Students' mathematical representation abilities in statistics

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Abstract
Representation is a form of student thinking about a problem that is used to find a solution to a problem. The form of student thinking can be in the form of words or verbs, tables, graphs, pictures and mathematical symbols. This study aims to analyze students performance in completing the mathematical representation ability test. The subjects of this study were 3 students of grade VIII in Mulyasari Village, Bayongbong District, Garut Regency with statistical material. In this study, the instruments used were in the form of written test questions and interviews. For written test questions in the form of descriptions with a total of 5 questions. Before being used in the study, the question instrument was first validated by the validator. The validators took 2 mathematics teachers. The data for this study were in the form of test results and interview results. Based on the results of the study, it states that students' mathematical representation abilities in statistics material are classified as moderate.
Keywords: mathematical representation ability; statistics; written test

Abstrak
Representasi merupakan bentuk pemikiran siswa terhadap suatu masalah yang digunakan untuk mencari solusi dari sebuah masalah. Bentuk pemikiran siswa dapat berupa kata-kata atau verba, table, grafik, gambardan symbol symbol matematika. penelitian ini bertujuan untuk menganalisi siswa dalam menyelesaikan tes kemampuan representasi matematis siswa. Subjek penelitian dalam penelitian ini adalah 3 orang siswa kelas VIII di Desa Mulyasari Kecamatan Bayongbong Kabupaten Garut dengan materi statistika. Pada penelitian ini instrument yang digunakan yaitu berupa soal tes tertulis dan wawancara. Untuk soal tes tulis berbentuk uraian dengan jumlah 5 soal. Sebelum digunakan dalam penelitian maka instrument soal tersebut divalidasi terlebih dahulu kepada validator. Untuk validatornya mengambil 2 orang guru matematika. Data penelitian ini berupa hasil tes dan hasil wawancara. Berdasarkan hasil penelitian menyatakan bahwa kemampuan representasi matematis siswa pada materi statistika tergolong sedang.
Kata Kunci: kemampuan representasi matematis; statistika; tes tertulis

Introduction

The quality of education in Indonesia is still considered low, this can be seen from the results of the Trend In International Mathematics and Science Study (TIMSS) test, an institution that measures and compares the mathematical abilities of students between countries, the mastery of mathematics of grade 8 students. In 1999 Indonesia was ranked 32nd out of 38 countries studied. In 2003 Indonesia was ranked 36th out of 45 studied, in 2007 Indonesia was ranked 41st out of 48 countries studied, the average score obtained by Indonesian students was 397. This score is still far from the international score of 500 (Setiawan, 2015).

Mathematics is a science that contains a collection of concepts and operations, but in learning mathematics, students' understanding of these things is more objective than in developing their calculations. A good teacher will explain the content area and relate mathematical problems to concrete situations. In essence, Mathematics as a structured and systematic science means that the concepts and principles in Mathematics are interrelated with each other (Permana & Sumarmo, 2007).

Mathematics is a basic subject taught in every formal education at elementary and secondary levels because mathematics is considered an essential subject. The purpose of mathematics subjects is for students to be able to have problem-solving skills that include the ability to understand problems, design mathematical models, solve models and create solutions accompanied by a tenacious attitude and confidence in solving problems (Khadijah et al., 2018).

Kartini (2014) stated that mathematical representation is an expression of mathematical ideas (problems, statements, definitions, etc.) that are used to show the results of their work in a certain way (conventional or unconventional) as a result of the interpretation of their thoughts. In general, mathematical representation is an expression of mathematical ideas as a tool to find solutions to the problem. Mathematical representation indicators according to Villages (Feriyanto, 2019), explain three main aspects in mathematical representation which include Pictorial Representation, Symbolic Representation, Verbal Representation of the word problem.

Mathematical representation ability is an ability related to students' mathematical understanding ability. Representation is students' knowledge and understanding that is constructed to understand a mathematical concept. Representation can support students' understanding between various interrelated mathematical concepts and apply mathematical concept models to realistic problems through modeling (Wahyudin, 2012). In communicating a mathematical idea, students can represent it in various forms, either in the form of writing, symbols, images, or real objects. This way of representing can help students to understand knowledge, can help students to solve mathematical problems

because problems that were previously complicated can become simple so that they can be solved more easily (Handayanir, 2015).

One of the abilities that support students to master statistics is representation ability. In learning mathematics, representation is the basis or foundation of how a student can understand and use mathematical ideas. As stated by Hwang, Chen, Dung, and Yang (2007), that when solving mathematical application problems, students need to observe and find special patterns in the problem. Namely, students need to formulate the problem into an abstract mathematical problem or mathematical model. According to Dahlan & Juandi (2011) stated that in this formulation process, students must have multiple representation skills to articulate the same problem in different forms or views (Mahmud & AR, 2018).

Several studies that have been conducted explain the mistakes made by students in representational abilities. Legi (2008) stated that students with low abilities have difficulty in creating and using symbolic and pictorial representations. In addition, Suryowati (2015) also revealed that students still do not understand how to represent real-world problems into representative mathematical problems. The two studies (Legi, 2008; Suryowati, 2015) recommend efforts that teachers can make so that students have representational abilities by choosing and using the right learning approach, so that the learning process takes place optimally and is able to develop mathematical representation abilities (Sulastri et al., 2017).

