Analysis of student's statistical thinking ability in understanding the statistical data

M Masjудin*, A Muzaki, Z Abidin, and I A P Ariyanti
IKIP Mataram, Jl. Pemuda No. 59A, Mataram 83125, Indonesia

*Corresponding author’s email: masjudinindo@gmail.com

Abstract. The purpose of this research is to describe the student’s statistical thinking ability in understanding statistical data. The statistical thinking consists of the following four indicators: (a) ability to describe data; (b) ability to organize and reduce data; (c) ability to represent data; and (d) ability to analyze and interpret data. This research uses a qualitative approach with a phenomenological method. Subject in this research were eighth grade students of SMP Negeri 3 Lingsar. Data collection techniques by providing evaluation tests statistical thinking abilities and interviews. The results of this research showed that 4.2% of students had high statistical thinking ability, 25% of students had medium statistical ability, and 70.8% of students had low statistical thinking ability. So that, can be concluded the statistical thinking ability of students is in the low category. Student achievement in each indicator of statistical thinking ability is detailed as follows: (a) students ability to describe data is in the medium category; (b) students ability to organize and reduce is in the low category; (c) students’ ability to represent data is in the medium category; and (d) Students’ ability to analyse and interpret data is in the low category.

1. Introduction
In this modern era, the development of an information technology is slowly and continuously taking an increasingly strategic role in meeting human needs. The existence of information technology strongly supports human needs, especially in the interests of presentation and obtaining information. The Information is usually presented in statistical data. Therefore, in order to be able to present or obtain this information, everyone must have the ability to understand the data. A person's ability to understand data is called statistical thinking ability. According to Martadiputra, statistical thinking is the ability to understand the statistical process as a whole, and apply understanding to real problems [1]. These capabilities include the following indicators: (1) Describe data; (2) Organizing and reducing data; (3) Represent data; and (4) Analyze and interpret data

In this modern era, everyone definitely needs statistical thinking ability. The ability of statistical thinking is used by everyone because each person must be in one of two choices, as a maker or presenter (producer) of statistics or as user (Consumer) statistics. Producers and consumers certainly must understand statistics. Ronald Seifer, R. said that "... both producers and consumers of statistics should be statistically thinking" [2]. The good statistical thinking ability will be an important basis for everyone to make the right decisions.

Given the importance of mastering statistical thinking for everyone, then at the education level, ideally a teacher should know the students' statistical thinking ability. Because in general, besides teaching, the task of a teacher is to ensure that the material taught can be understood by the students. This is in accordance with Masjudin's opinion that mastery of good mathematical concepts by students...
is a responsibility of educators [3]. Facts, obtained from the teacher of Mathematics at VIII grade student of SMP Negeri 3 Lingsar that the teacher had never studied the ability of students’ statistical thinking.

In fact, the study of students' statistical thinking ability is very important. This is in accordance with the opinions of McAlevey, Lynn and Sullivan, Charles that the ability to increase statistical thinking is an important requirement in a society full of statistical information [4]. By knowing the ability of students to think statistically, a teacher can know the material that is felt difficult by students, as well as the obstacles experienced by students in learning statistical material. Furthermore, the teacher can determine strategic steps to improve the ability to think about the students’ statistics. Teachers can help students develop their thinking ability in understanding statistical data. Thus, it is expected that each individual student can understand and interpret statistical messages in various contexts and to become students who are able to conclude or make accurate decisions from information or data.

This study aims to describe students' statistical thinking abilities. The students' statistical thinking abilities described include; (1) Describe data; (2) Organizing and reducing data; (3) Represent data; and (4) Analyse and interpret data.

