

Statistical Resoning Student In Statistical Problem Based On Sex Differences

Luthfaturrohmah^{1*}, Rooselyna Ekawati¹, Endah Budi Rahaju¹

¹Department of Mathematics Education, Universitas Negeri Surabaya, Surabaya, Indonesia, 60231

*Corresponding Author: luthfaturrohmah17@gmail.com

How to Cite: Luthfaturrohmah., Ekawati, R., & Rahaju, E.,B. (2019). Statistical Resoning Student In Statistical Problem Based On Sex Differences, *International Journal of Trends in Mathematics Education Research*, 2(1), 13-18. DOI: <http://dx.doi.org/10.33122/ijtmer.v2i1.110>

ARTICLE HISTORY

Received: 10 January 2019
Revised: 12 February 2019
Accepted: 27 February 2019

KEYWORDS

Statistical Reasoning
Statistical Problem
Sex Differences

ABSTRACT

The purpose of this study is to describe the level of statistical reasoning of male students in statistical problems, and describe the level of statistical reasoning of female students in statistical problems. The method used in this study is descriptive qualitative which describes the level of statistical reasoning of male and female students in statistical problems solving. The results of his research are there are differences in the level of statistical reasoning of male and female students in solving statistical problems. There are differences in the level of statistical reasoning between male and female students in the statistical reasoning process. Differences in the level of statistical reasoning between male and female students in the process of analyzing and interpreting data. Male students at level 4 and female students at level 5, whereas in the process of describing data, organizing data and replicating data on male and female students are at the same level. In describing data on male and female students at level 4, in the organizing process data on male and female students at level 3, in the process of representing data on male and female students at level 5.

This is an open access article under the CC-BY-SA license.



1. INTRODUCTION

One of the mathematics learning objectives includes the use of reasoning on patterns and traits, making mathematical manipulations in making generalizations, compiling evidence or explaining mathematical ideas and statements and solving problems. (Depdiknas, 2006, p.164). There are five basic abilities that are standard processes in mathematics, namely problem solving, reasoning and proof, communication, connections, representation (NCTM, 2000).

From some of the objectives of mathematics learning above, important reasoning in mathematics learning. Besides being used in solving problems, reasoning is also a learning goal. Stylianides states: "Reasoning-and-proving involves the investigation of whether and why "things work" in mathematics, generation of conjectures, and the formulation of arguments (which may be proofs) for the truth or falsity of mathematical assertions" (Stylianides, et al, 2013, p.1463).

This is supported by research conducted by Singh namely "Reduce the emphasis on teaching of a procedural method in teaching students to solve problems" (Singh, 2000, p. 598, Fonna, 2019, Sanawiyah, 2019). NCTM (2000) explains that there are five mathematical topics that must be understood by students, namely numbers and operations (number and operations), algebra (algebra), geometry (geometry), measurements (data analysis) and opportunities (data analysis and probability) Of the five topics in this study, the focus is on data analysis which is part of the statistics.

Statistics can be used in various fields of science such as economics, health, education and many other fields of science. This is as stated by Carmichael that at present statistics have been applied in sharing fields in everyday life, ranging from health to

politics. A person should have knowledge of statistics which aims to be able to understand statistical information that is related to issues in daily life (Carmichael, 2010, Purnawati, 2019). This shows that the importance of studying statistics.

There are two types of statistics, namely descriptive statistics and inferential statistics. Descriptive statistics are statistics that study how to collect data and present data, while inferential statistics are statistics related to hypotheses and conclusions (Hasan 2013). In this study only focuses on descriptive statistics. One of the topics contained in descriptive statistics is the presentation of data. Data presentation is one of the main material in mathematics subject taught to junior high school students.

The purpose of statistical learning is that students understand statistics well in order to obtain information from existing data, criticize and make decisions based on existing information (Rumsey, 2002). One statistical ability is statistical reasoning (Ben-Zvi and Garfield 2004). Statistical reasoning is a reasoning activity carried out by students on statistical topics using statistical concepts to solve statistical problems (Garfield 2002). This is consistent with the research conducted by Martin that in statistical reasoning is needed about students' cognitive abilities which consist of students' knowledge of statistical information, and students' understanding of statistical concepts (Martin et al, 2017, Putri, 2019).

