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Use of Scaffolding Techniques in Mathematical Problem Solving in Students Who Have Mathematics Anxiety

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Abstract

Solving mathematical problems is important in mathematics. This research aims to determine the mathematical problem solving abilities of students who have moderate levels of mathematics anxiety by using scaffolding techniques. This type of research is qualitative with a case study approach. The research subjects were 3 class VIII students at a junior high school in Purworejo, Central Java. The research instruments used included problem-solving ability test questions, mathematics anxiety questionnaires, and interview guides. Data is analyzed by reducing data, presenting data, and drawing conclusions. The results of this study indicate that subjects who have mathematics anxiety are having difficulty determining mathematical models and have difficulty with mathematical calculations. The scaffolding technique provided is level 2 in explaining, reviewing, and restructuring. After getting the scaffolding technique, students with mathematics anxiety are able to solve mathematical problems.
Keywords: Math Anxiety, Math Problem Solving, Scaffolding

INTRODUCTION

Mathematics is a field of science that can be found at every level of education, from elementary school, middle school, to college. This shows that mathematics is very important to learn. The important role of mathematics requires students to be able to master the material, because mathematics is a means of supporting various aspects of life (Rahayu et al., 2019). Apart from that, mathematics is a tool needed to solve problems in everyday life. This mathematical problem solving ability is students' efforts to use the skills and knowledge they have to find solutions to mathematical problems (Davita & Pujiastuti, 2020). Problem solving will be very influential in determining the success of mathematics learning. "Problem solving is an integrated part of all mathematics learning and an inseparable part of the learning program"(Wibowo et al., n.d.). Regulation of the Minister of Education and Culture No. 21 of 2016 concerning basic and secondary education content standards states that one of the competencies in mathematics learning is showing a logical, critical, analytical, careful and thorough attitude, being responsible, responsive, and not giving up easily in solving problems (Permendikbud, 2016). Basically, mathematical problem solving ability is an important ability and needs to be mastered by students in learning mathematics.

Based on the results of discussions between researchers and mathematics teachers at one of the state junior high schools in Purworejo, where the objectives of mathematics learning have not been achieved optimally, nor in the learning process are students' mathematical problem solving abilities still able to be said to be successful. The mathematics teacher said that students were only able to work on questions by following the steps given by the teacher. Students are used to memorizing a concept without knowing how the concept formation takes place. Students are able to memorize teaching material well, but do not understand it. Most students are also unable to solve questions that are different from the examples given by the teacher.

From the results of observations by researchers at SMP Negeri 25 Purworejo, one of the problems is that students' ability to solve problems is difficult because teachers always use the same learning model in every mathematics lesson and do not provide appropriate learning techniques, as a result the results of mathematics learning are not optimal. Teachers also give the same treatment to each student, whether students with high, medium or low ability, this also results in the material being delivered not being optimal. In fact, the potential that students have is different so that students with high abilities can easily grasp the material and can understand the problems given and are able to work on practice questions quickly, on the other hand they will get bored because they have to wait for students with medium abilities and low. For this reason, a learning technique is needed that starts from the actual abilities of students, so that they can achieve their potential abilities to the maximum. This process can be done by providing guidance in stages with the help of a teacher. This kind of concept in learning is known as scaffolding.

Scaffolding technique is the process of providing guidance or guidance to students to achieve what must be understood from what is now known. This guidance takes the form of encouragement, warnings, solving problems, providing examples, and other actions that allow students to carry out their own learning (Am & Sarawak, 2021). Based on the teacher's understanding of students' abilities, students are encouraged and assigned to work on tasks that are more difficult and higher than their current abilities with the intensity of guidance or assistance provided by the teacher decreasing. In this way, students' thinking abilities develop, apart from being in accordance with students' intellectual development, they are also influenced by the "thinking challenges" of the assignments given by the teacher.

Regarding this, research conducted by (Ramadhani et al., 2022), the results showed that the mathematical problem solving abilities of students who use scaffolding techniques are better than those using a scientific approach, scaffolding techniques can also be used as an alternative for teachers in improving students' mathematical problem solving abilities and student learning outcomes. Mathematical problem solving ability is one of the factors that can determine student success in learning. Apart from that, there are other factors that can also influence students' success in learning, namely students' psychological factors. One of the psychological aspects that can influence mathematics learning outcomes is students' mathematical anxiety. Mathematics anxiety can be called fear, causing anxiety when students learn or relate to mathematics lessons (Septiarini & Kesumawati, 2020). Generalized math anxiety is defined as feelings of tension, fear or worry that interfere with math performance. Mathematical anxiety can also be interpreted as a feeling of worry that occurs in a person when solving problems related to mathematics.