2. Methods
This research uses a qualitative approach with a phenomenological method that describes the ability of students to understanding statistical data. This is consistent with the opinion of Linarwati, et al. that is a form of research aimed at describing the phenomena that exist, both natural phenomena and man-made phenomena [5]. This phenomenon can be in the form of activities, characteristics, thought processes, or other phenomena. The subjects of this research were VIII B grade student of Public Middle School 3 Lingsar, West Lombok, amounting to 24 people. The instruments in this study include; (1) test sheet, in the form of description test, (2) unstructured interview guideline, and (3) documentary, used record of tape recorders and cameras. Furthermore, the procedure of the research conducted in this study was (1) test the ability of students to think statistically, (2) Perform data analysis on the ability of students to think statistically, both quantitatively (using category ability refer to Arikunto [6]) and qualitatively, (3) choose a subject and conduct an interview, (4) make interview transcript, and (5) draw conclusions and report the results of research using triangulation technique [7].

3. Result and Discussion
3.1. The result of student’s statistical thinking ability test
The results of student’s statistical thinking ability at VIII B grade of SMP Negeri 3 Lingsar. can be seen in the following Figure 1.

![Figure 1. Data on the level of student’s statistical thinking ability](image_url)

Based on Figure 1, student’s statistical thinking ability at VIII B grade consists of 3 levels namely high, medium and low. The category is described in Table 1 which is modified from Arikunto [6].
Table 1. Categories of Statistical Thinking Ability

| Ability Score | Ability Category |
|---------------|-----------------|
| 71-100        | High Category   |
| 41-70         | Medium Category |
| 10-40         | Low Category    |

The level of statistical thinking ability of students with 70-100 interval values is included in the high level consisting of 1 student with a percentage of 4.2%. The level of statistical thinking ability of students with interval values 41-70 belongs to the moderate level of ability consisting of 12 students with a percentage of 50%, while values with intervals of 10-40 are included in the level of low statistical thinking ability consisting of 11 students with the highest percentage that is 45.8%. The average score of students' statistical thinking ability reaches 40.21 which is included in the interval value of 10-40 with a low statistical thinking ability category. Thus, the statistical thinking ability of students in class VIII B of Lingsar 3 Public Middle School is included in the low category.

Furthermore, student achievement on each indicator of statistical thinking ability can be seen in the following Figure 2.

![Figure 2](image)

**Figure 2.** Students achievement of each indicator of student statistical thinking ability

Based on Figure 2, information can be obtained that the average score of indicator 1 (describing data) reaches 53.75. This means that the ability of students to describe the data is in the medium category. The average score of indicator 2 (organizing and reducing data) reaches 24.79. This means that students' ability to organize and reduce data is in the low category. The average score of indicator 3 (representing data) reaches 67.50. This means that students' ability to represent data is in the medium category. The average score of indicator 4 (analyzing and interpreting data) reaches 23.75. This means that students' ability to analyze and interpret data is in the low category. This is in line with Fadilah's findings, I.N [8] who conducted research in the mathematics department of IAIN Sheikh Nurjati Cirebon that the ability to think of student statistics is still in the low category.

3.2. **Interview Results**

The interview plan was carried out on 6 students representing each level of statistical thinking ability. However, based on the test results, only one person has the ability to have high statistical thinking abilities. So, the interview was only carried out on 5 people, with details: 1 student capable of high statistical thinking, 2 students capable of medium statistical thinking, and 2 students capable of low statistical thinking.
3.2.1. Interview results of students who have high statistical thinking ability

Students who have high statistical thinking ability are only 1 student (4.2% of the total number of students). So that the interview was carried out only to 1 person. Based on the results of the test of statistical thinking ability possessed by high-ability students, the errors made were incomplete in making data descriptions and not thorough in carrying out operations when calculating mode. So, when interviewing the researcher confirmed the mistake made. Overall, these students can master all indicators well, answers given in detail about the mistakes made, students are able to explain important points to answer the questions. Students are also able to understand the intent contained in the data, both implicit and explicit. These students have complete understanding and can identify important factors that are relevant to the problem given. Mistakes experienced when answering questions are only due to negligence in counting.

