

Analysis of Statistical Reasoning Process of Senior High School Students on the Size of Central Tendency

(The Case Study For Student's Low Math Ability)

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Abstract- Reasoning is one of fundamental aspects of mathematics learning, it is as one of the necessary abilities of each student in the era of globalization that is full of challenges. The ability to reason is not only needed when students learn, yet very necessary when a person determine the decision. The aim of this article was to describe the statistical reasoning of high school students with low math skills to solve problems statistics. This research was a qualitative descriptive study. A qualitative approach is used to describe in depth how the reasoning process statistic subject to resolve issues related statistical measure of central tendency (mean, median, mode). The subjects were two students of class XI SMA Negeri 15 Makassar, with low math skills. It could be seen from the behavior of the subjects in completing written assignments are given, followed by in-depth interviews related to a given task. The research revealed that the subjects know the algorithm for calculating the average. At the stage of determining the median there was a difference perception between the two subjects, while the second mode related subjects had the same perception of the majority. At this analysis and interpretation stage, both of the subjects had not been able to interpret the statistical values obtained in accordance with the context well.

Keywords: *Statistical Reasoning, Senior High School, Statistical Problem, Low Math Ability*

I. INTRODUCTION

The functions of statistics as a science plays important role in all aspects of human life, as means to develop way of logical and scientific thinking . Statistics is used in order to collect, present, arrange, analyze and draw a conclusion mathematically. Ben-Zvi & Garfield [1] states statistical learning can be a tool to analyze the information or data, resulting from the information or the data can be taken the right decision in solving a problem.

Statistics as a part of a math lesson taught ranging from basic education to higher education require reasoning for such a study. Every day we face a variety of situations, problems or phenomena that has happened, is happening and phenomena that will occur, where most of the problems or phenomena in the form of a set of data and required thinking or reasoning for taking a decision in the face of these problems. Statistical reasoning plays an important role in dealing with situations, someone who is dealing with a set of data or events in everyday life. For example, when someone is watching television, reading newspapers or magazines, while active on the political activities or other social activities, often times the information obtained may be represented in various forms; e.g. graphs, tables, diagrams or combination of both.

At this time the statistics have been used in all areas of science, even been used by many giant companies of the world, e.g. Japan's success in applying the science of probability in designing and marketing a variety of products such as various electronic goods, cars, motorcycles and various other

products. This accomplishment can be achieved due to the success of the Japanese education on the subjects of statistics given widely from upper secondary education to higher education. [2]

Related the importance of familiarization reasoning for students in the learning process of mathematics, Soedjadi [16] states: civilizing reasoning would be achieved if the effort to organize the reason that learners can run well so as to cultivate the habit of reasoning. By using the curriculum however reforming the reasoning required attention in the study of mathematics. It is becoming increasingly important in view of the future that is characterized by competition. In order to reasoning acculturation can be achieved, it is necessary that the presentation of mathematics in schools, both in the classroom and in textbooks, really directed to the structuring of reason.

In mathematics, as stated in the NCTM [14] it is expected that students will improve their ability in terms of reasoning (reasoning), problem solving, mathematical communication and in terms of using the mathematical representation. In the 2013 curriculum for all subjects are taught with the same approach that approach saintific through observe, to question, to reason, to try and form a network (here seems a shift of the students were told to the students to find out). It appears that the proficiency level on the reasoning aspects of the curriculum in 2013 is a very important thing, because if students are not developed reasoning ability, then for students of mathematics including statistical material will only be a matter that follow set procedures and emulate the examples without knowing its meaning.

The explanation above states that statistical reasoning ability is something that is sorely needed by the terms of the components of society, including students who take basic education to higher education which is the cornerstone of the nation's future in the future.

In this study the problem to be assessed is a matter of statistics. Completion of statistical problem is an important issue and needs to be studied, because it is through solving problems mainly related to the student experience in the daily life of students are expected to be skilled in identifying, selecting relevant knowledge in describing, interpreting the problem to make generalizations. However, in the study of mathematics in high school, statistics or mathematics problem solving cannot be done easily and quickly. To resolve these problems required reasoning.

Ability to solve problems related to mathematics and statistics is influenced by several factors, both internal and external factors. Internal factors include: interest, motivation, talent, intelligence and mathematical ability and gender, while external factors related facilities and infrastructure, curriculum, teachers, the media, other learning facilities.