Judging from the results of the study (Ribkyansyah et al., 2018) it states that students' representational abilities in involving mathematical models of the representations given to solve mathematical problems have a low percentage. Students' problems in solving representation problems are caused by several factors including students not understanding the questions, students not paying attention to the teacher when teaching the material, students are not taught enough by the teacher in applying mathematical problems to everyday life.

Based on the research results (Atjiang, n.d.) the ability to change representations in solving physical problems owned by students is still lacking (low), it can be seen from all the questions given only a few students can explain according to what is expected. Lack of understanding in solving problems makes it difficult for students to change representations.

In addition to the low mathematical representation ability, the lack of teacher knowledge of various learning models also greatly influences the learning process and results in the learning model being used being inappropriate (Isjoni, 2014). According to Effendi (2014), in the implementation of learning, students tend to feel bored because there is one-way communication that gives students little opportunity to think mathematically and discuss with other students, so that only a few forms of mathematical

representation are known and mastered by students. This results in students being given mathematical problems that are different from example questions or exercises, students cannot represent the mathematical problem into a mathematical expression or picture so that students cannot solve the problem (Intan, 2016). Therefore, representation skills need to be improved in mathematics learning because they can help students learn about mathematical concepts through drawing, using objects, giving reports, and verbal explanations (Syahdi, 2019). Students' mathematical representation ability is one of the cognitive abilities that influences mathematics learning outcomes and student achievement (Saputri & Maskudi, 2017). Students' representation ability is a benchmark for success in learning mathematics. If students have weak representation abilities, then the process of students solving the problems given is hampered (Hijriani et al., 2018). Therefore, representation ability plays an important role in determining students' attitudes towards a problem, especially mathematical problems (Umaroh & Pujiastuti, 2020).

Method

The type of research used is descriptive research with a qualitative approach. This study aims to analyze students in completing the mathematical representation ability test. The subjects of this study were 3 students of grade VIII in Mulyasari Village, Bayongbong District, Garut Regency with statistics material. In this study, the instruments used were in the form of written test questions and interviews. For written test questions in the form of descriptions with a total of 5 questions. Before being used in the study, the question instrument was first validated by the validator. For the validator, 2 mathematics teachers were taken. The data for this study were in the form of test results, interview results,. The results of the student test were used as material for student interviews. For research data, it was analyzed based on 4 stages, namely the preparation stage, the incubation stage, the illumination stage, and the verification stage.

Result

This section will describe the research results and discussions obtained in each stage of the research carried out. This study aims to analyze how students' mathematical representation abilities are in statistical materials.

a. Research Implementation Process

The questions given to students were questions that had been validated by 2 validators consisting of 2 mathematics teachers from MTS AL Jumhuriyah and a mathematics teacher from SMP Al Manar, students were also interviewed by the author to

obtain information about students' mathematical representation abilities. During the test, the author also made research notes.

After the author conducted tests and interviews with students, the author reviewed the students' test answers and interview results as well as the results of the research notes.

b. Data Reduction

The following are the results of observations from 3 subjects who have worked on the questions and have been interviewed.

1. Subject 1

Q: Have you ever known questions 1-5?
S-1: Yes, but maybe different sentences
Q: Did you read questions 1-5 before you filled in the questions?
S-1: Yes
Q: After seeing and reading what did you think?
S-1: I thought about how to solve the question

Based on the results of this interview, S-1 has known the five questions that the author gave but there are slight differences in terms of sentences. Before working on the questions, S-1 also read the 5 questions first and then thought about how to solve the questions.

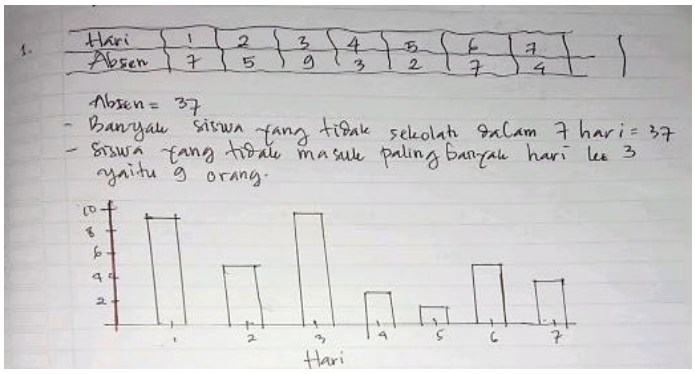

Figure 1. Question number 1

From Figure 1, it can be seen that S-1 can answer correctly and precisely and is able to represent the table into words and is able to represent the table into a bar chart. This means that S-1 reads the questions, understands the questions, and identifies the elements that are known and asked, thus students are able to answer the questions and are able to present data from a story problem back into a diagram representation.

In the answer above, S-1 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage from the question to the diagram representation, the coding stage is the stage where S-1 can work on the question well and correctly until drawing conclusions.

After redrawing the table, the subject added up the number of students who were absent from school and answered the number of students who were absent the most, then

the students represented the table into a bar chart. The analysis of the results of the mathematical representation was carried out by the author when S-1 worked on question number 1, S-1 did not have difficulty in solving question number 1.

P: Do you understand the question?
S-1: I understand, but in question number 2 I forgot not to use percentages so I only used degree measurements
P: So you didn't use percentages because you forgot?
S-1: Yes

Based on the results of the interview with S-1, it was concluded that S-1 understood the questions given and took the correct steps, S-1 was able to complete them correctly but there was one shortcoming, namely not using percentages.

