Students' Early Mathematical Ability and Its Contribution to Mediating Junior High School Students' Mathematical Ability: Correlational Studies

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Abstract. Students' initial mathematical abilities are considered to determine student success in learning. However, little is known about the contribution of early mathematical ability (MA) related to the mathematical power of junior high school students. For this reason, this correlational study was conducted to describe the relationship between students' initial mathematical abilities and junior high school students' mathematical abilities. This study involved 47 private junior high school students in the city of Ruteng, Indonesia. Data was collected by using a test technique to obtain data on initial mathematical abilities. Furthermore, hypothesis testing was carried out to see a positive and significant relationship between students' initial mathematical skills and students' mathematical abilities. The analysis results show a positive and significant relationship between the initial MA and the mathematical power of eighth-grade junior high school students. This is supported by the contribution of the initial ability to understand concepts to mathematical power.

Keywords: students' initial mathematical ability, student's mathematical power, correlational research

1 Introduction

In the process of learning mathematics, students must have initial mathematical abilities as a provision of knowledge to be able to learn the next material [1]. Students will find it easier to master new material if these students have initial abilities that are the basis or prerequisites for mastering the abilities to be learned [2]. In addition to these initial abilities, students must be able to adjust to their understanding of the concept. Understanding the concept has an important role in knowing that students understand a concept that has been studied. Thus, in the long term, a student can remember the subject matter that has been studied previously because students already understand the concept.

Meanwhile, it is known that increasing students' mathematical power is included in one of the objectives of learning mathematics [3], [4]. In the mathematics learning curriculum in Indonesia, the term mathematical power has an implicit meaning, which actually talks about several process skills. Process skills are the goal of the learning process. The learning objectives to be achieved are problem-solving ability, reasoning ability, communication ability, connection

ICEHHA 2022, October 21-22, Ruteng, Indonesia

DOI 10.4108/eai.21-10-2022.2329591

ability, and representation ability [5]. The five types of abilities are known as mathematical power.

Problem-solving ability is the ability to find a solution or a way out to solve a problem at hand. Students must also be supported by high mathematical reasoning abilities in solving a mathematical problem. Reasoning ability is the ability to analyze mathematical situations with logical thinking and explanations so as to get the expected solution by using appropriate mathematical procedures. Mathematical reasoning abilities lead students to be able to analyze mathematical situations and mathematical ideas so that they can express mathematical ideas verbally [6], [7]. Communication skills are a mathematical ability (MA) that is central to students expressing mathematical ideas orally in conveying and obtaining information. Increasing students' mathematical communication skills can affect students' mathematical connection abilities [8], [9]. Mathematical connection ability is the ability of mathematics to connect mathematics to other topics both conceptually and procedurally in everyday life [10], [11]. Representation ability is a MA that is able to present mathematical concepts in various mathematical models and is able to present them in the form of images, graphs, tables, or other mathematical expressions [12]–[14].

However, several international research results show that the mathematical power of students in Indonesia still needs to be improved. From the results of the TIMSS study, the problem-solving ability of students at the junior high school level in Indonesia is still very low, ranking 38th out of 42 countries participating in the math test [15]. Meanwhile, based on the results of previous research from [16], [17], stated that students' mathematical power in the aspects of reasoning, communication, and connection abilities is still relatively low. In this study, the aspects of mathematics and science surveyed were comprehension, problem-solving, mathematical communication, and reasoning abilities.

2 Method and Materials

This work is included in correlational research, which aims to identify relationships between variables [18]. Figure 1 illustrates the applied research design.

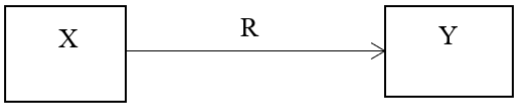

Figure 1. Correlational research design

Information:
X: Independent Variable (Early Concept Understanding Ability)
Y: Bound Variable (Mathematical Power)
R: The relationship between X and Y

The population in this study were all students in 8th grade at the Private Junior High School Recognized by Bina Kusuma Ruteng for the 2020/2021 Academic Year, totaling 47 people. Saturated sampling is a sampling technique in which all members of the population are used as samples. In the study, the population was relatively small, namely 47 students, so the population was used as a sample. Meanwhile, the analysis prerequisite test with correlation statistics requires that the analyzed data come from a population with normal distribution and linear

polarity. For this reason, the normality test and linearity test were carried out. The normality test used the chi-squared test ("χ" 2), and the linearity test used the F test/one-way ANOVA test. The research data were then processed and analyzed to test the research hypotheses using correlation analysis.

3 Results and Discussion

The results of the research and data analysis showed that results of the normality test analysis showed that the sample data for each variable came from a normally distributed population. Furthermore, the results of the linearity test analysis show that there is a linear relationship between X and Y. The data of this study were taken from the results of a written test on the initial ability to understand the concept. After being analyzed, the percentage of student grouping based on initial abilities is obtained, as illustrated in Table 1.