The research result of Nurman [14] states that a student math skills affect the ability of mathematical problem solving. Students are capable of higher mathematics has high ability in solving mathematical problems, while students who have low math ability of mathematical problem solving ability are less good.

Based on the description above, the research questions that will be discussed in this article is "How does a statistical reasoning of eleventh year students who have the ability to lower the Mathematics Statistics in solving the problem?"

II. LITERATURE REVIEW

According to Ben-Zvi and Garfield [1] Statistical Reasoning as the way people reason with statistical ideas and make-sense of statistical information. This involves making interpretation based on sets of data, the representation of the data, or statistical summaries of the data. Statistical reasoning may involve; connecting one concept to another (e.g. center and spread), or it may combine the data and ideas about chance. Reasoning means understanding and being Able to explain statistical processes and being-able to fully interpret statistical results. "

Martin [5] defines the statistical reasoning as follows: "Statistical Reasoning as forming conclusions and judgments According on the Data from observation studies, experiments or sample surveys". From the definition above can be concluded that the reasoning statistically is the mental activity in connecting some of the concepts, facts, procedures in reaching conclusions that include describing, organizing, data reduction, represent the data, interpret and make sense of the ideas of statistics in the conclusion and be able to interpret the data which is obtained. Lovett { 5 } claimed Statistical Reasoning involves the use of statistical ideas and tools to summarize the situation and draw assumptions and make conclusions from the data".

[8] stated statistical reasoning as a three-step process, among others:

1. Understanding (see particular problems as an issue)
2. Planning and implementation (to apply appropriate methods to solve the problem), and
3. Evaluation and interpretation (interpreting the results related to the initial problem.)

In practice, statistical reasoning involves being Able to assess how well the data are collected, describe the data, the draw Conclusions from the data, and allow for the UN- certainty that results from the use of a sample. Students, therefore, need to under- stand how sampling is influenced by the variation that is present in every process [6]

Garfield [9] states there are six reasoning goals for students: 1) reasoning about the data, 2) reasoning about representations of the data, 3) reasoning about statistical measures, 4) reasoning about uncertainty, 5) reasoning about samples, 6) reasoning about association , In this research framework Jones et al [6] in assessing the statistical reasoning that high school students of class XI; describing the data; organizing and reducing the data; representing the data; and analyzing and interpreting data. There are two types of reasoning commonly incorporated into the statistical reasoning assessment instrument namely reasoning about the center and spread. Reasoning concerns about the data center analysis that involves the mean, mode and median. Meanwhile, spread involves reasoning about range, quartile, variance, and standard deviation.

Jones et al [6] suggest that in order to assess a person's ability to describe data (describing data) can be viewed on the ability of a person a) an accurate reading raw data or can show role in the form of tables, charts or graphs, b) demonstrate an understanding of convention elements graphics, c) have an understanding when given different views for the same data, d) evaluate the different views of the same data. Meanwhile, to assess a person's ability to organize and reduce the data (organizing and reducing data) are: a) Classify and sort the data, b) Recognize that there is information that may be lost in the segment data, c) Describing the data, the types of data and representation of data d) Describe the distribution data.

To represent data (representing data), [6] states that to assess a person's ability to represent data is:

- a. Complementing the display of the data presented is not complete
- b. Build the display of data representing different classification of the data set.

Jones et al [6] also stated that to assess a person's ability to analyze and interpret data (analyzing and interpreting data) is as follows:

- a. Comparing and combining the data
- b. Extrapolation and predict data.

Mooney [6] states: (1) describing the data e.g. tables, graphs, a list of which is looking for information explicitly stated in the display, acknowledge graphics conventions, and make a direct connection between the original data and display. This means that when describing data explicitly require

the reading of the data presented in tables, charts or graphs representation; (2) organize and reduce the data associated with the process of organizing, categorizing, or consolidation of data in summary form; (3) represents the data associated with the data is displayed in graphical form. The process according to Groth (2003: 6) is able to make the display of data or an alternative view for a given set of data; (4) analyze and interpret data related to how to identify trends and make conclusions or predictions about the data.