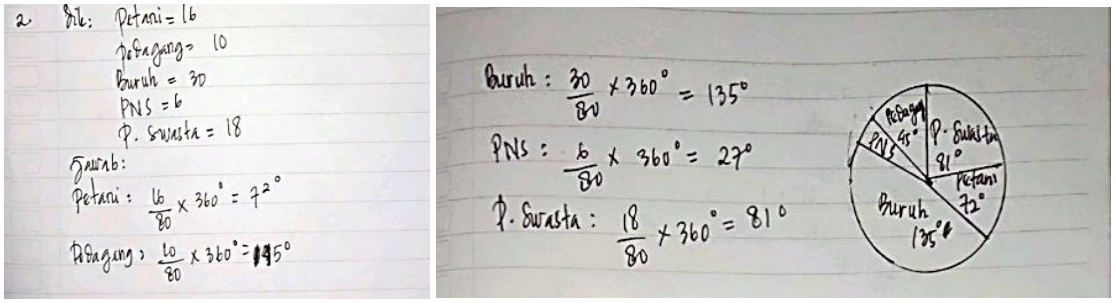

Figure 2. Answer S-1 question number 2

From Figure 2, it can be seen that the subject wrote down what was known in the question, which means that the subject has read the question so that he can identify the known elements, thus the subject seems to know what to do to continue working on the given representation question. After writing down what was known, the subject calculated the degree of each type of work and then the subject represented it in the form of a pie chart.

In the answer above, S-1 has already carried out the stage of reading the question first, the stage of understanding the question, but there is one step missing, namely not calculating the percentage so that the transformation stage is not perfect.

P: Have you ever seen a question like number 3?
S-1: yes I have
P: but why is part C, namely the mode, not filled in?
S-1: yes, I forgot because earlier to fill in question number 3, I filled in A first and then skipped to number 4, so I missed C.
P: Not careful enough huh
S-1: Yes

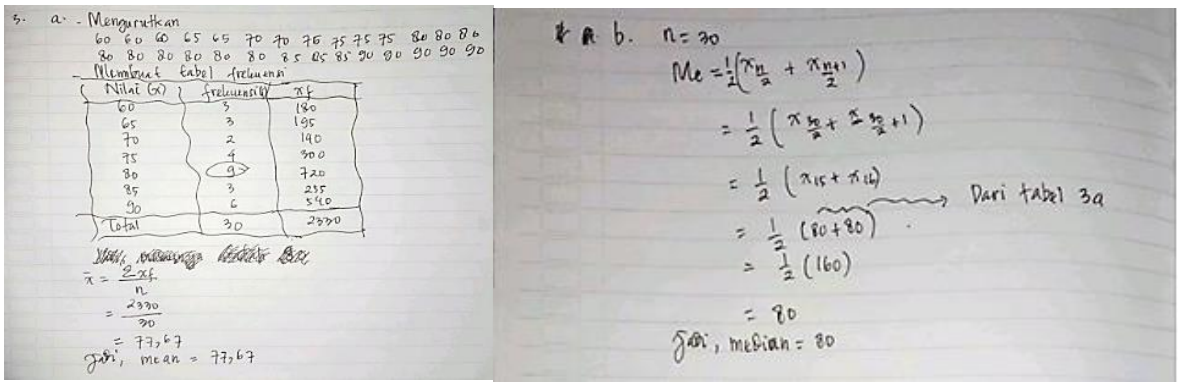

Figure 3. Answer to question number 3

From Figure 3, it can be seen that the subject has sorted the data, meaning that the subject has read the questions so that he can identify the known elements, thus the subject seems to know what to do to continue working on the given representation questions. For question A, after sorting the data, the subject makes a frequency table, after making the frequency table, then writes the formula for the average (mean). Now for part B, because sorting the data has been done in part A, S-1 writes the median formula. However, in part C, it was missed because it was not careful in refilling the questions that were previously skipped.

In the answer above, S-1 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage of the question starts from sorting data to create a frequency table and writing the mean and median formulas, the coding stage is the stage where S-1 can work on the question properly and correctly until drawing conclusions.

P: Have you ever seen a question like no. 4?
S-1: yes, I have
P: was there any difficulty in filling in question no. 4?
S-1: none.
P: are you sure the answer is correct?
S-1: I'm sure

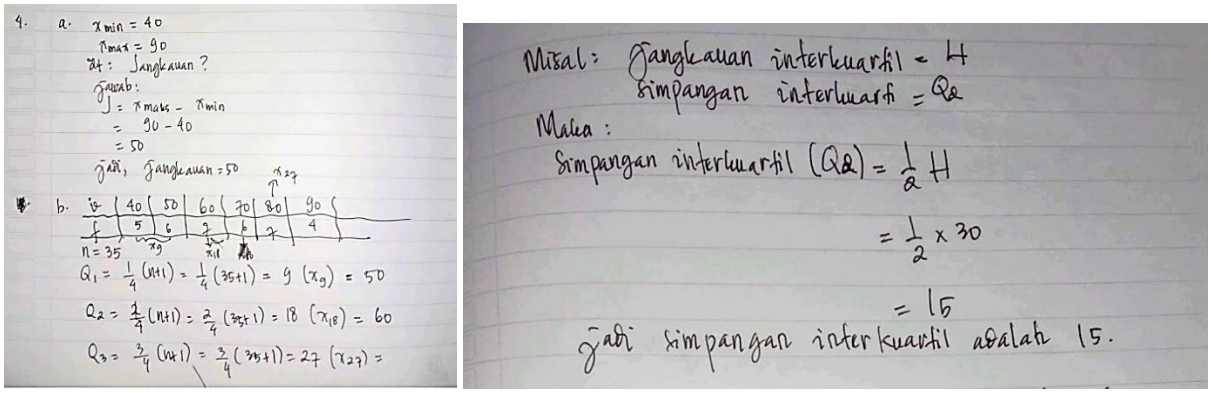

Figure 4. Answer number 4

From Figure 4, it can be seen that the subject has written known, asked and answered, which means that the subject has read the question so that he can identify the

