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Analysis of Mathematical Reasoning Ability and Mathematical Creative Thinking Elementary School Students in Solving Story Problems

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Abstract. This research is motivated because the level of students' ability in solving story problems is still relatively low. So the objectives of this study are: (1) to determine the level of students' mathematical reasoning abilities from how to solve story problems; (2) to find out the misconceptions on each indicator of mathematical reasoning ability; (3) to determine the level of students' creative thinking ability on mathematical reasoning abilities. This study uses a descriptive qualitative method with the research subject being class V students, totaling 32 students at SD Negeri 58 Lubuk linggau for the Academic Year 2021/2022. The instruments used in data collection are test questions, observations, interviews and documentation. From the results of the study, it was found that the students' mathematical reasoning ability in solving story problems was 43.25% and students' creative thinking in solving story problems was 39.5%. From these results, students' creative thinking ability in solving story problems can be influenced by students' mathematical reasoning abilities. The conclusion is that students' mathematical reasoning and creative thinking skills in solving story problems are still relatively low.

Keywords: Analysis, Reasoning, Creative, Mathematical, Problem, Story

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INTRODUCTION ~ Mathematics is a tool to develop human thinking, because it is indispensable in solving the problems of everyday life and in dealing with advances in science and technology (Maimunah et al., 2016). Every student is expected to be able to study Mathematics in order to develop science and technology. according to Suhermah (2003) Mathematics is a basic science that continues to develop because of the thinking process. Mathematics is currently being studied by students from elementary school to university. As described (Utami & Wutsqa, 2017) Mathematics is one of the subjects that must be studied by all students at every level of education. The importance of mathematics is not only used in the classroom, but mathematics is always present in everyday life. As stated in Permendikbud Number 58 of 2016 that mathematics is a universal science that is useful for human life and also underlies the development of modern technology, and has an important role in various disciplines and advances the power of human thought.

Mathematics is able to train students' ability to think mathematically will have a big impact on the mindset in everyday life. Five goals of learning mathematics for students have been formulated by NCTM (2000), namely: (1) learning to communicate (mathematical communication), (2) learning to reason (mathematical reasoning), (3) learning to

solve problems (mathematical problem solving), (4) learn to relate ideas (mathematical connections), (5) the formation of positive attitudes toward mathematics (positive attitudes toward mathematics). In detail described in the KTSP (in the Ministry of National Education 2006), students must have the ability to use reasoning on patterns and traits, perform mathematical manipulations in making generalizations, compiling evidence, or explaining mathematical ideas and statements.

Uno (2010) berpendapat bahwa pembelajaran matematika adalah suatu aktivitas mental untuk memahami arti dan hubungan-hubungan serta simbol-simbol kemudian diterapkan pada situasi nyata. Pembelajaran matematika bagi para siswa merupakan pembentukan cara berpikir dalam memahami suatu pengertian maupun dalam penalaran suatu hubungan diantara konsep-konsep. As discribde (Habibatul Izzah & Azizah, 2019) that in learning mathematics, there is a process where students are accustomed to gaining an understanding through experience about the properties that are owned and not possessed from a set of objects (abstraction). During the process of learning mathematics, students will experience the formation of mathematical thinking, one of which is reasoning. According to Ross, quoted by Lithner (2003) that one of the very important goals of learning mathematics is to teach students how to reason. Something bad will happen if the reasoning ability is not developed in students, then for students mathematics will only be material that follows a series of procedures and imitates examples without knowing their meaning.

(Habibatul Izzah & Azizah, 2019) Reasoning ability in mathematics is an ability to use concepts, rules, properties or mathematical logic to get a correct conclusion. Agree with (Agustin, 2016) that reasoning is an activity of logical thinking to collect facts, manage, analyze, explain, and draw conclusions. Reasoning is also defined by Lithner (2003) as a way of thinking taken to process statements and produce conclusions in solving problems. While Turmudi (2008) said that mathematical reasoning ability is a habit of the brain as well as habits in general that must be developed consistently using various contexts, recognizing reasoning and proof are fundamental aspects that must be familiarized in mathematics.

according to Sumarno (Sumartini, 2015) there are eight indicators of mathematical reasoning, namely (1) drawing logical conclusions; (2) Provide explanations with models, facts, characteristics, and relationships; (3) Estimating the answer and the solution process; (4) Using patterns and relationships to analyze mathematical situations; (5) Develop and study the conjecture; (6) Formulating opponents Following the rules of inference, checking the validity of arguments: (7) Compiling valid arguments; (8) Develop direct, indirect proof, and use mathematical induction.