3.2.2. Interview results of students who have moderate statistical thinking ability

Students’ ability of statistical thinking are in medium category consisting of 12 students (50% of the total number of students). Of the 12 people, 2 were made the subject of the interview. Based on the results of tests of statistical thinking ability possessed by high-ability students, mistakes made include: unable to describe the data in full, unable to calculate the mean, median, and mode perfectly, and misconceptions in the meaning between median and mode. In addition, many students with moderate abilities cannot analyze and interpret data properly. When the errors were confirmed through interviews, information was obtained that in describing the data, students presented incompletely. But when guided, students can explain it well. This is in line with the research conducted by the Rosidah [9] that students can identify facts that exist on the graph, but require stimulus from researchers. Another finding is that students memorize the formula given by the teacher in learning. So, in solving the problem, one student in searching for the median, he uses the mode formula, while in determining the mode he uses the median search method. A misconception occurs between the median and the mode. In addition, they are not thorough and hasty in working on the questions. But when confirmed, students can correct their mistakes. It can be concluded that students with moderate statistical thinking ability are good enough in performing count operations. Students understand the steps or how to solve problems even if they are not perfect. Students can present data in the form of images properly. The difficulty experienced is analysing and interpreting data, and making decisions based on data.

3.2.3. Interview results of students who have low statistical thinking ability

Students with low statistical thinking ability consist of 11 students (45.80% of the total number of students). Of the 11 students, 2 were taken as interview subjects. Based on the answers to the test results students have low statistical thinking ability, and information is obtained that the mistakes made are more complex and start from simple things. In describing data based on tables, students only write a small portion of some data that needs to be described. Some students cannot understand the meaning of the table. Some students don’t even answer at all about calculating the mean, median, and mode. Some students cannot present data in the form of diagrams. Students also cannot make decisions about data. Based on the results of the interview, students cannot describe the data properly. But with the help and guidance of researchers in the end the student can describe the data. What’s worse, interview subjects cannot carry out simple counting operations, especially division and multiplication. As a result, the student cannot answer all the problems given related to calculating the mean, median, and mode. In presenting data with images and interpretation of data, students are only inconsequential in writing answers. The results of the interview also showed students did not understand the meaning of the data provided, students did not answer in a procedure, students were not able to analyse and develop their thinking in solving problems. This is in line with the opinion of Zuhri et al., Who stated that if students do not understand a statistical concept, then when they predict they tend to answer or use their imagination in giving reasons [10].
In general, the researcher draws some obstacles experienced by students in thinking statistics. Firstly, when describing data, students only write part of the expected answers. This difficulty is experienced by all good students who have the ability to think high, medium, and low statistics. This is because students are not used to writing or describing data. Secondly, when organizing and reducing data, students are not careful in carrying out operations, and are in a hurry so they are wrong in counting. Some students also only memorize formulas, without understanding them. Especially students who have moderate and low statistical thinking ability. If students learn only by memorization, it will be difficult for students to remember the material for a long time. Students tend to forget quickly the material. This is in line with Masjudin's opinion that what is most needed in learning mathematics is understanding, not rote learning [11].

The third difficulty is data representation. Students who have the ability to think high and medium statistics can do the representation of data in the form of a diagram well and able to explain the process carried out in making table diagrams. But students with low statistical thinking ability cannot do data representation because they do not understand the procedure of drawing graphs or diagrams. The last, when student analyse and interpret the data, high statistical ability students are able to draw conclusions from the data using clear reasons. But students with moderate and low statistical thinking ability cannot make conclusions from the data. Draw conclusions and determine attitudes towards a data one of the difficulties of students in solving statistical problems.

4. Conclusion
Based on the results of data analysis and discussion, it can be concluded that the students' ability to think statistically in understanding statistical data there are three categories, namely high, medium and low. Students who have high statistical thinking abilities reach 4.2%. Students who have moderate statistical thinking abilities reach 50%, and students who have low statistical thinking abilities reach 45.8%. The average score of students' statistical thinking ability test reaches 40.21. Thus, the statistical thinking ability of students in class VIII B of Lingsar 3 Public Middle School is included in the low category. Furthermore, based on the indicators of students' thinking ability, it was concluded that the students' ability to describe the data was in the medium category, the students' ability to organize and reduce data was in the low category. Students' ability to analyze and interpret data is in the low category.

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