known elements, thus the subject seems to know what to do to continue working on the given representation question. The first step to fill in part A is to find Xmin and Xmaks then enter the range formula. For part B, create a frequency table, enter the quatile formula (Q1, Q2, and Q3) after Q1, Q2, and Q3 are known, enter the interquartile range formula (H). After H is known, go directly to the interquartile deviation formula.

In the answer above, S-1 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage of the question starts by finding Xmin and Xmax then entering the range formula. For part B, making a frequency table enters the quatile formula (Q1, Q2, and Q3) after Q1, Q2, and Q3 are known, enter the interquartile range formula (H). After H is known, go directly to the interquartile deviation formula. The coding stage is the stage where S-1 can work on the question properly and correctly until drawing conclusions.

P: Have you ever seen a question like no. 5?
S-1: Never, but I don't think the question is too difficult
P: Are you sure the answer is correct?
S-1: I'm sure
P: Why are you sure?
S-1: Because the largest value of Y is very far from the value of X while the other values are on average the same so, the mean of Y will be greater than the mean of X.

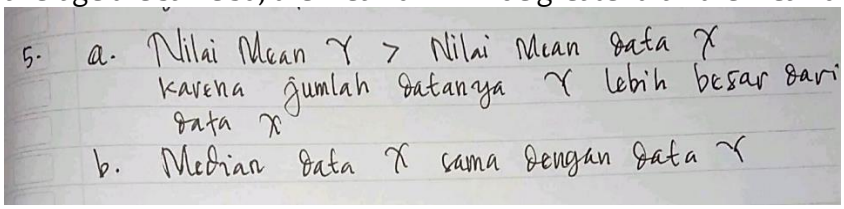

Figure 5. Answer number 5

From Figure 5, S-1 immediately fills in the main question. In the answer above, S-1 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage writes the mean value between X and Y, the coding stage is the stage where S-1 can work on the question well and correctly until drawing conclusions.

2. Subject 2

P: Have you ever known questions 1-5?
S-2: Yes, except for questions 1 and 5, I just saw questions like that
P: So, out of the five questions, only 2 are unfamiliar to you? Did you read questions 1-5 before you filled in the questions?
S-2: Yes, I read the questions first before filling in the questions
P: For questions 1 and 5, you have never seen those questions, can you do them?
S-2: Yes, I tried to fill them in and could
P: Okay, after seeing and reading what do you think?
S-2: I thought about how to solve the question and designed how to solve it in my mind before I filled it in on the answer sheet

Based on the results of this interview, S-2 had known 3 of the 5 questions that the author gave the sentence. Before working on the questions, S-2 also read the 5 questions first and then thought about how to solve the questions.

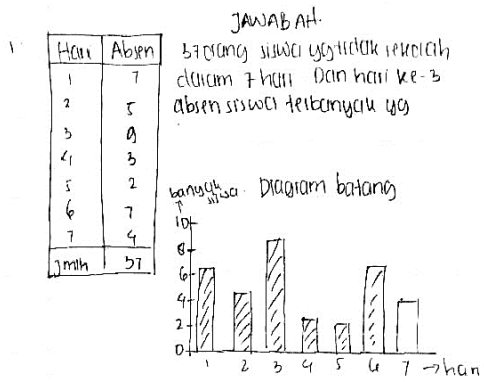

Figure 6. Question no. 1 student 2

From Figure 6, it can be seen that S-2 can answer correctly and precisely and is able to represent the table into words and is able to represent the table into a bar chart. This means that S-2 reads the questions, understands the questions, and identifies the elements that are known and asked, thus students are able to answer the questions and are able to present data from a story problem back into a diagram representation.

In the answer above, S-2 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage from the question to the diagram representation, the coding stage is the stage where S-2 can work on the question well and correctly until drawing conclusions.

After redrawing the table, the subject added up the number of students who were absent from school and answered the absence of the most students who were absent from school, then the students represented the table into a bar chart. The analysis of the results of the mathematical representation was carried out by the author when S-2 worked on question number 1, S-2 did not have difficulty in solving question number 1 even though the student had just seen a question like that.

P: Do you understand the question?
S-2: Understand,
P: Is there any difficulty in filling in question number 2
S-2: The difficulty is probably when filling it in the first one we have to find the degree and then the percentage and that is quite difficult in my opinion because there are fractions too
P: So in your opinion the question is easy but time consuming because in the calculation there are fractions
S-2: Yes
P: But can you fill in the question?
S-2: Yes, I can

Based on the results of the interview with S-2, it was concluded that S-2 understood the questions given and took the correct steps, but S-2 had difficulty in finding the degree and percentage. S-1 was able to complete it correctly but there was one drawback, namely not using the percentage.