The research conducted by Chan is as follows: Framework descriptors were established at all levels of statistical reasoning and four key constructs. The former consists of idiosyncratic reasoning, verbal reasoning, transitional reasoning, procedural reasoning, and integrated process reasoning. The latter include describing data, organizing and reducing data, representing data, and analyzing and

interpreting data. In this study, this initial framework is formulated a complete and consistent statistical reasoning framework. A statistical reasoning assessment tool is then constructed from this initial framework. The tool was administered to 10-grade students in a task-based interview. The initial framework was refined, and the statistical reasoning assessment tool was revised. The findings showed that the students' statistical reasoning levels were consistent across the four constructs, and this result confirmed the framework of cohesion Chan et al. (2016, p.1).

Research conducted by Chan et al. (2016) which explains the initial framework in statistical reasoning. The initial framework consists of five levels of statistical reasoning, namely idiosyncratic reasoning, verbal reasoning, transitional reasoning, procedural reasoning and integrated reasoning; and four constructs in statistical reasoning, namely describing data, grouping data and reducing data, representing data, analyzing and interpreting data. In a study conducted by Chan et al. (2016) the initial framework consisting of five levels of statistical reasoning and four constructs in statistical reasoning was tested on students. After being tested the students' initial framework was revised, the results of the initial framework in the form of five levels of statistical reasoning and four revised statistical reasoning constructs were tested back to students. The results of the two initial framework tests are the level of students' statistical reasoning and the four constructs did not change.

This research is a study adapted from research conducted by Chan et al. (2016). In the study of Chan et al. (2016) explained that the level of statistical reasoning in the four statistical constructs did not change, while in this study four processes in statistical reasoning will be explained. There can be a process consisting of describing data, organizing data, representing data, analyzing and interpreting data, and reaching the level of how students can understand the statistical process. Jones et al explained that there are four processes in statistical reasoning, namely: (1) "Describing data includes reading the data presented as raw or in a graph, table or scheme", (2) "Organizing data includes organizing, classifying and summarizing data, as grouping the relevant data, summarizing the data using central tendency measures, and describing the variation of the data". (3) "Representing data is related to data in form of a graph", (4) "Analyzing and interpreting data including the determination of patterns and tendencies in the data and estimation and inference based on the data" (Ulusoy & Atlay, 2017, p.21)

In this study adapting the opinions expressed by Ulusoy & Atlay (2017). This study uses four processes, namely: (1) Describing data: understanding data in the form of tables to determine the type of chart used in the data presented in table, (2) Organizing data: grouping relevant data. Grouping data in the form table of grouping data mode and mean, (3) Representing data: describing the chart of data in the tables, (4) Analyzing and interpreting data: making conclusions from data in the form tables

Garfield explained the level framework in statistical reasoning which consists of five levels, namely: (1) Level 1 "Idiosyncratic reasoning: Students can use several statistical words and symbols but cannot completely comprehend and relate them to the appropriate information", (2) Level 2 "Verbal reasoning: can perform better because they know the definitions of some statistical ideas, but they still fail to apply them correctly", (3) Level 3 "Transitional reasoning: students are capable of recognizing one or two aspects of the statistical process, but they cannot practically incorporate these concepts into answers ", (4) Level 4" Procedural reasoning: students can identify statistical processes accurately, but they still

lack the ability to fully comprehend or integrate them ", (5) Level 5" Integrated process reasoning: have full knowledge of statistical processes and are competent in coordinating rules and behavior as well as elucidating the process in their own words "(Chan et al, 2016, p.2).

At level 1 and level 2 in statistical reasoning what is meant by understanding or understanding is understanding the data presentation material. Hiebert & Carpenter stated that reasoning is "the degree of understanding is determined by the number and connection. "A mathematical idea, procedure, or fact is thoroughly understood if it is linked to an increased network with more connections" (Stylianiades, 2007, p. 106). The level of understanding of students is determined by the ability of students to connect the knowledge they already have with new knowledge received in the learning process. In this case, what is meant is understanding related to statistical concepts. Statistical ideas, procedures or steps in resolving data presentation problems. At level 3, level 4 and level 5 students have started using four processes in statistical reasoning.