Mathematical reasoning ability can directly improve student learning outcomes. Students with low reasoning abilities will cause students difficulty in understanding mathematical concepts (Puspendik Team, 2014). Reasoning ability is one of the goals in learning mathematics in schools, namely training ways of thinking and reasoning in

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drawing conclusions, developing problem-solving skills, and developing the ability to convey information or communicate ideas through oral, written, picture, graph, map, diagram, and so on. so on (Depdiknas, 2006).

The reasoning process that develops problem-solving skills and is communicated in the form of ideas will also train students' mathematical creative thinking skills. According to Torrance (Ali and Asrori, 2011), creativity is the process of an individual's ability to understand the gaps or obstacles in his life, formulate new hypotheses, and communicate the results, as well as modify and test the hypotheses that have been formulated wherever possible.

Evan (Siswono, 2018) argues that creative thinking is a mental activity to make continuous connections, so that the right combination is found or until the person gives up. According to Munandar (2012) creative thinking is an activity to see or think about extraordinary, unusual things, combining seemingly unrelated information and sparking new solutions or ideas that show fluency, flexibility, originality in thinking (originality) and elaboration. Williams (Siswono, 2018) shows the characteristics of creative thinking skills, namely fluency, flexibility, originality, and elaboration. Isaksen, Puccio and Treffinger. (Fardah, 2012) describes that creative thinking emphasizes the aspects of fluency, flexibility, originality, and elaboration.

To see the reasoning ability and creativity of students in this study, it will be seen from the way students solve math story problems. according to Haji (Amalia, 2017) argues that story questions are the result of modifications to counting questions related to the realities that exist in the student's environment. Math story problems are presented in the form of sentences or short stories related to students' daily life problems.

METHOD

The method in this research is descriptive research method. The type of research used in this research is qualitative. The subjects in this study were grade 5C students with a total of 32 students at SD N 58 Lubuklinggau in the 2021/2022 academic year who had obtained the material for fractional arithmetic operations. Data collection techniques in this study are test, observation, interview and documentation techniques.

The test questions in this research instrument are accurate questions taken from students' books. Problems are used to determine the mathematical reasoning ability and mathematical creative ability of students. Interviews were conducted on research subjects to determine directly the reasoning ability and creativity of research subjects. The observation questionnaire in this study was used to analyze the reasoning and creativity abilities of students' answers. The interview guide in this study was used to find out directly from the research subject in finding information on mathematical reasoning abilities and mathematical thinking creativity. Interviews were also conducted to determine the match between the answers that had been written on the answer sheet and what the students would say orally. Meanwhile, documentation was conducted to obtain information on student data and grades related to students' mathematical abilities during mathematics lessons,

especially on fractional arithmetic operations in class V.

The validity of the data in this study includes four criteria, including the degree of confidence (credibility), the criteria for transferability, the criteria for dependability (dependability), and the criteria for certainty (confirmability). The triangulation technique in this study was carried out by comparing the data on the results of written tests of students' mathematical abilities and creativity, observation data on students' reasoning and creativity abilities and the results of direct interviews with research subjects.

RESULTS

To determine students' reasoning abilities in solving story problems, students are given test questions from the material they have learned, namely fractional arithmetic operations material. In this study, the reasoning indicators analyzed are analyzing mathematical situations, planning the completion process, predicting answers, compiling conjectures, compiling arguments, checking the validity of arguments, compiling evidence and drawing logical conclusions.

Each reasoning indicator is analyzed to find out the misconceptions of the process of solving story problems given to students. The research subjects were divided into 3 categories, namely students with high abilities, students with moderate abilities and students with low abilities.