The level of anxiety for each student is different. Here researchers use anxiety levels according to (Cooke et al., 2018) with a classification of high, medium and low levels of anxiety. This research focuses on students who have a moderate level of anxiety, because there is a possibility that students who have a moderate level of anxiety may not be able to correctly understand a problem and also solve mathematical problems. Based on this description, mathematics anxiety referred to in this research is the attitude or emotional reaction that students show or feel when taking part in learning or interacting with mathematics. Based on the things previously explained by the researchers, it is suspected that students' mathematics anxiety can influence students' achievement of learning outcomes. Although the level of mathematical anxiety that each student has is different in understanding the mathematical problems given. To achieve good problem solving skills, students must be able to reduce their anxiety.

RESEARCH METHODS

This type of research is qualitative research with descriptive design and case studies. This research aims to describe a clear and detailed picture of problem solving abilities through scaffolding in students who have moderate mathematics anxiety. Therefore, a case study is an appropriate design for this research. The subjects of this research were 3 class VIII students at one of the junior high schools in Purworejo Regency, Central Java. Three instruments were used to collect data, namely problem solving test questions, a mathematics anxiety questionnaire adapted from the Development and Validation of the Mathematical Anxiety Scale for Secondary and Senior Secondary School Students" (Ko & Yi, 2011) and an interview guide.

Before use, the questions were validated by two mathematics education experts. Based on the validation results, the questions can be used. After that, the researcher tested the test instrument on 2 students who were not included as research subjects. Based on these trials, researchers made improvements to the questions so that students could better understand them. Next, the researchers used a mathematics anxiety questionnaire to classify students' levels of mathematics anxiety, which then took students with moderate levels of anxiety for research. In addition, researchers used interview guidelines to reveal students' problem solving processes by providing scaffolding techniques. Before use, the interview guide was also validated by experts.

Based on the analysis of mathematical problem solving, students who have moderate levels of mathematical anxiety with the provision of scaffolding show that their ability to solve problems is in accordance with the indicators, but the subjects experience several difficulties in the problem solving stage. Therefore, the researcher investigated how the subject's abilities were provided with the scaffolding technique in solving a mathematical problem solving problem. These questions are presented in Table 1

Table 1. Mathematics Problem Solving Test Questions

Statement
Najwa lives with her mother, Tuntun. Najwa's age four years ago was $\frac{1}{10}$ th of her mother's age in twenty years. Najwa is now five years older than $\frac{1}{6}$ of her mother's age six years ago. How old is Najwa now?

RESEARCH RESULTS AND DISCUSSION

The researcher will describe data regarding the use of scaffolding techniques in solving mathematical problems among students who have mathematics anxiety regarding two-variable linear equation systems. In this study, we used scaffolding technique indicators to solve problems with two-variable linear equation systems in students who had moderate mathematics anxiety. Based on the data obtained, the following is data on providing scaffolding in solving mathematics problems from S1 which consists of four indicators of mathematical problem solving.

1) Identify the problem

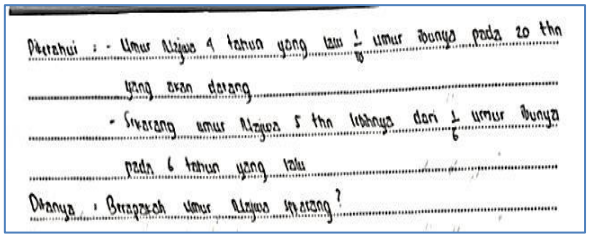

Figure 1. Results Of S1 Answers To The Problem Identification Stage

Based on Figure 1, at the problem identification stage, S1 is able to write down what is known and what is asked about the problem. So scaffolding techniques are not needed at this stage. Apart from the results of the question work, researchers also conducted interviews with S1. The following is an excerpt from an interview with S1.

P	:	Do you know what is known and asked in the question?
S_1	:	You know, sis
P	:	Try mentioning it
S_1	:	Najwa's age four years ago was $\frac{1}{10}$ th of her mother's age in the next twenty years and Najwa's current age is five years more than $\frac{1}{6}$ th of her mother's age six years ago, and what is being asked is Najwa's age now.

2) Plan a solution or build a model

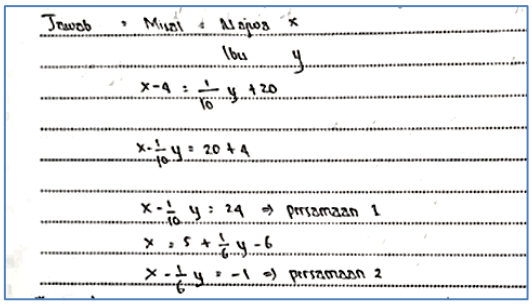

Figure 2. Results Of Undergraduate Students' Answers To The Stage Of Planning A Solution Before Getting Scaffolding

Based on Figure 6, S1 experienced difficulty in creating his mathematical model at the planning solution stage. S1 already understands the steps in building a model by making examples, but S1 is less precise in translating information into mathematical form. Apart from the results of the question work, researchers also conducted interviews with S1. The following is an excerpt from an interview with S1.