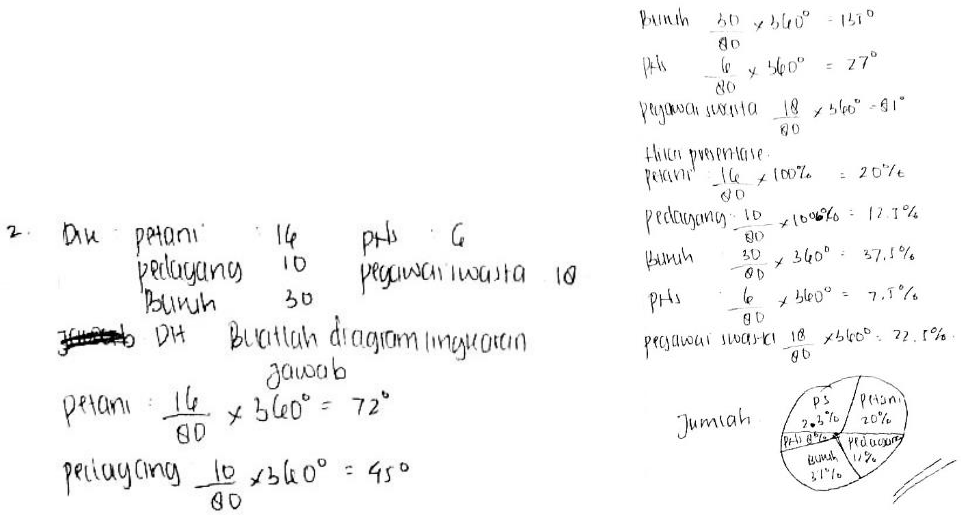

Figure 7. Answer no. 2 s-2

From Figure 7, it can be seen that the subject wrote down what was known in the question, which means that the subject has read the question so that he can identify the known elements, thus the subject seems to know what to do to continue working on the given representation question. After writing down what was known, the subject calculated the degree of each type of work and then the subject represented it in the form of a pie chart.

In the answer above, S-2 has carried out the stage of reading the questions first, the stage of understanding the questions, the stage of good transformation.

P: Have you ever seen a question like no. 3?
S-2: yes I have
P: but why is part B, namely the median, not filled in?
S-2: I didn't fill in part B because I forgot the formula for finding the median
P: so when you don't know the formula you immediately don't fill in the question
S-2: Yes, the problem is confusing but I wanted to fill it in but I remembered it but forgot
P: okay

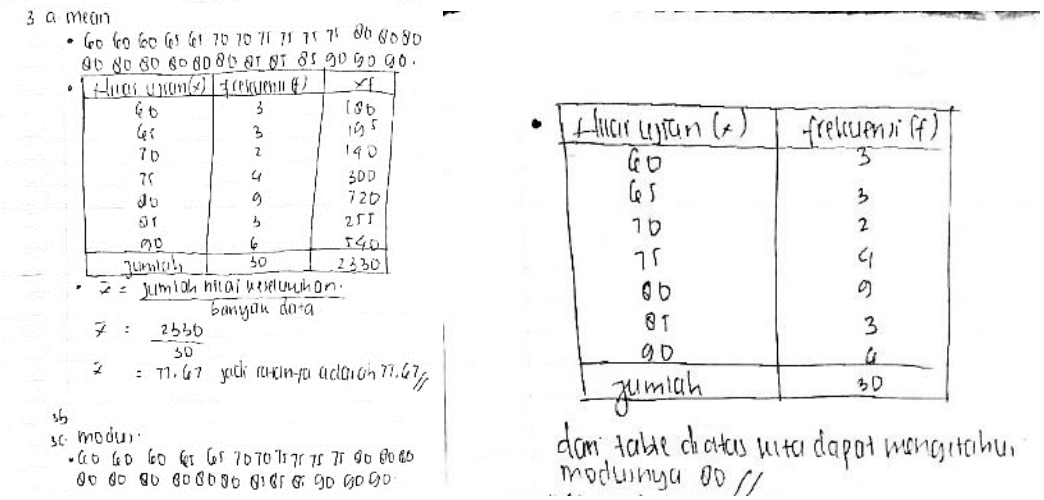

Figure 8. Answer no 3 s2

From Figure 8, it can be seen that the subject has sorted the data, meaning that the subject has read the questions so that he can identify the known elements, thus the subject seems to know what to do to continue working on the given representation questions. For question A, after sorting the data, the subject makes a frequency table, after making the frequency table, then writes the formula for the average (mean). Now for part B, S-2 did not fill in the questions because he forgot the formula so that the question was skipped to be filled in. Now for part C, S-2 sorted the data again, then made a frequency table, then S-2 wrote the mode.

In the answer above, S-2 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage of the question starts from sorting data to making a frequency table and writing the mean and median formulas, the coding stage is the stage where S-2 can work on the question properly and correctly until drawing conclusions.