In a study conducted by Chan et al. (2016) students in the class were given a test of the level of statistical reasoning by considering the student had already studied material about basic statistics. Whereas in this study the test of statistical reasoning level was given by considering the student gender, namely male students and female students. In this study to choose a subject consisting of male students and female students based on the results of giving a relatively similar test of students' mathematical abilities.

In understanding the statistical process, each student has different reasoning abilities. Each student is a unique individual, that is, individuals do not have the same as other individuals (Hasrul, 2009). Maccoby and Jacklyn state that men and women have different abilities, namely: (1) Women have verbal knowledge better than men, (2) Men are superior in visual spatial abilities (spatial vision) than women, (3) Men are superior in mathematical abilities (Firmanti, 2017).

2. RESEARCH METHOD

The type of research used in this study is qualitative research and the approach used uses a qualitative descriptive approach. Qualitative research is a research that emphasizes data deepening aspects in order to get the quality of the results of a study. Qualitative research is a study that focuses on the description of words arranged carefully from collecting data to analyzing data.

The time for this study was on Tuesday and Thursday 08 and 10 Desember 2018 during the mathematics lesson, where the research was in one of the junior high school in Tulungagung district. Data collection in this study was carried out through tests of mathematical abilities, tests of statistical reasoning levels, and interviews. Mathematical ability tests are conducted to determine the research subject consisting of male and female students. The reasoning level test is conducted to determine the level of student reasoning in solving statistical problems. Interviews conducted were semi structured interviews using guidelines from interview guidelines and adjusted to the answers of junior high school students.

Qualitative data analysis techniques carried out in an effort to compile, categorize the data to a conclusion of the data analysis to be achieved. Data analysis is a process of systematically searching and compiling data obtained from the results of statistical reasoning tests, results from interviews, field notes and documentation, by organizing data into categories, describing into units, synthesizing,

arranging into patterns, choosing names that are important and will be learned and make conclusions so that they are easily understood by themselves or others.

3. RESULT AND ANALYSIS

3.1 The results of the test of the statistical reasoning level of male students (S1) are as follows:

On the answer sheet number 1 on the test of the level of statistical reasoning in the process describing data, S1 writes the type of diagram used is a bar diagram by giving reasons because bar charts that are easy to use for dynamic values. It is like the following picture:

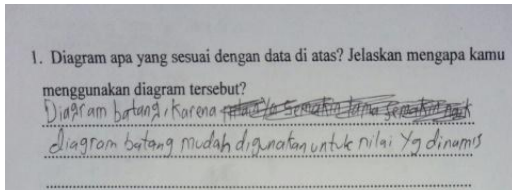


Figure 1. Answer S1 for question number 1 on the test level of statistical reasoning in the process of describing data

According to S1 the easiest chart to use is a bar chart. From the existing data you can use chart other than bar charts, such as line chart and pie chart. S1 uses bar chart because S1 is easy and diagrams are understood by S1.

Based on the written answer S1 writes the answer, namely the chart used is a bar chart. S1 gives the reason that the bar chart is the easiest chart. From the written answer, S1 uses reasons that are in accordance with the process describing data at level 4 in statistical reasoning, namely understanding information from the data presented in table, knowing the type of chart used from the data presented in table, but not correctly in giving explanation of why to use the selected chart.

On the answer sheet number 2 on the statistical reasoning level test in the organizing data process, S1 states that the mode values of class VII A and class VII B is 75, and S1 states mode is the highest value of existing data. That is like in the picture below:

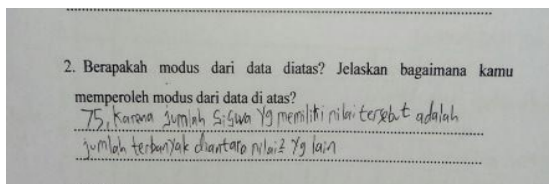


Figure 2. Answer S1 for question number 2 on the test level of statistical reasoning in the process of organizing data