P	:	Once you know what you know and what you ask, what do you do?
S_1	:	Create an example by assuming that Najwa's age is x and the mother's age is y, then from what is known, a mathematical model will be created, then there will be equations one and two.
P	:	Is there anything difficult about solving this problem?
S_1	:	Yes, of course there is, I'm still confused about the mathematical model

At this stage of planning the solution or building the S1 model, it is difficult to determine the mathematical model. Then the researcher provides a scaffolding technique, namely at level 2 the explaining or explaining part. The researcher explained again in more detail the meaning of the question. With a more detailed explanation, S1 was able to form a mathematical model correctly. The following is S1's answer at the stage of planning a solution or building a model.

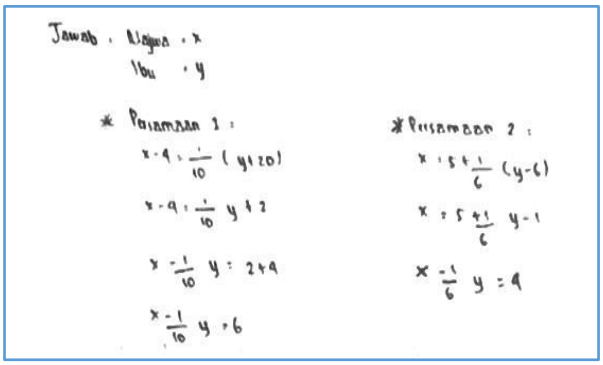

Figure 3. Results Of S1 Students' Answers To Planning A Solution After Getting Scaffolding

3) Menerapkan strategi atau metode untuk menyelesaikan masalah

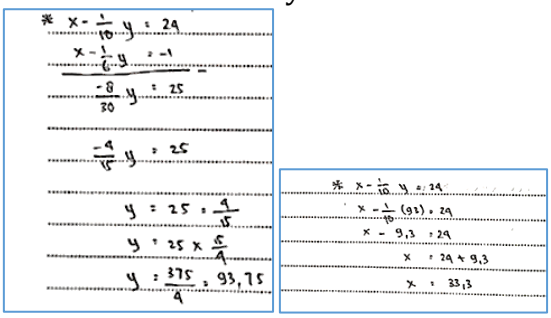

Figure 4. Results Of S1 Students' Answers Applying Strategies Or Methods To Solve Problems Before Getting Scaffolding

After planning, S1 then applies a strategy or method for completion. S1 was able to use the right strategy, but during the solution before getting the scaffolding, S1 experienced an error in building the model, so that at the stage of solving the problem, S1 also experienced an error. Apart from that, in the S1 mathematical calculation process there was an error when solving the mathematical model before getting the scaffolding where the result was $-\frac{1}{10}-\left(-\frac{1}{6}\right)=-\frac{8}{30}$ where the answer should be $\frac{2}{30}$.

Apart from the results of the question work, researchers also conducted interviews with S1. The following is an excerpt from an interview with S1.

P	:	Apart from that, is there anything else difficult?
S_1	:	No, sis.
P	:	What about the elimination section?
S_1	:	Oh yes sis, it's just that you weren't careful enough to subtract it, sis.
P	:	but after that, sis, explain and tell me to check again, then you can do it. Does that mean you understand?
S_1	:	Yes, I understand, sis

From the data above, it shows that S1 is able to apply strategies or methods to solve problems correctly, but errors when building the model cause calculation errors to occur in subsequent stages. Apart from being caused by errors in building the mathematical model in S1's calculation process, there were genuine errors, this was due to S1's lack of accuracy in operating numbers. At this stage the researcher applies the level 2 scaffolding technique, the reviewing part, where the researcher asks S1 to check the answer again to ensure the correctness or find out where the error is. After S1 received the scaffolding, S1 was immediately in the process of solving the problem and getting the correct results. The following is S1's answer at the stage of applying strategies or methods to solve problems.