High ability subject (ST)

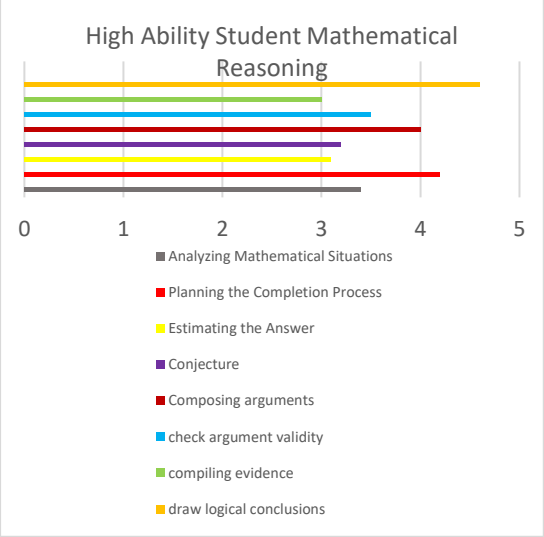

Figure 1. Graph of Mathematical Reasoning of High Ability Students

From the picture above describes the results of the analysis of mathematical reasoning totaling 10 students. There are 8 indicators of mathematical reasoning in this study, which can be described from the graph above. the ability to analyze mathematical situations is quite good, it can be seen from the graph that the score is 3.4 or 68% good. The indicator estimates that the answer is at a score of 3.15 or 63% good. The indicators for compiling arguments are at a score of 4 or 80% good. The indicator of compiling evidence is still relatively low compared

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to other indicators, which is at a score of 3 or 60%. Students are classified as good at planning the problem-solving process well and looks systematic, the indicator is at a score of 4.2 or 84%. In the indicators of constructing conjectures, students also have good reasoning skills in doing conjectures with a good score of 3.2 or 64%. Students who have good abilities also have good argument validity, namely 3.5 or 70%. While the students' ability to draw conclusions is very good, where the score obtained is 4.6 or 92% good.

High ability students are still weak in doing proof, it can be seen from the graph that the proof is in the lowest position. It is also supported by the results of interviews that students can only answer the story questions in writing or orally, but are not able to prove that it is true. Because students are rarely given examples or working on questions that must be proven, students only know the answer is correct if the teacher corrects it.

From these results, it can be concluded that on average students who have good abilities have good mathematical reasoning abilities as well. this is supported by the results of interviews by 5 students who are known from the answers they write with those they know really understand the mathematical situation to be able to draw logical conclusions from the story questions presented.

Medium Ability Subject (SS)

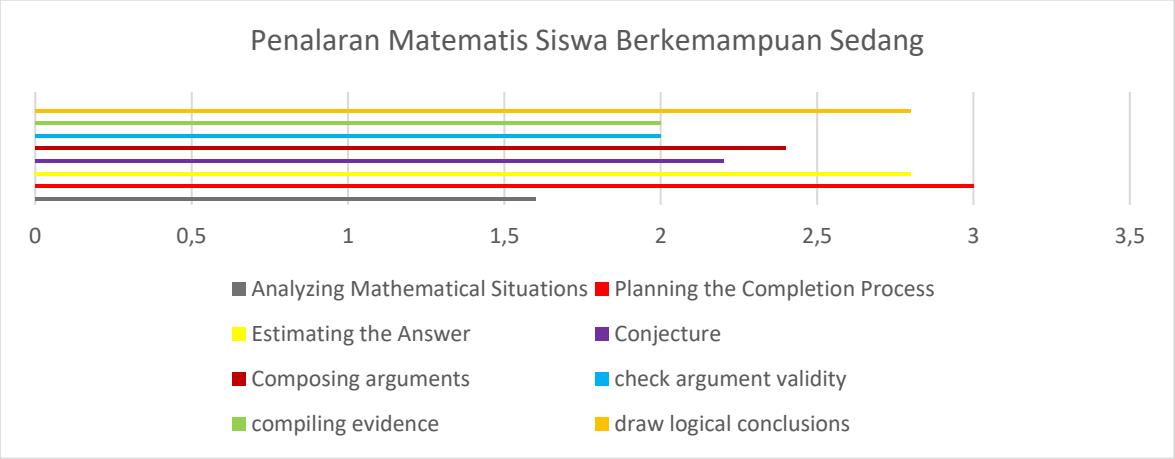

Figure 2. Graph of Mathematical Reasoning of Medium Ability Students

From the picture above, the results of the analysis of students' mathematical reasoning, totaling 11 students with moderate abilities, were obtained. In analyzing the mathematical situation, the average student is still relatively less mastered, it can be seen in the students' correct answers in planning the completion process, but at certain steps many are stopped and the answers are not completed. In the indicator of analyzing mathematical situations in solving story problems, students get a score of 1.66 or 34%. In predicting the answer, the students were good enough. This can be seen when 5 students were interviewed to clarify the answers they were working on, that students understood the situation of the story that was difficult to understand, many

students did not know the steps or procedures that had to be done.