On answer sheet number 3 on the level of statistical reasoning test in the process organizing data, S1 states that the mean value of class VII A and class VII B is, and S1 states the mean by summing all the values of the data presented in table form VII A class then dividing it by the number of students in class VII A, as well as on class VII B data, S1 sums all the value of the data presented in table form in class VII B then divides it by the number of students in class VII B. That is as shown below:

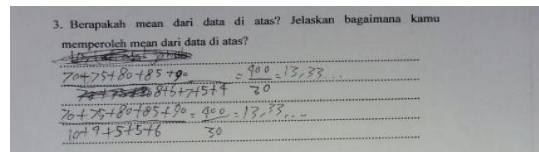


Figure 3. Answer S1 for question number 3 on the test level of statistical reasoning in the process of organizing data

S1 writes the mode value of class VII A and class VII B together, that is, the mode is obtained from the highest value among the other value of the data presented in the form of table. S1 writes the mean of class VII A and class VII B together, that is, the mean is obtained from summing all the values and dividing them by the number of students from class VII A and class VII B

Based on exposure to written answers S1 knows what mode or mean of data is presented in table form, but it is still not correct in determining the mode or mean. It can be concluded that S1 in the process of organizing data reaches level 3.

On the answer sheet number 4 on the level statistical reasoning test in the data-critical process, S1 describes the bar diagram as much as 2 bar charts which are representations of data presented in table, the first bar diagram is a representation of data class VII A and the second bar chart is a representation of data class VII B. In the steps in describing the bar chart, namely (1) make a line x and y, (2) write the data in the form of values on the two lines, (3) make a bar chart according to the data contained in step 2. That is in the following picture:

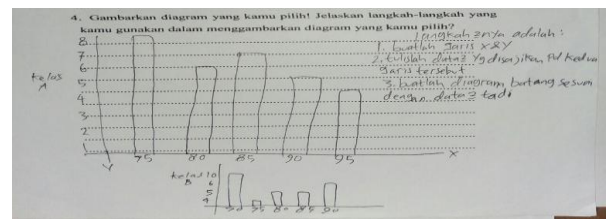


Figure 4. Answer S1 for question number 4 on the test level of statistical reasoning in the process of representing data

S1 describes two bar charts consisting of the first bar chart which is a representation of data class VII A presented in table, and the second chart is a representation of data class VII B presented in table. S1 explain the steps in describing bar chart, namely (1) making lines x and y, (2) writing data in the form of values on two lines, (3) making bar charts according to the data contained in step 2. S1 distinguishes the first chart with the second chart by looking at the value of students in each class

Based on exposure to written answers and S1 describes diagrams of data presented in table form correctly, determines steps in drawing diagrams correctly and reveals differences from correctly selected diagrams. It can be concluded that S1 in the process representing data reaches level 5.

On the answer sheet number 5 on the test of statistical reasoning level in the process of analyzing and interpreting data, S1 shows how to draw conclusions, namely by using the mode values, namely the modes of class VII A and Class VII B together. That is in the following picture:

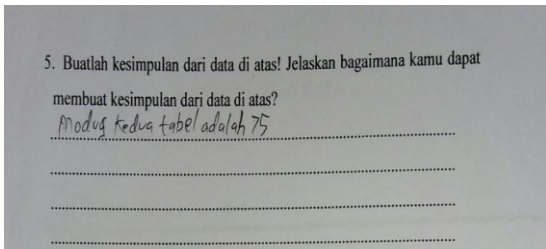


Figure 5. Answer S1 for question number 5 on the test level of statistical reasoning in the process of analyzing and interpreting data

S1 shows how to make conclusions, namely by looking at the mode values of the two data presented in the form of tables, namely the modes of class VII A and Class VII B the same, namely 75.

Based on exposure to written answers S1 makes conclusions from Based on exposure to written answers and interview results, it appears that S1 makes conclusions from data presented in table form correctly but has not fully provided an explanation of existing data. It can be concluded that S1 in the process of analyzing and interpreting data reaches level 4.

