

# Analysis of Students' Mathematical Reasoning Abilities During the Covid-19 Pandemic

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## ABSTRACT

This study aimed to analyze students' mathematical reasoning abilities during the Covid-19 pandemic. This study used a qualitative approach with a descriptive method. The subjects of this research were students of Mathematics Education at the State Islamic University of Alauddin Makassar who were selected using the purposive sampling technique. The data collection technique used a mathematical reasoning ability test and interviews. The data were analyzed through data reduction, data display, and conclusion drawing. The results showed that students' mathematical reasoning abilities were not optimal during the Covid-19 pandemic.

**Keywords:** *Mathematical Reasoning Abilities, Covid-19 Pandemic.*

## 1. INTRODUCTION

Covid-19 characteristics' has very strong and fast to spread so that it impacts all life sectors in the world, one of which is in the education sector [1]–[4].

Learning that used to use a face-to-face system must now be changed to online learning [5]–[7]. Online learning is defined as a learning experience in a synchronous or asynchronous environment using one kind of device (e.g., smartphones, computers, laptops, etc.) with internet access. In online learning, the students can be anywhere (independent) to learn and have interacted with the instructor and their friends [8], [9].

One of the subjects at school that can invite students to sharpen their brains is mathematics. Mathematics is a science with special characteristics, one of which is axiomatic deductive reasoning in mathematics, which deals with abstract ideas, concepts, and symbols arranged hierarchically so that mathematics education and teaching need to be explicitly handled [10].

One of the abilities that students must have in studying Mathematics is the ability to reason mathematically. Reasoning plays an important role in today's educational and workplace contexts [11], so each student must have mathematical reasoning [12]. In learning activities, students are trained and required to be able to think logically, creatively, thoroughly,

and independently. With mathematical reasoning abilities, students can develop their thinking, creativity, and foresight in learning [13].

According to Nurjanah et al., reasoning is a thought process in drawing conclusions based on facts or premises considered true [14]. According to Adilla & Nurhabibah, mathematical reasoning ability is an ability that trains thinking and reasoning in concluding, even conveying information, ideas through oral and written [15].

Indeed, teachers must be able to understand students' problems in mathematical reasoning abilities to get a solution by providing guidance and training students to work on mathematical reasoning problems. [16]. Observing students during the exploring and summarizing phase of mathematics helps teachers pay attention and consider how students can prove, justify conjectures, and explain their reasons when responding to challenging assignments [17].

Based on the data in the field, the researchers found that students have different reasoning abilities. Some students were able to analyze and solve problems well, but others also seemed to have difficulty solving them, even if they did not understand the questions. One of them is the difficulty in proving a theorem and applying the theorem.

This is in line with research conducted by Pandu and Suwarsono that students with high abilities display

mathematical reasoning abilities that meet the indicators of proposing conjectures, performing mathematical manipulations, compiling evidence, providing reasons or evidence for the correctness of solutions, drawing conclusions from a statement, and checking the validity of a statement. Arguments and mathematical reasoning abilities displayed by students who are moderately capable of solving mathematical problems meet the indicators of proposing conjectures and providing conclusions [18].

Research conducted by Muhammad also explained that the mathematical reasoning ability of third-level students as measured in the evaluation process after learning the Algebra II was still lacking even though it was not at a low stage, it was proven that the average achievement was only 48.23%, most of the students still had difficulties in learning. Answer the question of proof or not yet skilled in proving a theorem/proposition, as well as mistakes that often occur, is in applying concepts/theorems/previous knowledge to show something that has not been proven true [19].

## 2. RESEARCH METHOD

This study used a qualitative approach with a descriptive method. The subjects of this study were students of Mathematics Education, Alauddin State Islamic University Makassar, then 3 students each with high, medium, and low mathematical reasoning abilities were selected to be interviewed; this selection used a purposive sampling technique.

Data collection techniques used mathematical reasoning ability tests and interviews. Mathematical reasoning tests were used to categorize students based on their level of mathematical reasoning ability (high, medium, and low categories). Interviews were used to examine more deeply about students' mathematical reasoning abilities.

Data were analyzed through data reduction, data display, and conclusion drawing. In this study, the indicators of reasoning ability used are making conjectures, performing mathematical manipulations, compiling evidence, providing reasons, and drawing conclusions.