P: Have you ever seen a question like no. 4?
S-2: yes, I have
P: is there any difficulty in filling in question no. 4?
S-2: yes, I forgot how to find the quartile range and quartile deviation
P: so you forgot the formula, huh?
S-2: yes, so that's why I only sorted the data and the example

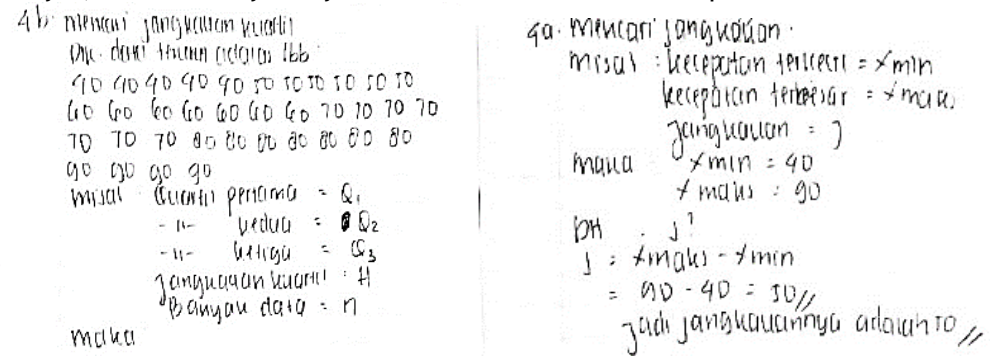

Figure 9. Answer no. 4 S-2

From Figure 9, it can be seen that the subject has written known, asked and answered, which means that the subject has read the question so that he can identify the known elements, thus the subject seems to know what to do to continue working on the given representation question. The first step to fill in part A is to find Xmin and Xmaks then enter the range formula. For part B S-2 only sorts the data by writing the example.

In the answer above, S-2 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage of the question starts by looking for Xmin and Xmaks then entering the range formula. For part B, S-2 only sorts the data by writing the separator which in the following should go directly to the formula. S-2 did not continue answering because he forgot the formula. The coding stage is the stage where S-1 can work on the question properly and correctly until drawing conclusions in part A. S-2 managed to do it until the coding stage but in part B S-2 did not reach the coding stage.

P: Have you ever seen a question like no. 5?
S-2: never, but I can answer the question
P: are you sure the answer is correct?
S-2: I'm sure
P: why are you sure?
S-2: look at the Y value because the largest Y value is very far from the X value while the other values are on average the same so, the mean Y will be greater than the mean X

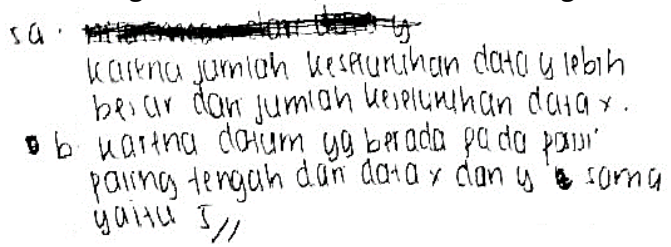

Figure 10. Answer no. 5 S-2

From Figure 10, S-2 immediately fills in the main question. In the answer above, S-2 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage writes the mean value between X and Y, the coding stage is the stage where S-2 can work on the question well and correctly until drawing conclusions.

3. Subject 3

P: Have you ever known about questions 1-5?
S-3: There are some that I have seen and some that I haven't
P: Judging from your answers, there are many questions that have not been completed
S-3: Yes, I only answered most of the questions half-heartedly
P: Why? Are the questions difficult?
S-3: Yes, because in my opinion it is difficult.. especially number 4, I didn't fill in that number

Based on the results of this interview, S-3 only knows a few of the five questions that the author gave. Before working on the questions, S-3 also read the 5 questions first and then thought about how to solve the questions. However, S-3, in filling out the test questions, many of them were only filled in half the answers.

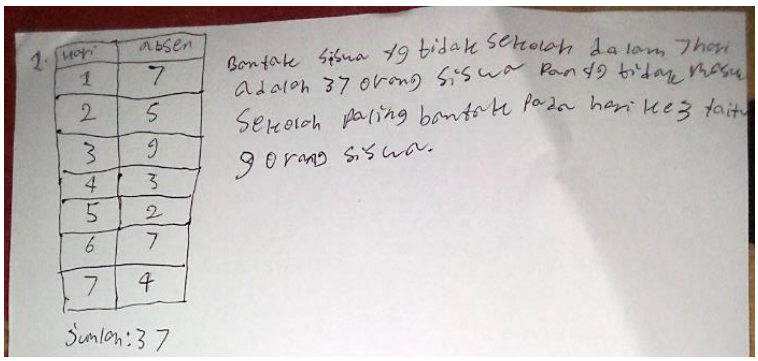

Figure 11. Question number 1

From Figure 11, it can be seen that S-3 can answer correctly and precisely and is able to represent the table into words and is able to represent the table into a bar chart. This means that S-3 reads the questions, understands the questions, and identifies the elements that are known and asked, thus students are able to answer the questions and are able to present data from a story problem back into a diagram representation.

In the answer above, S-3 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage from the question to the diagram representation, the coding stage is the stage where S-3 can work on the question well and correctly until drawing conclusions.

After redrawing the table, the subject added up the number of students who were absent from school and answered the absence of the most students who were absent from school, then the students represented the table into a bar chart. The analysis of the results of the mathematical representation was carried out by the author when S-3 worked on question number 1, S-3 did not have difficulty in solving question number 1.

P: Do you understand question number 2?

S-3: I don't understand how to fill in question number 2

P: Why?

S-3: I don't understand and there's not enough time

Based on the results of the interview with S-3, it was concluded that S-3 did not understand the questions given and took the wrong steps, S-3 was unable to complete them correctly.