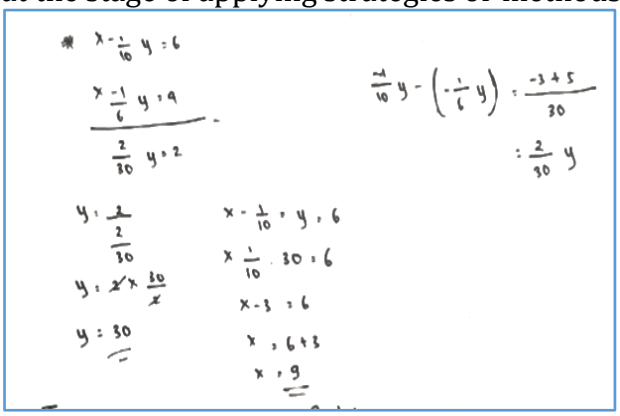

Figure 5. The Results Of The Two Undergraduate Students' Answers Applying Strategies Or Methods To Solve Problems

4) Evaluate the results that have been achieved

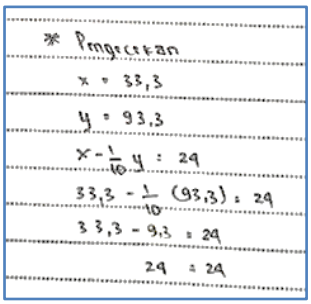

Figure 6. Results Of Undergraduate Students' First Answers At The Evaluation Stage

After S1 finds the final result, S1 writes down the results of checking the answer again to ensure its correctness. Errors in examination results are due to errors at previous stages, but in general S1 is capable and able to carry out examination of the answers he wrote to find out the truth. So at this stage of evaluating the results the researcher did not provide scaffolding techniques to S1. The following is S1's answer at the stage of evaluating the results that have been achieved.

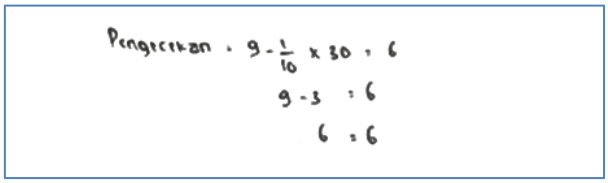

Figure 7. Results Of The Answers Of The Two Undergraduate Students Evaluating The Results That Have Been Achieved

Discussion

Results of research on students' abilities in solving mathematical problems using two-variable linear equation systems in students who have moderate mathematics anxiety using the scaffolding technique. Providing scaffolding in question is providing assistance to students to overcome the difficulties faced by students when solving problem solving problems given by researchers. After giving scaffolding, students can complete it without any more difficulties, so there is no need to give scaffolding again. As said by Sari & Hidayanto (2016), if the problem has been resolved, the scaffolding will be stopped. However, after giving scaffolding, for example, students still have difficulty making mathematical models, so they have to be given scaffolding again and in more detail.

The mathematical problem solving ability of students who have moderate mathematics anxiety by providing scaffolding in several problem solving indicators, the subject experiences errors or difficulties, especially in the part of planning a solution/building a model, the researcher uses the scaffolding technique for the subject to overcome difficulties in planning a solution or building a model. mathematics, namely explaining (scaffolding level 2 at the explaining stage). The researcher explained in detail the meaning of the problem and how to build a mathematical model from the information in the problem, then with a more detailed explanation, the subject was able to form a mathematical model correctly.

Errors in building the model can influence errors at the next stage. Apart from planning the solution/building the model, the subject also experienced errors at the stage of applying strategies or methods to solve the problem. Subjects experienced difficulties in calculating during the elimination process, this was due to the subjects' lack of accuracy in operating numbers, in addition to their inability due to errors when building the model which caused calculation errors in subsequent stages.

In mathematical calculations, the researcher provides a level 2 scaffolding technique in the reviewing section by asking the subjects to re-check the answers they wrote to ensure they are correct or find out where the errors are, so that they can build their understanding. Researchers collaborated a little to help in the solution. After giving scaffolding, the subject was able to complete all the indicators correctly. This shows that the initial provision of scaffolding has been successful, so that the subjects have been able to build their understanding in solving mathematical problems. So it can be concluded that providing scaffolding techniques in learning is said to be effective in improving mathematical problem solving abilities in students who have moderate levels of mathematics anxiety. The results of this research are not much different from the results of research conducted by (Nurhayati et al., 2016), which shows that students' achievement of mathematical problem solving abilities is said to increase with the application of the scaffolding technique.

CONCLUSION

Based on the description of the data and discussion of the results of the research that the researchers conducted, it was concluded that students who have moderate levels of mathematics anxiety experience some difficulties in solving mathematical problem solving questions. Students find it difficult to identify the problems in the questions. Most students do not understand the information contained in the questions to be translated into mathematical form. In the solution, students who are moderately anxious about mathematics are still not careful in mathematical calculations.

After being given the scaffolding technique to students who are anxious about mathematics while solving mathematical problems, the students are able to solve problems with appropriate and correct steps. Students are able to identify problems and are able to determine mathematical models according to the purpose of the problem. Students are also able to explain the steps to solve it. The use of scaffolding techniques in learning mathematical problem solving has been proven to help students who experience moderate anxiety about mathematics.

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