3.2 The test results for the level statistical reasoning of female students (S2) are as follows:

On answer sheet number 1 on the level of statistical reasoning test in the process describing data, S2 writes the type of chart used is a bar chart by giving reasons because we are easier and understand it. This is like the following picture:

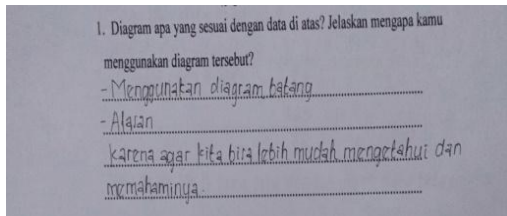


Figure 6. Answer S2 for question number 1 on the test level of statistical reasoning in the process of describing data

According to the S2 the mostly easy to use chart is salted stem. From the existing data you can use chart other than bar chart, such as line chart and pie charts. S2 uses a bar chart because S2 is easy and the chart is understood by S2.

Based on the written answer S2 writes the answer, namely the chart used is a bar chart. S2 gives the reason that bar charts are the easiest chart. From the written answer, S2 uses reasons that are in accordance with the describing process of data at level 4 in statistical reasoning, namely understanding information from the data presented in table, knowing the types of chart used from the data presented in table, but not correctly in giving explanation of why to use the selected diagram.

On answer sheet number 2 on the level of statistical reasoning test in the process organizing data, S2 states that the mode value of the daily test value of class VII A is 75 and the daily test mode value of class VII B is 75, and S2 declares mode is the most emergent value, because of the data in class VII A and class VII B is 75, the mode value is 75. This is as in the following picture:

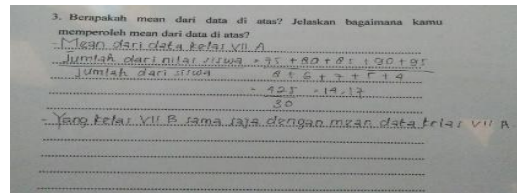


Figure 7. Answer S2 for question number 2 on the test level of statistical reasoning in the process of organizing data

On answer sheet number 3 on the level of statistical reasoning test in the process of organizing data, S2 states that the mean value of class VII A is the sum of student grades divided by the number of students, so the mean value of class VII A is 14,17. In class VII B how to do it is the same as class VII A and the mean of class VII B is the same as the mean in class VII A It is like in the following picture:

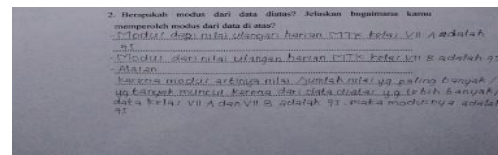


Figure 8. Answer S2 for question number 3 on the test level of statistical reasoning in the process of organizing data

S2 writes the mode value, that is, the mode is obtained from multiple values that appear from the data presented in table. S2 writes the mean values of class VII A and class VII B the same, that is the mean is obtained from summing all grades of students in class VII A and summing all grades of class VII B students and dividing them by the number of students from class VII A and dividing them by the number of students from class VII B

Based on exposure to written answers S2 knows what mode or mean of the data presented in the form of tables, but is still not correct in determining the mode or mean. It can be concluded that S2 in the organizing process reaches level 3

On the answer sheet number 4 on the level of statistical reasoning test in the process representing data, S2 describes the bar chart as much as 2 bar charts which are united based on the value of the data presented in table, where the bar charts is distinguished by class VII A and class VII B In class VII A shaded bar chart and class VII B shaded bar chart, bar chart is a representation of data presented in table. In the steps in describing the bar chart, namely (1) making a line x and y, (2) we must first distinguish which data class VII A and data class VII B, (3) we only data the number of class VII A and class VII B, (4) then we know the number of values from the bar chart, (5) then write your answer according to the bar chart. That is in the following picture:

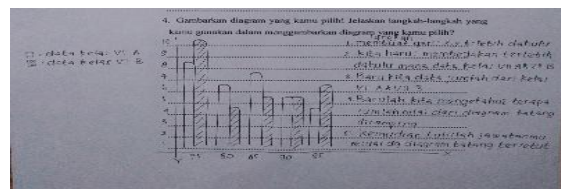


Figure 9. Answer S2 for question number 4 on the test level of statistical reasoning in the process of representing data

S2 describes a bar chart of 2 bar charts which are united based on the value of the data presented in the form of tables, where the bar chart is distinguished based on class VII A and class VII B. In class VII A unshaded bar chart and class VII B bar chart that shaded, bar charts are representations of data presented in table. In the steps in describing the bar chart, namely (1) making a line x and y, (2) we must first distinguish which data class VII A and class VII B, (3) we only data the number of class VII A and class VII B, (4) then we know the number of values from the bar chart, (5) then write your answer according to the bar chart. S2 distinguishes the first chart with the second chart by looking at the value of students in each class.