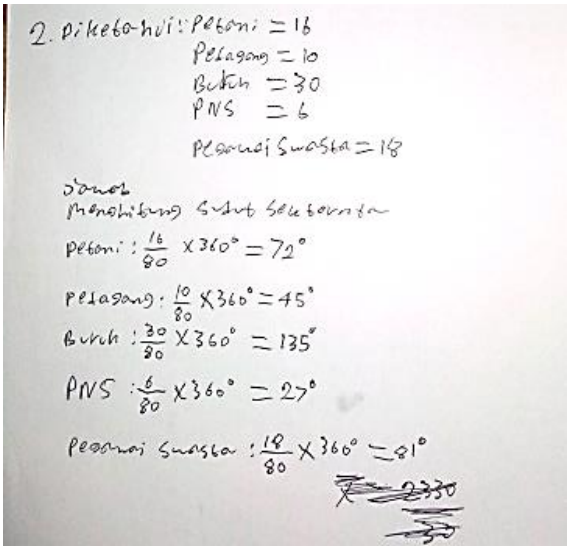

Figure 12. Answer S-1 question number 2

From Figure 12, it can be seen that the subject wrote down what was known in the question, which means that the subject had read the question so that he could identify the known elements, thus the subject seemed to know what to do to continue working on the given representation question. After writing down what was known, the subject calculated the degree of each type of work. After that, the subject did not continue filling in the question because he did not understand and felt that he did not have enough time.

In the answer above, S-1 has carried out the stage of reading the question first, the stage of understanding the question, but the subject did not continue the answer so that the transformation stage was not perfect.

Q: Have you ever seen a question like no. 3?
S-3: yes I have
Q: can you answer that question?
S-3: yes I can.

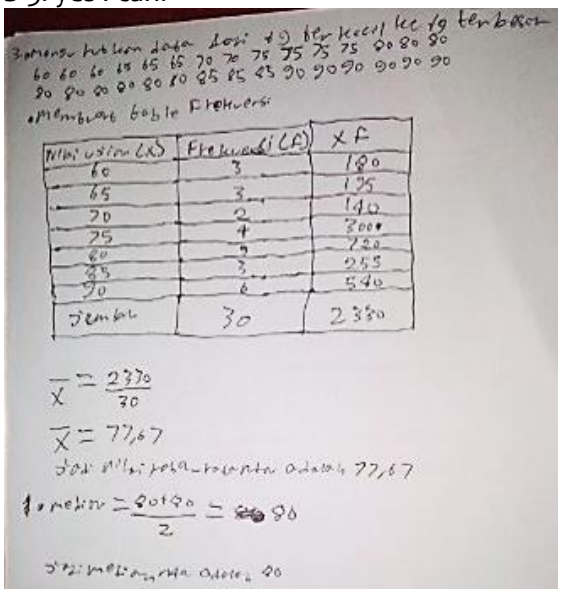

Figure 11. Answer to question number 3

From Figure 11, it can be seen that the subject has sorted the data, meaning that the subject has read the questions so that he can identify the known elements, thus the subject seems to know what to do to continue working on the given representation questions. For question A, after sorting the data, the subject makes a frequency table, after making the frequency table, then writes the formula for the average (mean). Now for part B, because the data has been sorted in part A, S-3 writes the median result. And in part C, it is the same, go directly to the answer.

In the answer above, S-3 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage of the question starts from sorting data to making a frequency table and writing the mean and median formulas, the coding stage is the stage where S-3 can work on the question properly and correctly until drawing conclusions.

P: Have you ever seen a question like no. 4?
S-3: Yes, but I didn't answer it because I didn't understand how to solve it
P: You can't answer that question at all?
S-3: Yes
P: Have you ever seen a question like no. 5?
S-3: Never, but I don't think the question is too difficult
P: Are you sure the answer is correct?
S-3: I'm sure
P: Why are you sure?
S-3: Because it can be seen from the X and Y values

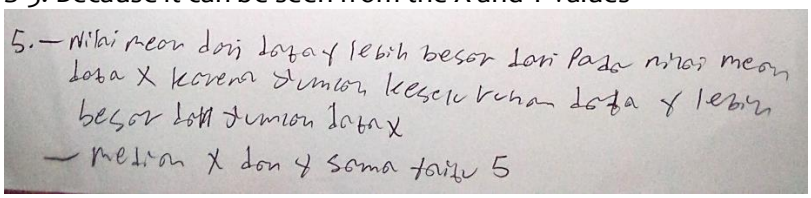

Figure 12. Answer number 5

From Figure 12, S-3 immediately fills in the main question. In the answer above, S-3 has done the stage of reading the question, the stage of understanding what is known, and what is asked in the question. The transformation stage writes the mean value between X and Y, the coding stage is the stage where S-3 can work on the question well and correctly until drawing conclusions.

Discussion

Mathematical representation is a critical skill in the study of statistics, as it allows students to translate abstract concepts into visual, symbolic, or verbal forms that facilitate understanding and problem-solving. The ability to represent statistical data effectively is essential for grasping complex ideas, analyzing data, and communicating results clearly. In this discussion, we will explore the importance of mathematical representation in

statistics, the challenges students face in developing these abilities, and the implications for teaching and learning.

In statistics, mathematical representation takes various forms, including graphs, charts, tables, equations, and verbal descriptions. These representations help students to visualize data, identify patterns, and draw conclusions. For example, a scatter plot can reveal the relationship between two variables, while a histogram can show the distribution of data. The ability to switch between different forms of representation—such as moving from a verbal description to a graphical representation—enhances students' understanding and supports deeper learning.

Mathematical representation also plays a key role in the interpretation of statistical results. Students who can effectively represent data are better equipped to interpret the results of statistical analyses and make informed decisions based on data. This skill is particularly important in real-world applications of statistics, where clear communication of findings is essential.