For other indicators, it is still influenced by the ability to analyze situations and construct conjectures. It can be seen from the answers of students who cannot solve the questions in the answers, but at the time of the interview the students understand the formula and how to solve the formula. The questions presented in the form of story questions are difficult for students to analyze in compiling answers. Students are also unable to make conjectures or conjectures because they are not able to analyze the story in question. So that students have difficulty in answering math problems in the form of story questions.

Students who have moderate abilities have good abilities in the indicators of planning the completion process, which are at a score of 3 or 62%. Planning in completion affects indicators in drawing conclusions, where students who are good at planning completion on average are correct in drawing conclusions. Meanwhile, students who are not able to develop a settlement plan cannot draw conclusions from the answers that students write on their respective answer sheets.

Low Ability Subject (ST)

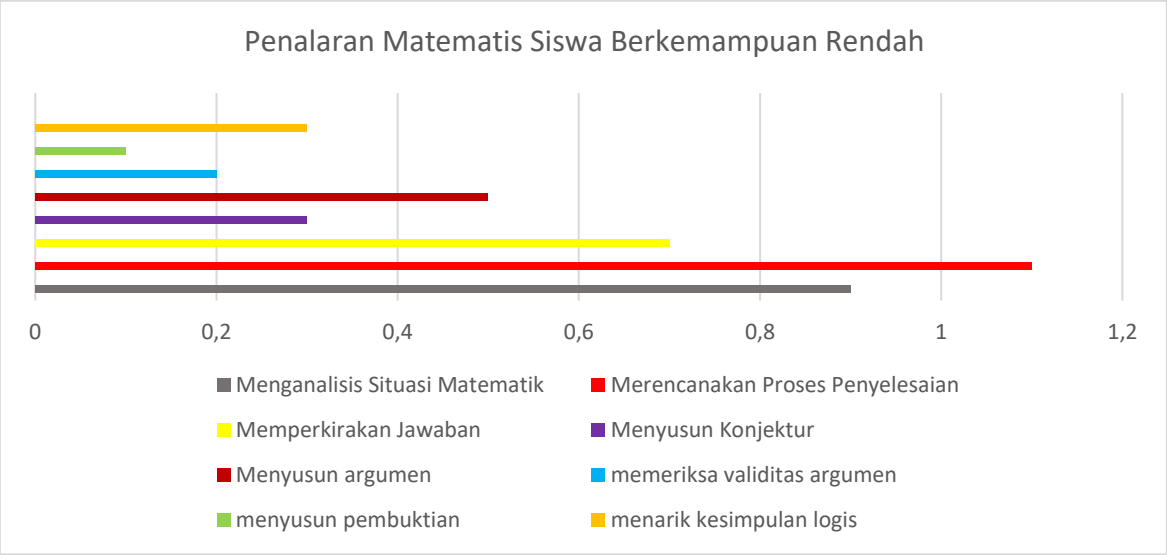

Figure 3. Graph of Mathematical Reasoning of Low Ability Students

From the picture above, the results of the mathematical reasoning analysis of students with low abilities are obtained with a total of 11 students. The average reasoning results based on the answers to test questions with fractional arithmetic operations material in the form of story questions, students are classified as having good reasoning abilities.

Students with low abilities on average are less able to analyze mathematical situations to draw conclusions. From the students' answers, students were only able to write numbers or mathematical symbols and almost the answers could not be corrected because students' reasoning was still low. When the interview was conducted, the arguments given by the students were not structured

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so that it was very visible that the students did not have the ability to reason, and the students could not predict the answers to the story questions orally. Of the 5 students who were interviewed there were also those who mentioned the process of planning the answers even though they were not in order, but in fact the answers could not be written down.

From all research results, it can be seen from 32 students who were given story test tests, only 43.25% of students were said to have good mathematical reasoning abilities. The student can answer the story questions correctly and completely. While the remaining 56.75% of students still do not have good mathematical reasoning abilities. Students who have the ability to reason can answer fractional arithmetic operations even though they are presented in the form of story questions. While students who have low abilities have difficulty in answering math problems in the form of story questions.