Based on the explanation of written answers and interview results, it can be seen that the S2 describes a chart of the data presented in table form correctly, determines the steps in drawing a chart correctly and reveals the differences from the selected chart correctly. It can be concluded that the S2 in the representing data process reached level 5

On answer sheet number 5 on the level of statistical reasoning test in the process of analyzing and interpreting data, S2 shows how to draw conclusions, namely concluding that the mode of data class VII A and class VII B is 75, concluding that the mean of class VII A and class VII B, and the chart used is a bar chart. S2 makes conclusions from the data above because S2 already knows about the data collection above and S2 knows the mean and mode of the data above. That is in the following picture:

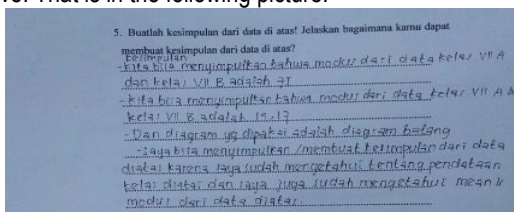


Figure 10. Answer S2 for question number 2 on the test level of statistical reasoning in the process of analyzing and interpreting data

S2 shows how to make conclusions, namely by looking at the mode values of the two data presented in the form of tables, namely the mode of class VII A and class VII B same which is 75, from the mean of class VII A and class VII B is, and the type of diagram used is a bar chart.

The following is the transcript of the interview results for answer number 5 on the level of statistical reasoning test in the process of analysis and interpreting data.

Based on exposure to written answers and interview results, it appears that S2 makes conclusions from data presented in table form correctly and has fully provided an explanation of the data presented in table form. It can be concluded that S2 in the process of analyzing and interpreting data reaches level 5.

4. CONCLUSION

The level of statistical reasoning of male student in process of describing data reaches level 4, male student is said to reach level 4 which is when students understand information from data presented in table form, knowing the type of chart used from the data presented in table, but it is still not correct in giving an explanation of why to use the selected chart. In the process of organizing data up to level 3, male student in the process of organizing data is said to arrive at level 3 which is when the students know what mode or mean of data is presented in table form, but still in the process of determining the mode value or mean.

In the process of representing data up to level 5, male student in the process of representing data are said to level 5, namely when student describe the chart of data presented in table form correctly, determine the steps in describing the chart correctly and reveal differences from data presented in table form, and in the process of analyzing and interpreting data at level 4, male student in the process of analyzing and interpreting data is said to arrive at level 4 which is when the student draws conclusions from the data presented in the table form correctly, but have not fully provided an explanation of the data available.

The female student level of statistical reasoning in the process of describing data reached level 4, the female student in describing data were said to reach level 4, namely when the student understood the information from the data presented in table, knowing the types of chart used in the data table, but it is still not correct in providing explanations for why to use the selected chart. In the process of organizing data up to level 3, female students in the organizing data process are said to arrive at level 3 which is when students know what mode or mean of data is presented in table form but is still wrong in the process of determining mode value or mean. In the process of representing data up to level 5, female student in the process of representing data is said to arrive at level 5, namely when student describe the chart of data presented in table form correctly, determine the steps in describing the chart correctly and confirm differences from the data presented in the form of tables and in the process of analyzing and interpreting data at level 5, female student in the process of analyzing and interpreting data are said to arrive at level 5, namely when students provide conclusions from data presented in table form correctly and fully provide an explanation of data presented in table.