Despite its importance, many students struggle with mathematical representation in statistics. One common challenge is the difficulty in selecting the appropriate representation for a given problem. Students may not always recognize which type of graph or chart best illustrates the data or how to properly construct these representations.

Another challenge is the interpretation of statistical representations. Students may be able to create a graph or chart but may struggle to interpret what it means or how it relates to the statistical concepts they are studying. This gap between creating and understanding representations can hinder students' ability to apply statistical knowledge effectively.

Moreover, the abstract nature of statistics can make it difficult for students to relate representations to real-world contexts. Without a strong understanding of the underlying concepts, students may rely on rote procedures for creating representations without truly grasping their significance.

To improve students' mathematical representation abilities in statistics, educators must emphasize the importance of these skills in the curriculum. Teaching should focus not only on how to create different types of representations but also on how to interpret them and understand their relevance to statistical concepts.

One effective approach is to provide students with opportunities to practice creating and interpreting representations in a variety of contexts. This can include using real-world data, engaging in hands-on activities, and encouraging students to explain their reasoning behind the representations they choose.

Additionally, integrating technology into the classroom can enhance students' ability to create and manipulate statistical representations. Software tools that allow for dynamic

visualization of data can help students explore different representations and gain a deeper understanding of the relationships between variables.

Finally, fostering a classroom environment that encourages exploration and discussion of representations can help students develop their skills. Collaborative activities where students compare and critique each other's representations can lead to a richer understanding of statistical concepts and improve their ability to communicate mathematical ideas effectively.

The development of strong mathematical representation abilities is crucial for students' success in statistics. These skills enable students to visualize data, interpret statistical results, and communicate their findings effectively. However, challenges in selecting, creating, and interpreting representations highlight the need for targeted instructional strategies. By providing diverse learning opportunities and integrating technology, educators can support students in mastering the critical skill of mathematical representation in statistics.

Conclusion

Based on the results of research and discussion that have been carried out by researchers regarding mathematical representation skills, it can be concluded that representation skills are in the moderate category. Representation skills are important skills for students and are goals to be achieved in mathematics learning in schools. This representation can greatly assist students in solving a problem to make it easier and representation can also be used as a tool to communicate students' mathematical ideas or ideas to other students. Teaching and learning activities in the classroom are good for providing opportunities for students to develop mathematical representation skills.

Conflict of Interest

The authors declare that no conflict of interest regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely by the authors.

Reference

Atjiang, N. N. (n.d.). Analisis Kemampuan Siswa Mengubah Representasi dalam Physics Problem Solving Pada Siswa SMA Kelas X. *Jurnal Pendidikan Fisika Tadulako (JPFT)*, 2(3), 1–7.

Feriyanto, F. (2019). Analisis Kemampuan Representasi Matematis Mahasiswa Dalam Menyelesaikan Soal Program Linear Ditinjau Dari Perbedaan Gender. *Seminar Nasional Penelitian Dan Pengabdian Masyarakat LP4MP Universitas Islam Majapahit*, 90–97.

Handayanir, H. (2015). Pengaruh Pembelajaran Kontekstual Terhadap Kemampuan Pemahaman Dan Representasi Matematis Siswa Sekolah Dasar. *Didaktik: Jurnal Pendidikan Guru Sekolah Dasar*, *I*(1), 142–149.

Khadijah, I. nur afifah, Maya, R., & Setiawan, W. (2018). Analisis kemampuan komunikasi matematis siswa smp pada materi statistika. *JPMI(Jurnal Pembelajaran Matematika Inovatif)*, *1*(6), 1095–1104.

Mahmud, N., & AR, R. A. (2018). Analisis Kemampuan Representasi Matematis Dalam Pemecahan Masalah Geometri Serta Faktor- Faktor Yang Mempengaruhinya. *Jurnal Review Pembelajaran Matematika (JRPM)*, *3*(2), 146–160.

Permana, Y., & Sumarmo, U. (2007). Mengembangkan Kemampuan Penalaran dan Koneksi Matematik Siswa SMA Melalui Pembelajaran Berbasis Masalah. *Educationist*, *I*(2), 116– 123.

Ribkyansyah, F. T., Yenni, & Nopitasari, D. (2018). Dilihat dari hasil penelitian Trends in International Mathematics and Science Study (TIMSS) pada tahun 2007 kemampuan representasi matematis siswa masih jauh dari kata representasi matematis siswa SMP pada pokok bahasan statistika. Prosedur penelitian. *Prima: Jurnal Pendidikan Matematika*, *2*(2), 149–155.

Sulastri, S., Marwan, M., & Duskri, M. (2017). Kemampuan Representasi Matematis Siswa SMP Melalui Pendekatan Pendidikan Matematika Realistik. *Beta Jurnal Tadris Matematika*, *10*(1), 51. https://doi.org/10.20414/betajtm.v10i1.101

Sundayana, R. (2016). Kaitan antara Gaya Belajar, Kemandirian Belajar, dan Kemampuan Pemecahan Masalah Siswa SMP dalam Pelajaran Matematika. *Mosharafa: Jurnal Pendidikan Matematika*, *5*(2), 75–84.

Umaroh, U., & Pujiastuti, H. (2020). Analisis Kemampuan Representasi Matematis Siswa dalam Mengerjakan Soal PISA Ditinjau dari Perbedaan Gender. *Jurnal Pendidikan Matematika Raflesia*, *5*(2), 40–53.