## 3. RESULTS AND DISCUSSION

Based on the mathematical reasoning test that has been carried out on 35 students, the following table is obtained:

**Table 1.** The Percentage of Students' Reasoning Ability Level

Category of Mathematical Reasoning Ability	F	Percentage
High	5	14,29%
Medium	21	60,00%
Low	9	25,71%
Total	35	100%

Based on table 1, it is known that 5 students have high mathematical reasoning abilities, 21 students have medium mathematical reasoning abilities, and 9 students have low mathematical reasoning abilities. Based on these results, 3 students, each representing each category of mathematical reasoning ability was selected to be interviewed further.

### 3.1 Students Who Have High Mathematical Reasoning Ability

Based on the mathematical reasoning test and the interview' results with subjects S02, S05, and S20, it was found that the subjects were able to convey things that were known and asked from the questions, but they did not write them down on the answer sheet. This is due to the subject's habit of not writing down known and asked things when working on similar practice questions. So, it was found that students who had high mathematical reasoning abilities were able to make conjectures.

In addition, the subjects are able to write and explain the steps for solving the problem correctly and adequately. So, it was found that students who had high mathematical reasoning abilities were able to perform mathematical manipulation.

Based on the mathematical reasoning test and the interview' results with subjects S02, S05, and S20, it was found that the subject was able to compile evidence and provide reasons for the steps written by the subject. So, it was found that students who had high mathematical reasoning abilities were able to compile evidence and provide explanations.

The subjects also were able to conclude reasonably. The subject knows the difference between convergent and divergent, so they are able to make the correct conclusions.

This is also supported by research conducted by Oktaviana and Aini, who concluded that students who have high category mathematical reasoning abilities have been able to complete all questions correctly from all indicators of mathematical reasoning ability [20].

Research conducted by Astiati also explains that students with high mathematical reasoning abilities in the aspect of identifying problems can find elements that are known and asked. Furthermore, in drawing logical conclusions, students with high mathematical reasoning abilities can provide logical reasons at each step of the completion [21].

### **3.2 Students Who Have Medium Mathematical Reasoning Ability**

Based on the interview result with S06, S17, and S20, it was found that students who had medium mathematical reasoning abilities were able to make conjectures. The subjects were able to convey things that were known and asked from the questions, but they did not write them down on the answer sheet. This is due to the subject's habit of not writing down known and asked things when working on similar practice questions. The subjects also were able to compile evidence and give reasons for the complete steps he had written.

Besides that, it is also found that the subjects have not been able to manipulate. The subjects were able to design ways to solve the problem but were wrong in doing the integration so that the final result was also wrong. The subjects also have not been able to conclude appropriately. The subject knows the difference between convergent and divergent, but the final result is wrong, so that the conclusion drawn is also wrong.

Linola et al. stated that students with medium reasoning abilities could manipulate mathematics correctly, but the answers were still incomplete [22].

Astiati also explained in her research that moderately capable students can only formulate solutions but cannot find other alternatives in solving the problems given. Students who have medium mathematical reasoning abilities can also not give logical reasons at each step of the solution [21].

### **3.3 Students Who Have Low Mathematical Reasoning Ability**

Based on the interview result with subjects S01, S10, and S16, it was found that students who had low mathematical reasoning abilities were able to make conjectures even though they were a little doubtful. The subject conveyed things that were known and asked about from the questions, although they were still unsure. Subjects also did not write it down on the answer sheet. Even the subject does not know the material of the question.

Besides that, it is also found that the subjects have not been able to manipulate. Based on the interview

result with S16, it was found that the subjects only knew the initial stage or the initial steps in solving the problem, so the subject could not solve the problem.

The subject also has not compiled the evidence that he got and still did not know the reason for the complete steps he wrote down. The subjects also have not been able to conclude a problem. The subject doesn't even know how to solve the problem.

This is also supported by the results of Astiati's research, which explains that students with low mathematical reasoning were also unable to arrange solutions and could not fulfill the aspect of drawing logical conclusions by giving reasons at each step of the completion [21]. Pradana and Murtiyasa also explained that students with low mathematical reasoning have not been able to determine sufficient and necessary conditions in understanding the problem, have not been able to decide on problem-solving strategies, have not been able to carry out plans, and have not been able to check the calculation of answers [23].

Jelita and Zulkarnaen's research also explained that students who have low-category reasoning abilities still cannot understand the information in the problem, then they do the solution they are still not right so they can't explain again [24].

## **4. CONCLUSION**

The results showed that students' mathematical reasoning abilities were not optimal during the Covid-19 pandemic. Students who have high mathematical reasoning abilities are only 14.29% and are able to perform all reasoning indicators. Students who have medium mathematical reasoning, as many as 60.00% of students, have been able to submit conjectures and compile evidence and provide reasons. Students have low reasoning; these students are 25.71%, they were only able to make conjectures and even still have doubts.

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