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The Relationship between Statistical Thinking Skills and Students' Ability to Solve Problems on Mean, Median, and Mode

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Abstract

One of the important factors that affects the quality of Natural Resources (HR) is education. Since the early stages of formal education, mathematics lessons have become an integral part in the development of logical thinking and data analysis skills. Mathematics is a very important subject, but in practice it is often considered difficult and less popular by some students. One branch of mathematics taught in schools is statistics. The reality in the field shows that statistical material, especially on the topic of mean, median, and mode, is still not fully mastered by most students. This can be caused by the lack of students' statistical thinking skills, which is the ability to understand, analyze. This study aims to analyze the strength and direction of the relationship between statistical thinking skills and students' ability to solve problems on basic statistical material, especially the material on mean, median, mode. This study was conducted on students in class VIII of Muhammad Shodiq Middle School. The approach used in this study uses a correlational method, which aims to identify and measure the relationship between two variables without providing a direct causal interpretation. The data collection technique was carried out through a written test, which was designed to measure the two research variables, namely statistical thinking skills and the ability to solve basic statistical material questions. The population in this study was 150 students, and 50 students were selected as samples. The results showed that out of 50 students, 13 students (32.5%) were at level 1 of the introduction stage, 22 students (55%) were at level 2 of the analysis stage, and 5 students (12.5%) were at level 3 of the sequencing stage. Although students' abilities in calculating mean, median, and mode were generally good, the results of the analysis showed that none of the students reached a higher level of statistical thinking. Based on the results of the data analysis, it can be concluded that there is a positive and significant relationship between statistical thinking skills and students' abilities in working on questions on basic statistics material. It turns out that students who have higher statistical thinking skills are usually also more adept at solving questions about mean, median, and mode. The higher the level of thinking, the better the results.

Keywords Thinking, Basic Statistics, Mean, Median, And Mode, Junior High School Students

INTRODUCTION

One of the main factors that influences the quality of Human Resources (HR) is education.(Hakim, 2023; Sholihah & Firdaus, 2019). Education, as stated in Law Number 20 of 2003(Pelawi & Is, 2021), is a conscious and planned effort to create a

learning atmosphere and process that allows students to actively develop their potential, including spirituality, self-control, personality, intelligence, and skills. This demonstrates the strategic role education plays in preparing students for real life in society.

In general, education is divided into two, namely formal and non-formal education. (Hasanah, 2019; Syaadah et al., 2022)Formal education is structured and tiered, starting from Early Childhood Education (PAUD), Elementary School (SD), Middle School (SMP), and High School (SMA). One of the subjects consistently taught in formal education is mathematics. Mathematics has an important role in everyday life (Tampubolon et al., 2019), including in financial transactions, calculations, and problem-solving. Mathematics learning emphasizes not only mastering formulas but also developing logical, critical, and analytical thinking skills. The goal of mathematics teaching in Indonesia is to develop a comprehensive understanding of concepts, establish relationships between concepts, and effectively apply them to problem-solving.(Hadi & Novaliyosi, 2019; Siswondo & Agustina, 2021).

However, mathematics is still considered a difficult and unpopular subject by most students. This contributes to low student learning outcomes, including in statistics, a branch of mathematics. Statistics helps students develop logical and systematic thinking skills to solve problems based on data. However, many students still struggle to understand statistical material, and their achievement in this field is suboptimal. These difficulties may be caused by conventional learning methods that are unable to accommodate the differences in students' thinking levels. Therefore, a learning approach that takes students' statistical thinking skills into greater depth is needed. The material on mean, median, and mode taught in the eighth grade of Muhammad Shodiq Middle School falls within the scope of basic statistics. Based on initial observations at the school, it was found thatproblems in mastering the material, which indicates that there are obstacles in the statistics learning process.

Based on this background, this study aims to examine the relationship between the level of students' statistical thinking abilities and their learning outcomes in solving basic statistics problems, especially on the material of mean, median, and mode.

