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DIFFICULTIES AND CONTRIBUTING FACTORS FACED BY JUNIOR HIGH SCHOOL STUDENTS IN SOLVING DATA REPRESENTATION PROBLEMS

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ABSTRACT

This study aims to analyze the difficulties experienced by students in solving problems related to data presentation. The research employed a descriptive qualitative method with seventh-grade students at a junior high school in Tasikmalaya City as the subjects. Data were collected through written tests and interviews to explore students' understanding and identify the causes of their difficulties. The results revealed three main types of difficulties: (1) difficulties in presenting data in the form of diagrams such as bar, line, and pie charts, (2) difficulties in converting data into percentages and degrees, and (3) difficulties in reading and interpreting information from diagrams. These difficulties are caused by a lack of understanding of basic concepts, limited technical skills, and the absence of critical thinking habits in interpreting visual data representations.

Penelitian ini bertujuan untuk menganalisis kesulitan yang dialami siswa dalam menyelesaikan soal pada materi penyajian data. Metode yang digunakan adalah deskriptif kualitatif dengan subjek penelitian siswa kelas VII di salah satu SMP di Kota Tasikmalaya. Pengumpulan data dilakukan melalui tes tertulis dan wawancara untuk menggali lebih dalam pemahaman serta penyebab kesulitan yang dialami siswa. Hasil penelitian menunjukkan bahwa terdapat tiga jenis kesulitan utama, yaitu: (1) kesulitan dalam menyajikan data ke dalam bentuk diagram seperti batang, garis, dan lingkaran, (2) kesulitan dalam mengonversi data ke dalam bentuk persen dan derajat, serta (3) kesulitan dalam membaca dan menafsirkan informasi dari diagram. Ketiga jenis kesulitan tersebut disebabkan oleh rendahnya pemahaman konsep dasar, keterbatasan keterampilan teknis, serta kurangnya kebiasaan berpikir kritis terhadap representasi data visual.

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1. INTRODUCTION

Mathematics plays a crucial role in everyday life not only in academic settings but also in various practical situations. According to Tampubolon et al. (2019) mathematical

skills and their application are essential requirements, as the absence of basic mathematical concepts and processes would create numerous obstacles in modern human life, particularly in decision-making and technological development. Mathematics provides the foundation for many aspects of life, from technology to economics. Without a sound understanding and application of basic mathematics, individuals may encounter significant difficulties in planning, decision-making, and innovation. Therefore, a deep comprehension of mathematical concepts is necessary to enable students to apply them effectively in relevant real-world contexts.

One mathematical topic that is highly relevant to daily life is data representation. This topic is part of the statistics curriculum for seventh-grade students in Indonesian junior high schools, as outlined in Regulation of the Minister of Education and Culture No. 24 of 2016. The core competency to be achieved is the ability to analyze the relationship between data and its representation using line graphs, bar charts, and pie charts (Kenedi et al., 2018). This material not only teaches students how to organize and present data, but also trains them to analyze and interpret information accurately through visual forms such as diagrams. As stated by Govind Shinde and Shivthare (2024), visualizing data using diagrams helps students comprehend complex information more efficiently and with greater clarity. Furthermore, Jia et al. (2024) argue that data representation contributes to the development of students' data literacy skills, which are essential for preparing them to thrive in an increasingly data-driven world. Consequently, a solid mathematical foundation is crucial for mastering this material and achieving conceptual understanding.

Despite its importance, many students continue to face significant challenges in understanding data representation. Puspitasari et al. (2024) highlight that students often struggle to connect information and accurately interpret graphs. Similarly, Chang et al. (2024) identify difficulties such as recognizing types of data, representing them graphically, and drawing valid conclusions. Nggadas et al. (2024) further emphasize issues including identifying the intersection between horizontal and vertical axes, inaccurate grouping of data by category or interval, and difficulties in reading diagrammatic information. A study conducted in Yogyakarta revealed that 95% of junior high school students had low levels of data literacy, particularly in drawing conclusions and constructing arguments based on data (Trisnawati & Mahmudi, 2024).

These difficulties do not arise in isolation but are influenced by a combination of internal and external factors. Internal factors include low learning motivation, limited computational skills, and a lack of experience with context-based problems that involve real-world data representation (Manik et al., 2024; Puspitasari et al., 2024). On the other hand, external factors such as monotonous teaching methods, limited learning resources, and distractions from technology also contribute to students' limited understanding of the topic (Saleha et al., 2024; Fauziah et al., 2024). Additionally, characteristics of the problems themselves play a significant role, where the level of complexity and contextual relevance to students' daily experiences can either support or hinder their thinking processes (MacGillivray, 2023).