Table 1. Category of Students Based on Initial MA

Value Range	Criteria	N	Percentage
$X \geq 72$	Very high	2	4,26%
$72 > X \geq 64$	High	4	8,51%
$64 > X \geq 56$	High Enough	14	29,79%
$56 > X \geq 48$	Low	18	38,30%
$X < 48$	Very low	9	19,15%

Table 1 illustrates that students' initial understanding of concepts is in a low category (38.30%), or out of 47 students, 18 students have scored in the low sort. Meanwhile, at least how many are in the very high category (4.26%), or from 47 students, two students have scores in the very high category. Furthermore, research data for mathematical power. The data of this study were taken from the results of the written test of students' mathematical power. Descriptively, the student's mathematical power test results showed the lowest score of 40 and the highest score of 80. The analysis results also showed that the average (mean) was 56.7, the median was 56, the mode was 52, the variance was 89.4, and the standard deviation was 9,5. Furthermore, it can be determined the percentage of student grouping based on the mathematical power of 8th grades students at the Private Junior High School Recognized by Bina Kusuma Ruteng in Table 2.

Table 2. Student Criteria Based on Students' Mathematical Power

Value Range	Criteria	N	Percentage
$X \geq 72$	Very high	3	6,38%
$72 > X \geq 64$	High	9	19,15%
$64 > X \geq 56$	High enough	12	25,53%
$56 > X \geq 48$	Low	16	34,04%
$X < 48$	Very low	7	14,89%

Based on Table 2 above, it can be seen that the categories of mathematical power of students at the Private Junior High School Recognized by Bina Kusuma Ruteng for the 2020/2021 academic year are included in the low (34.04%) or from 47 students 16 students have scored in

the low category. Meanwhile, at least how many are in the very high category (6.38%), or from 47 students, there are three students who have scores in the very high category.

Inferential analysis, preceded by a prerequisite test. Test the normality of the data of the chi-squared formula ("χ" 2). The normality test of the student's mathematical power data used was chi-squared ("χ" 2). The description of the data about the results of the normality test of the initial ability to understand the concept data can be presented in Table 3 below.

Table 3. Normality Test Results

Variable	X^2_{count}	X^2_{table}	**Decision**
Early Concept Understanding Ability	3,36	11,07	Normal distribution
Mathematical power	2,57	11,19	Normal distribution

Based on Table 3 above, the results of the calculation of the normality test of the student's initial ability to understand the concept of the data show the amount and value at the significance level. The results of the data processing show or, can be said that the data on the students' initial ability to understand concepts is normally distributed. Based on Table 3 above, the results of the calculation of the normality test of students' mathematical power data show the amount and value at the significance level. Testing the linearity of the data on the initial ability to understand concepts with the mathematical power of students used is chi-squared ("χ" 2) with the help of Microsoft Excel. The summary of the results is illustrated in Table 4.

Table 4 Linearity Test Results of Early Concept Understanding and MA

F_{count}	F_{table}	**Decision**
-0,59	2,00	Linear pattern

Based on Table 4, it is obtained that the value of and the value of. The results of the data processing show that it has a linear pattern. Based on the calculation results, it was found that the data on the initial ability to understand concepts and the data on students' mathematical power were normally distributed and had a linear pattern. The results of the analysis of the relationship between the initial ability to understand concepts and students' mathematical power, it was found that the strength of the relationship was at the moderate level or category (0.400 – 0.599), with a correlation coefficient of 0.598. The correlation coefficient is positive, which means that there is a positive relationship between the initial ability to understand concepts and students' mathematical power. Furthermore, the significance test is obtained, and the error level is. Thus, based on the results of the data hypothesis testing, it can be concluded that there is a positive and significant relationship between the initial ability to understand concepts and the mathematical power of 8th grades students at Private Middle School Recognized by Bina Kusuma Ruteng for the 2020/2021 academic year. This shows that the lower the initial ability to understand concepts, the lower the mathematical power, or the higher the initial ability to understand concepts, the higher the mathematical power.

Hasil ini didukung oleh penelitian sebelumnya yang telah ada pada literatur. Penelitian sebelumnya melaporkan bahwa tingkat kemampuan matematika awal siswa memediasi peningkatan kemampuan matematis siswa seperti self-efficacy dan self-regulated baik dari level tinggi, sedang maupun rendah [19]. Selain itu kemampuan matematis siswa ditemukan bervariasi di seluruh masalah dan siswa karena dimediasi oleh pengalaman sebelumnya dari matematika yang mendasari masalah [20]. These findings indicate that students' initial abilities are important to identify and receive serious attention from the teacher to be improved.

4 Conclusion

This research was conducted to clarify the relationship between students' initial mathematical abilities and their ability to understand concepts. The analysis results show a positive and significant relationship between eighth-grade junior high school students' initial MA and the MA. These findings contribute to literature and practitioners to classify students' initial abilities before starting learning to make it easier for teachers to provide proportional treatment.

Acknowledgments. Thank you to the research and community service institutions of the Indonesian Catholic University of Santu Paulus Ruteng, who contributed to this research.

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