REFERENCES

- Ben-Zvi, D., & Joan, G. (2004). *Statistical Literacy, Reasoning, and Thinking: Goals, Definitions, and Challenges*. Kluwer Academic Publishers, 3-15. ISBN: 978-1-4020-2278-4
- Carmichael, C.S. (2010). *The Development of Middle School Children's Interest in Statistical Literacy*. Disertasi doktoral yang dipublikasi oleh Universitas Tasmania. Diperoleh dari <http://eprints.utas.edu.au/10782/>
- Chan, S.W., & Zaleha, I., & Bambang, S. (2016). *A Framework for Assessing High School Students' Statistical Reasoning*. Plos one, doi: 10.1371/journal.pone.0163846
- Depdiknas. (2006). *Peraturan Menteri Pendidikan Nasional Nomor 22 Tahun 2006 Tentang Standar Isi untuk Satuan Pendidikan Dasar dan Menengah*. Jakarta: Kemendiknas-Depdiknas.
- Fonna, M., & Mursalin, M. (2019). *Using of Wingeom Software in Geometry Learning to Improving the of Mathematical Representation Ability*. *Malikussaleh Journal of Mathematics Learning (MJML)*, 1(2).
- Garfield, J. (2002). *The Challenge of Developing Statistical Reasoning*. *Journal of Statistics Education*, 10(3). doi: 10.11080/10691898.2002.11910676
- Hasan, I. (2013). *Pokok-Pokok Materi Statistik 1 (Statistik Deskriptif)*. Jakarta: Bumi Aksara
- Hasrul. (2009). *Pemahaman Tentang Gaya Belajar*. *Jurnal MEDTEK*, 1(2)
- Litner, J. (2008). *A Research Frame Work For Creative and Imitatif Reasoning*. *Educational Studies in Mathematics*, 6(70), 255-276
- Martin, N., & Jeffery, H., & Jonathan, F. (2017). *The Roles of Eksperience, Gender, and Individual Differences in Statistical Reasoning*. *Statistics Education Research Journal*, 16(2), XX-XX, <http://iase-web.org/Publications.php?p=SERJ>
- National Council of Teacher of Mathematics. (2000). *Prinsiples and Standard for School Mathematics*. Library of Congress Cataloguing-in-Publication Data: ISBN 0-87353-480-8.
- Pumawati, N. (2019). *Increased Learning Outcomes of Class VIII D Students in Cultural Arts and Skills Subjects on Illustrated Image Materials Through Project Based Learning Models at SMP Negeri 3 Surabaya*. *Indonesian Journal of Contemporary Education*, 1(1), 21-23.
- Putri, M. P., & Solfema, S. (2019). *The Relationship Between Variations in the Use of*

- Learning Media and the Learning Activity of Citizens Learning. *Indonesian Journal of Contemporary Education*, 1(1), 36-40.
- Rumsey, D. (2002). Statistical Literacy as a Goal for Introductory Statistics Courses. *Journal of Statistics Education*, 10(3). www.amsat.org/publications
- Sanawiyah, S. (2019). Improving Hyperactive Student Learning Behavior in Teaching Learning Activities Using Self-Counseling Method in Class VII-B SMPN 3 Surabaya. *Indonesian Journal of Contemporary Education*, 1(1), 10-14.
- Singh, P. (2000). Understanding The Concepts of Proportion and Ratio Among Grade Nine Students In Malaysia. *International Journal of Mathematical Education in Science and Tecnology*, 31(4), 579-599. DOI: 10.1080/002073900412688
- Styliandes, G.J., & Styliandes, A.J., & Shiling-Traina, L.N. (2013). Prospective Teachers' challenges in teaching reasoning-and-proving. *Intrenational Journal of Sience and Mathematics Education*. 11, 1463-1490
- Stylianides, A.J., & Gabriel, J.S. (2007). Learning Mathematics with Understanding: A Critical Consideration of the Learning Principle in the Principles and Standards for School Mathematics, 4(1). issn: 1551-3440, 103-114
- Ulusoy, C.K., & Mesture, K.A. (2017). Analyzing the Statistical Reasoning Levels of Preservice Elementary School Teachers in the Context of Model Electing Activity. *International journal of Reaserch in Education and Science*, 3(1). issn: 2148-9955
- Yusfita, Y. (2017). Konstruksi Penalaran Statistis pada Statistika Penelitian. *Scholaria*, 7(1), 60-69