NCTM [10] defines mathematical ability as "Mathematical power includes the ability to explore, conjecture, and reason logically; non-routine to solve problems; to communicate about and through mathematics; and to connect ideas within mathematics and between mathematics and other intellectual activity".

According to A.M. Blackwell [12], mathematical abilities are: "Mathematical ability indicates that Reviews These abilities can be interpreted as abilities for selective thinking in the realm of quantitative relationships (quantitative thinking) and for deductive reasoning, and as the ability to apply general principles to particular cases in the realm of numbers, symbols, and geometric forms "Meanwhile, according to G.Revesz [12] mathematical skills, namely: "Examines two basic forms of mathematical ability: Applicative (the ability to find mathematical relationships quickly intervening, without preliminary trials, and to apply the Appropriate information in analogous instances) and productive (the ability to reveal relationships that do not follow Immediately from the available information)"

A measure of central tendency is a single value that attempts to describe a set of data by identifying the central position within that set of data. As such, measures of central tendency are sometimes called measures of central location. They are also classed as summary statistics. The mean (often called the average) is most likely the measure of central tendency that you are most familiar with, but there are others, such as the median and the mode. The mean (or average) is the most popular and well known measure of central tendency. It can be used with both discrete and continuous data, although its use is most often with continuous data. The mean is equal to the sum of all the values in the data set divided by the number of values in the data set

Average is judged as measures of central tendency which comprised of mode, median, and mean by several statisticians. Nonetheless, average was interpreted in a different way based on problem context as argued by Konold & Pollastek [11], for instance fair share, data reduction, signal in noise, and typical value.

There are seven properties of average as declared by Strauss and Bichler [17]. The first property of the average is put between the extreme values and the second property is the summation of the deviations from the average is equal to zero. The third property is the average is affected by val ues except the average while the fourth property is the average is not primarily the same as one of the added values. The average could be a fraction that has no matching part in physical reality is the fifth property. The sixth property is the zero value ought to be considered when computing the average and the seventh property is the value of the average is indicative of the values that were averaged.

Furthermore, Mokros and Russell [13] found out five approaches to obtain the average that employed by the students from fourth, sixth and eighth grades including average as mode, average as algorithm, average as reasonable, average as midpoint, and average as mathematical point of balance. Those approaches were classified as two groups, i.e. approaches that do not view average as representative including average as algorithm and average as mode, as well as approaches that view average as representative including average as reasonable, average as midpoint, and average as mathematical point of balance.

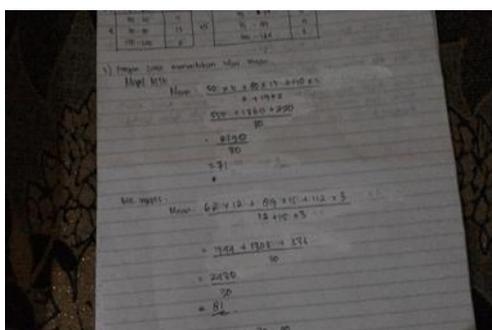
III. RESEARCH METHOD

This research applied a descriptive qualitative method, the research seeks to find meaning behind the symptoms or phenomena that occur. This study aimed to describe the statistical reasoning of eleventh grade high school students who had poor math skills. The approach used was a qualitative approach based on the grounds that this study met the characteristics of qualitative research, namely: (1) it was natural, that research was conducted according the actual circumstances in which the researcher as the main instrument, (2) the data was descriptive in the form of a series of words or image, (3) focus more on the process than the results, (4) the data processing tends to be done inductively, and (5) the main focus research is aimed at all the activities carried out individually [7]

The subjects of this research were students with low math skills. The process of collecting data in this study using a task-based interviews in which subjects were given the task of statistical reasoning (TPS), then the subject in asking reveal what he was thinking and asked to describe in detail his thinking process. Furthermore, do interviews and observations to explore the reasons, why take these conclusions and possible other solutions that could be done, including the unique things done by the subject when disclosing or submit comments. At the time of data collection, all activities performed research subjects recorded using audio and audiovisual recording devices, as well in the interview.