METHOD

The approach used in this study is a quantitative approach with a correlational approach. This is because this research deals with the processing of numerical data. This study aims to determine the effect of statistical thinking skills on students' ability to solve statistical problems and identify whether there are significant differences

between students with high and low statistical thinking skills in solving problems related to the mean, median, and mode. Problem-solving ability is an individual's capacity or skill in working on or solving problems. The data collection technique used in this study was a written test with questions intended to measure the mathematical abilities of eighth-grade students at Muhammad Shodiq Middle School. The test was given to students after a learning process using the Realistic Mathematics Education (RME) approach. This study's population was all eighth-grade students at Muhammad Shodiq Middle School. The following table shows the total population:

Table 1. Population and Sample Size

Population	Sample
150	50

The sampling technique used in this study was Cluster Random Sampling, which is a technique for randomly selecting samples from members of the population without considering the level of the population members. The sample in this study was 5 eighth-grade students at Muhammad Shodiq High School. The type of research instrument used by this researcher was a written test. This research test examined student learning outcomes in multiple-choice format. Previously, the test instrument underwent validity and reliability testing. This study used correlational quantitative data collection and data analysis techniques using prerequisite tests, namely the normality test and the homogeneity test. For the normality test, the data was tested using the Kolmogorov-Smirnov formula, while the homogeneity test was performed using the homogeneity of variance test.

RESULTS AND DISCUSSION

Variables	Problem Solving Ability
Statistical Thinking Skills	Pearson Correlation = 0.750**
	Sig. (2-tailed) = 0.000
	N = 42

Based on the Pearson correlation test, a significant positive relationship was found between statistical thinking skills and descriptive statistics problem-solving skills (*r* = 0.75, *p* < 0.001). This coefficient value indicates a strong relationship. The coefficient of determination (R^2 = 0.5625) indicates that 56.25% of the variability in students' problem-solving scores can be explained by statistical thinking skills.

DISCUSSION

Based on the achievement of indicators from each question item, students' ability to work on questions on the material of mean, median, mode in class VIII SPM Muhammad Shodiq is as follows:

A. Explaining the Meaning of Mean

Mean is the average value of a data set.

Finding the average can be determined using the formula:

$$Arithmetic\ mean = \frac{jumlah\ semua\ nilai\ data}{jumlah\ data}$$

a. Mean of single data

The way to calculate the average (mean) for single data is as follows.

If ,…., are n values of variable X, then the arithmetic average is as follows:$X_y, X_2 X_n$

$$X = \frac{\sum X}{n} = \frac{X_1 + X_2 + \cdots + X_n}{n}$$

Here's how to calculate the average of the scores 7, 6, 3, 4, 8, 8

Solution:

X = 7, 6, 3, 4, 8, 8

n = 6

$= 7 + 6 + 3 + 4 + 8 + 8 = 36 \sum X$

$X = = = 6 \frac{\sum X}{n} \frac{36}{6}$

b. Mean of group data

For group data, the average is calculated using 3 methods, namely the normal method, the average deviation method, and the coding method.

1. The usual method

If a regular frequency distribution has been formed, with = frequency in the first class interval, = midpoint of the first class interval, then the average is calculated using the formula.$f_i X_i$

$$X = \frac{\sum fx}{\sum f}$$

BeBody Mass Index of 100 Students of Muhammad Shodiq High School in 2024

Body Weight (kg)	Number of Students
60-62	10
63-65	25
66-68	32
69-71	15
72-74	18

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Body Weight (kg)	Midpoint (X)	Frequency	*fx*
60-62	61	10	610
63-65	64	25	1,600
66-68	67	32	2,144
69-71	70	15	1,050
72-74	73	18	1,314

Amount	-	100	6,718

X = = = 67.18$\frac{\sum fx}{\sum f}$ $\frac{6.718}{100}$

2. Mean deviation method

M is an initial guess to save on calculations. Instead of calculating the usual complicated average, we first choose a benchmark value (M), then correct the difference between each data and that benchmark. The formula is as follows:

$$X = M + \frac{\sum fd}{\sum f}$$

Determine the average from table 4.1 using the mean deviation method!

Solution

From the frequency distribution, the midpoint of the mode class is 67, so M = 67.

