on the answers given by AJ and the results of interviews 2 and 3 above, it can be seen that AJ can improve and explain the steps in determining answers to questions. With the scaffolding provided by the researcher, it can be seen that AJ can describe how the stages of problem solving are

carried out, starting from the stage of understanding the problem to the stage of finding the final answer. This proves that AJ has fulfilled the reproduction stage by determining steps and obtaining solutions.

Discussion

Based on the answers and interview results, RA subjects with high mathematical thinking abilities, at the reproduction stage RA were able to understand the questions well and could write down information that was already known about the questions, and at the connection stage, RA could understand the problem problems and their characteristics well, but RA could not determine the steps that are appropriate to the conditions of the question, meaning that RA does not meet the analysis stage. This is in line with research (Layyina, 2018) that students with rational personality types, on reproduction criteria, students can find out basic information, apply standard algorithms, and develop technical skills, while on connection criteria, the ability to think mathematically can integrate information, make connections in and between domains of mathematics, and determine formulas (tools) that will be used to solve problems. The thinking process of Guardian students in solving math problems refers to Polya's steps, starting from the students' thinking processes in understanding the problem, developing a solution plan, solving the problem according to the plan, and re-examining the results. In thinking mathematically, students are trained to think and reason well, create conclusions from problem solutions, explore, create experiments, show similarities and differences, and be consistent and inconsistent (Fajri, 2017).

When the RA subject stops at the connection stage, the researcher provides scaffolding in the form of questions that can attract RA to make conclusions about the solutions that have been found. Meanwhile, subjects from a low level of mathematical thinking, namely AJ, AJ can solve problems only at the reproduction stage. AJ cannot connect, prepare strategies, find solutions, and draw conclusions. AJ only fulfills the reproduction stage, so the researcher provides scaffolding, namely asking questions related to determining the steps in answering the questions. So that question made AJ think about describing the steps to answer the problem correctly. Then AJ wrote down the steps to answer the problem correctly.

Furthermore, the researcher asked questions related to how to conclude the solutions that had been obtained. This is in line with research results (Chairani, 2015; Nugroho, 2017; Sunaryo & Fatimah, 2019) that providing scaffolding techniques can help students develop their mathematical thinking well to solve mathematical problems. This proves that purchasing scaffolding techniques can encourage students to think mathematically and appropriately in solving mathematical problems. In addition, the scaffolding techniques provided are not just questions but in the form of

encouragement and guiding students in solving math problems so that students can answer independently through the encouragement and guidance given (Khusnil Khatimah, Cholis Sa'dijah, 2018). (Sidik, 2016) scaffolding helps overcome student failures in cognitive development, self-esteem, and self-esteem; the drawback is that sometimes students lack confidence in completing their assignments if assistance is reduced or eliminated. In general, scaffolding techniques can improve students' thinking processes and help solve math problems (Chairani, 2015).

CONCLUSION

Referring to the results and previous discussion, it can be concluded that the scaffolding technique can improve students' mathematical thinking processes through several questions, instructions, and directions or encouragement so that students can think mathematically well in solving a mathematical problem. The results of this study indicate that the scaffolding technique can improve students' mathematical thinking. After receiving scaffolding, Students with high mathematical thinking skills can improve mathematical thinking from the reproduction and connection stages to the analysis stage. In contrast, students with low mathematical abilities, after being given scaffolding, can improve mathematical thinking from the reproduction stage to the connection stage. In this research, of course, it can be further deepened. It can be used to develop further research on students' mathematical thinking processes, especially in solving Social Arithmetic problems with the HOTS type of questions. Not only that but the effectiveness of scaffolding techniques must also be reviewed in improving students' mathematical thinking processes.

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