To measure the ability to think creatively in mathematics in solving story problems, three indicators are used, namely fluency, flexibility and novelty. The results of this study were obtained from test data using story questions with arithmetic operations material.

High ability subject (ST)

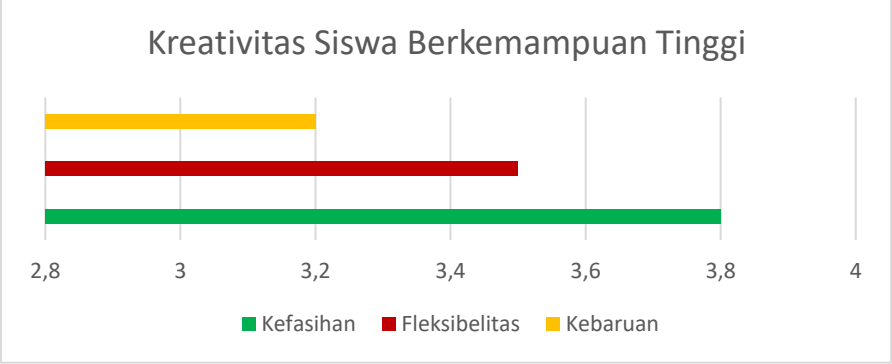

Figure 4. Graph of High-Ability Student Creativity

From the graph above, students have good fluency in answering story questions. Students are not rigid in answering questions on the answer sheet provided. The story problems given are solved with good procedures and accuracy. Of the 10 students there are 6 people who use the answer style with the pattern of knowledge they have. The answer is not the same as the others based on the procedures in the book, but in drawing conclusions the results are the same.

Medium Ability Subject (SS)

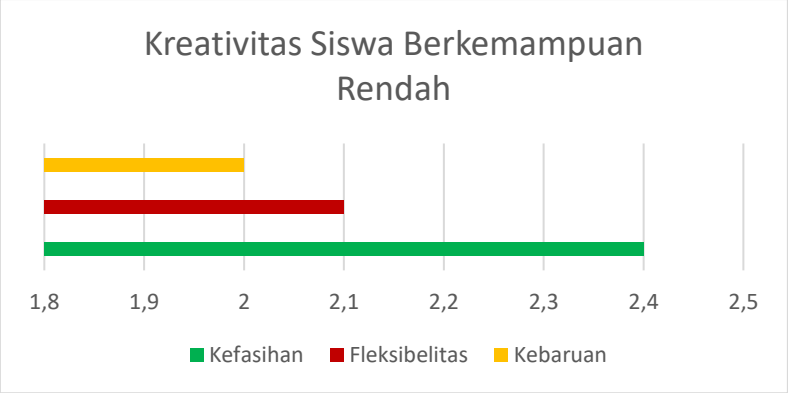

Figure 5. Graph of Medium Ability Students Creativity

In moderately capable students, students are only fluent in answering the story questions given, still many students are not used to answering questions that require an analysis process of the problems presented in the form of stories. Students are more accustomed to direct questions without using sentences or stories, this can be seen when students are interviewed. Of the 11 students, 5 interviewed were able to answer the questions briefly mentioned. While the answers to the story questions do not match the correct answers.

Students also have not come up with many new ideas in answering story questions, this is influenced because students have not been able to analyze story questions that require a reasoning process.

Low Ability Subject (ST)

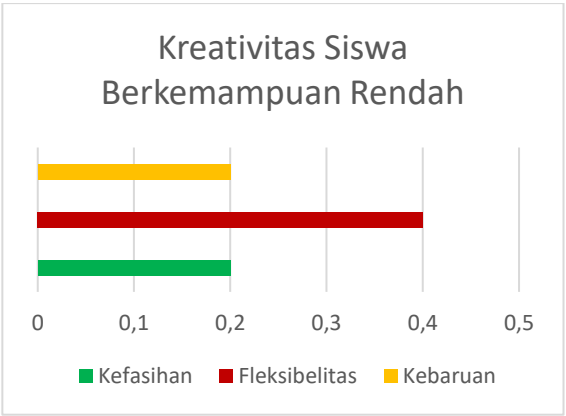

Figure 6. Graph of Low Ability Students Creativity

Low-ability students, when given story questions. From the answers of 11 people, on average they have not been able to think creatively in solving story problems. The way students answer questions is not right and students' answers are also not

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systematic or procedural. Students who have not been able to develop a completion plan or a conjecture will have difficulty in performing fluency, flexibility or novelty to come up with new ideas in answering a story problem.