Body Weight (kg)	*f*	*x*	*d = X - M*	*fd*
60-62	10	61	-6	-60
63-65	25	64	-3	-75
66-68	32	67	0	0
69-71	15	70	3	45
72-74	18	73	6	108
Amount	100	-	0	18

$$X = M + \frac{\sum fd}{\sum f}$$

$$= 67 + \frac{18}{100}$$

X = 67.18

3. Coding method

The coding method is often used when values in the data are found in the form of large numbers. Formulated.

$$X = M + C \times \frac{\sum fu}{\sum f}$$

How to find the average of group data using the coding method to make it faster.

Settlement

From table 4.1 it is known that

C = 62.5 – 59.5 = 3, so

u = and M = 67$\frac{d}{3}$

Body weight (kg)	*f*	*x*	*d*	*u*	*fu*
60-62	10	61	-6	-2	-20
63-65	25	64	-3	-1	-25
66-68	32	67	0	0	0
69-71	15	70	3	15	15
72-74	18	73	6	36	36

Amount	100	-	0	0	6

$$X = M + C \times \frac{\sum fu}{\sum f}$$
$$= 67 + 3 \times \frac{6}{100} = 67{,}18$$

B. Explaining the Meaning of Median

The median is the middle value of the existing data after the data is sorted from smallest to largest.

a. Median of Single Data

If the number of data is odd, the median is the middle data point, while if the number of data is even, the median is the result of dividing the sum of the two middle data points. The formula is as follows:

- For odd data (n = odd)

  Me = $X\frac{n}{2}$
- For even data (n = even)

Me = + or briefly the median can be determined: Me = the (n + 1)th value.$X\frac{n}{2}X\ \frac{n+2}{2}\frac{1}{2}$

b. Median of group data

The median for group data can be found using the following formula:

$$M_e = B + . C\frac{\frac{1}{2}n-(\sum f2)0}{f_{me}}$$

Before calculating the median of group data, you first need to find the median class. You can find the median class by:

$(\sum f2) \geq \frac{1}{2}n$

Determine the median of the following frequency distribution!

Table 4.2 DIAMETER OF 40 PIPE PIECES

Pipe Diameter (mm)	Frequency (f)
65-67	2
68-70	5
71-73	13
74-76	14
77-79	4
80-82	2

Settlement

Frequency (n) = 40

$= 20\frac{1}{2}n$

The median class is $)(\sum f2 \geq \frac{1}{2}n$

$$f1 + f2 + f3 = 20 \geq 20$$

So, the median class is class 3.

B = 70.5

$(\sum f2)_0$ = 7
C = 3
F_{me} = 13
M_e = B + $\frac{\frac{1}{2}n-(\sum f2)0}{f_{me}}$. C
= 70.5 +$\frac{20-7}{13}$ 3
= 73.5

C. Explaining the Meaning of Mode

The mode is the value that appears most frequently in a data set. Imagine you're counting something—the value that occurs most frequently is the mode.

a. The mode of single data is the data with the highest frequency.
Determine the mode of the following data: 1, 1, 3, 3, 7, 7, 12, 12, 14, 15
Settlement
The mode = 1, 3, 7, and 12.

b. The mode for a group is data that has been grouped into several ranges (intervals) because the amount of data is very large.
The mode of group data can be found using the following formula:

$$M_{0=L+\frac{d_1}{d_1+d_2}\ C}$$

The following explains how to find the mode from Table 4.1.
Settlement
From the data in Table 4.1, the class data group with the most members or which appears most frequently is the third group.
L = 65.5
d_1 = 32 – 25 = 7
d_2 = 32 – 15 = 17
C = 3
M_0 = L +$\frac{d_1}{d_1+d_2}$. C
= 65.5 +$\frac{7}{7+17}$x 3
= 66, 375

CONCLUSION

There is a close and unidirectional relationship between students' statistical thinking skills and their ability to solve mean, median, and mode problems. This means that students with strong statistical thinking skills tend to be good at solving these problems, while students with low statistical thinking skills tend to have more difficulty solving them. The strength of this relationship is very strong (indicated by a Pearson correlation value of 0.75) and the results are very convincing (*p* < 0.001). Statistical thinking skills have a significant impact on statistics.

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