IV. RESULT AND DISCUSSION

Results based interview task of the two subjects on the collection of data describing the reasoning process of the subject on the size of the symptoms of the center when given the task of determining the average, median and mode were as follows: (1) At the stage of determining the average of the first subject using the formula average for grouped data in a way: first determine the subject of the largest and smallest values to determine the range, then create a table and specify the interval and determine the frequency of each interval. After that subject calculate the average value by multiplying the value of the center of each interval with a frequency followed by summing and further divided by the number of frequencies. This showed that a procedural subject can organize the data and know the algorithm for calculating the average, but when asked to explain the meaning of the average of the results obtained, the subject stated the average was mostly or at most. Here is the work of the first subject.



(The picture above was one of the student's work)

(2) At the stage of determining the Median of first subject and the second subject did not know the formula median for grouped data. But for the first single data subject can explain how to determine the median of the data even or odd numbers well, which was a way to first sort the data from the smallest to the largest data. If even then the data after the data burst, then the median was the middle of the two data divided by two, but if the data was odd, the data lays the middle was the median. Subject to the two states to determine the median is the same as determine the average. The results indicate that the two subjects into trouble and did not know the formula for a median of grouped data, but there were cognitive differences between the first and second subject of the median, where the first subject can distinguish how

to calculate the median and average. The median for the two subjects was the middle value. Here are excerpts of an interview with both of the subject.

Excerpts of an interview with the first subject:

Researcher : What is average?

Interviewee : Add and divide by the number

Researcher : What is the definition of average?

Interviewee : The most

Researcher : What is median?

Interviewee : The mid-point

Researcher : How do you determine the median?

Interviewee : If a single data in advance data is sorted from smallest to largest data

Researcher : And then?

Interviewee : If the data is an even number, the two most central data summed and then divided by two is the median, but if the data is odd, then the data that most middle after a median of data sequences.

Excerpts of an interview with the second subject:

Researcher : What is average?

Interviewee : Add and divide by the number

Researcher : What is the definition of average?

Interviewee : The most

Researcher : What is median?

Interviewee : The mid-point

Researcher : How do you determine the median?

Interviewee : Same way with an average

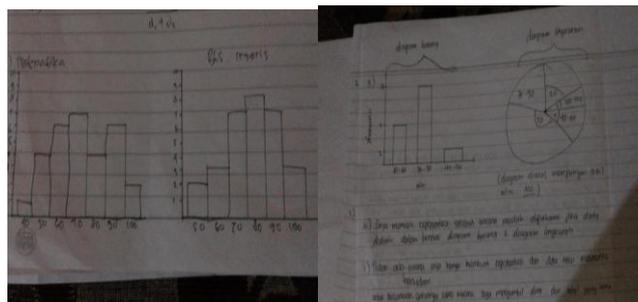
Researcher : Is there a difference in determining the average and median?

Interviewee : Different formula ma'am.

Researcher : Before using the formula, what should be done on the data?

Interviewee : Nothing ma'am, is the same as the average. To determining the median value I take the data center.

(3) Related to the second mode is the mode of the subject states that the value of most appear and younger determine the mode by looking at the highest bar chart. (4) In the phase represents the data in the form of charts or graphs, the first subject can represent data in the form of pie charts or graphs, while subject to the two cannot represent data, this may happen because they do not know how to draw a good diagram. (5) In the analyze phase and interpreting data in the two subjects have not been able to analyze and interpret every value-value statistic obtained in accordance with the context. This indicates that the subject has not been able to link her internal network when analyzing and resolving problems or represent data.



V. CONCLUSION

Based on the results obtained in this study, it can be concluded: in the reasoning process of describing the data students can identify the facts on the question asked, but requires the stimulus of researchers. The reasoning process of the students in organizing and reducing data is only the first subject that can sort and group the data appropriately. Statistical reasoning process of the subject in the data representing the first subject can be represented well in the form of charts and graphs, while the second subject cannot represent the data in the form of charts or graphs. Statistical reasoning process of analyzing and interpreting the subject in the second data subjects cannot draw conclusions and interpret the value statistic in context well. The second subject had a median-related reasoning is wrong with stating the average and median alike.

VI. SUGGESTION

Based on the above conclusions, it is recommended that some of the following:

1. In teaching statistics, high school teachers should use static reasoning stage, so that students can be trained reasoning as early as possible
2. In teaching mathematics and statistics teachers should pay attention to the reasoning process and designing a model student and learning methods by considering the mathematical abilities of students vary.

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