The average of the results of the analysis of students' creativity in solving story problems is still relatively low, namely 39.5% of the 32 students of class 5C who are categorized as good. while the remaining 60.95% of students do not have the ability to think creatively in mathematics.

DISCUSSION

Mathematical reasoning is an important aspect that must be possessed by students, despite the fact that there are still many students who are not able to do reasoning. From the research results of 32 students, only 43.25% of students are said to have good mathematical reasoning abilities, the remaining 56.75% of students still do not have good mathematical reasoning abilities. Mathematical reasoning is an important aspect that must be possessed by students, even though in reality there are still many students who have not been able to do mathematical reasoning and think creatively. From the research results of 32 students, only 43.25% of students are said to have good mathematical reasoning abilities, the remaining 56.75% of students still do not have good mathematical reasoning abilities. At the level of students' mathematical creative thinking skills based on the results of the study, only 39.5% have been able to think creatively, while the other 60.5% have not been able to think creatively.

From the results of the research analysis there is a misconception on the indicators of mathematical situation analysis. Students are able to plan solutions, students are able to predict answers and draw conclusions, but the fact is that at the stage of mathematical manipulation of story questions, students' answers are still not quite right. Also explained by (Linola et al., 2017) students with low category mathematical reasoning abilities if students can manipulate mathematics correctly but are incomplete, can compile evidence and give reasons for the truth of solutions correctly but incompletely, cannot present mathematical statements in writing, diagrams, and pictures, can draw conclusions logically correctly and completely.

Students do not understand in arranging conjectures correctly. It can be seen that the answers of students who are not able to arrange manipulations so that the completion of the answers are carried out correctly from the story questions given. When interviewed, students tend to answer procedures directly without understanding examples or arranging manipulations. The results of other studies also strengthen misconceptions about the indicators of constructing conjectures, (Suprihatin et al., 2018) students still do not understand the questions well reinforced by interviewing some of the students. With an inaccurate interpretation, it causes the completion that is done is also less precise. So that the indicator of performing mathematical manipulation does not appear.

Misconceptions also occur in indicators compiling a proof. In story questions where students are asked to prove, students can only write answers briefly,

but cannot fully and precisely prove the process or procedure. This happened in a study conducted by (Afif, 2016) This can be seen from the students' written test answers which were written briefly but they were able to explain at the time of the interview.

From the results of the study which stated that students' mathematical creative thinking skills were low, it was started from students' answers based on their reasoning abilities. Creative thinking proposed by (Fardah, 2012) that students can understand the problem and they can estimate the solution, then make a plan, implement the plan and evaluate if there are obstacles in obtaining a solution. They can communicate their ideas both orally and in writing clearly and coherently. From this theory, students' mathematical creative thinking ability can also be seen from the results of students' mathematical reasoning in solving story problems. From high-ability students have good mathematical reasoning abilities and the results of the analysis of students' mathematical creative thinking abilities are also good. Meanwhile, students who are classified as having low abilities from the results of tests and interviews have low mathematical reasoning abilities and mathematical creative thinking.

From the results of this study the teacher must make a new innovation, on learning styles, teaching materials or teaching media that can improve students' mathematical abilities. Students who have mathematical reasoning abilities will be very influential in answering mathematical problems in the form of story questions and problems in everyday life. From the results of student interviews, it is known that students lack confidence due to poor learning outcomes. Students also rarely practice in class or at home in solving story problems. In other studies, similar results were also obtained (Afif, 2016) Lack of students' mathematical reasoning ability is also influenced by several factors such as learning styles, mathematics instruction anxiety, lack of self-confidence, teacher trust, environment, lack of parental attention, and gender.

CONCLUSION

The conclusion is that students' mathematical reasoning and creative thinking skills in solving story problems are still relatively low. The misconceptions of mathematical reasoning experienced by students are indicators of analyzing mathematical situations, compiling conjectures, and compiling a proof. The level of students' creative thinking skills in solving story problems can be influenced by students' mathematical reasoning abilities.

The ability of mathematical reasoning and mathematical creative thinking of students can be determined from the way the teacher teaches, a new innovation is needed in learning mathematics and the need for teaching materials or media that can make it easier for students to understand mathematical material, especially in solving story problems.

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