For this reason, it is crucial for educators to identify the challenges students face in learning data representation, so that more effective and responsive instructional strategies can be designed. As noted by Gais and Afriansyah (2018) understanding learning barriers allows teachers to develop more adaptive and contextualized approaches. By identifying the sources and types of students' difficulties, educators can implement more suitable methods such as incorporating real-world contexts, using visual tools for data representation, or utilizing software like GeoGebra. This step is also essential in evaluating whether students have acquired the prerequisite knowledge and in assessing their initial understanding of the topici (Suryani et al., 2020).

Although previous studies have examined students' difficulties in understanding data representation, most have focused on general conceptual issues or the effectiveness of specific instructional models. Few have explored the specific types of errors that occur during problem-solving in data representation and directly linked these errors to their underlying causes. Therefore, this study seeks to fill that gap by analyzing the forms of student errors and identifying the contributing factors that lead to these difficulties. By gaining a deeper understanding of both the nature and causes of these challenges, this research aims to inform the development of more effective and adaptive teaching strategies. The findings are expected to serve as a reflection tool for educators in designing instructional approaches that not only focus on learning outcomes but also pay close attention to students' thinking processes, including the misconceptions and errors they experience throughout the learning process. Ultimately, the results of this study are anticipated to support the creation of more meaningful learning experiences, foster active student engagement, and enhance their conceptual understanding of data representation.

2. METHOD

This study employed a descriptive qualitative approach aimed at exploring the difficulties encountered by junior high school students in understanding data representation, particularly in reading graphs and other forms of data visualization. According to Li (2024), qualitative research seeks to understand complex phenomena by deeply examining participants' experiences, perspectives, and social contexts, rather than relying solely on statistical data, as demonstrated in his research on access challenges faced by rural-to-urban migrants. This study is also descriptive in nature, as it emphasizes the participants' viewpoints, learning processes, and the conceptual details that emerge throughout the investigation (Sa'adah et al., 2023). The approach prioritizes the depth of meaning over quantification, relying on qualitative data such as narratives, interview results, and observations. Through this strategy, the study aims not only to map the types of errors students make but also to identify their root causes in a comprehensive manner. The insights gained are expected to serve as a foundation for designing more effective and contextually relevant instructional strategies.

2.1. Research Subjects

This study involved 16 seventh-grade students from a junior high school in the city of Tasikmalaya as research participants. The selection of seventh-grade students was based on the consideration that data representation is one of the learning objectives at this educational level, as outlined in the Kurikulum Merdeka. This curriculum emphasizes introducing students to various forms of data presentation, such as tables, bar charts, line graphs, and pie charts, while training them to interpret the information contained within these representations. Therefore, seventh-grade students are at a critical early stage in understanding the fundamental concepts of data representation, making them highly relevant for analyzing the types of errors they make and the factors contributing to those errors. Furthermore, the number of participants was deemed sufficient to provide an initial overview of common error patterns while allowing for an in-depth exploration of students' thought processes in solving problems related to the topic.

2.2. Data Collection

Pengumpulan data dalam penelitian ini dilakukan melalui dua tahapan utama. Tahap Data collection in this study was carried out in two main stages. The first stage involved the administration of a written test designed to assess students' ability to understand and solve problems related to data representation, such as reading and constructing bar charts, line graphs, and pie charts. The purpose of this test was to identify various types of errors

found in the students' written responses. According to Sunuvala and Fatima (2021), written tests serve as valuable tools for evaluating students' mathematical understanding and reasoning, as they integrate diverse assessment approaches, allow for response variation, and provide meaningful feedback for both students and teachers. The second stage involved conducting semi-structured interviews with a selection of students based on their performance on the written test. The aim of these interviews was to further investigate students' thought processes while solving problems and to uncover the reasons behind their mistakes. As Celeri (2024), explains, interviews in research are intended to explore participants' experiences in depth, reveal how they construct understanding and identity during the learning process, and create a reflective dialogue that supports their development. Through these two stages, the researcher aimed to obtain a more comprehensive picture of students' errors both in terms of their written work and the underlying cognitive processes that led to those errors.

2.3. Data Analysis

In this study, data analysis was conducted using the interactive model proposed by Miles and Huberman, which consists of three main stages: data reduction, data display, and conclusion drawing and verification. Data reduction is the initial process aimed at simplifying and filtering raw data into more meaningful and relevant information for analysis (Zhai & Song, 2022). At this stage, the researcher summarized the results of written tests and interviews by highlighting the types of errors made by students and the underlying reasons behind them. The next stage is data display, in which the condensed information was organized systematically in the form of descriptive narratives and categorized tables (Sabharwal, 2023). This presentation was intended to facilitate the identification of error patterns and contributing factors. The final stage is conclusion drawing and verification, which involves interpreting the displayed data and validating the findings through triangulation of the test and interview data, in order to obtain a comprehensive understanding of the forms and causes of students' errors in data representation (Marhasova et al., 2022). This approach provides a robust foundation for building a deep and trustworthy understanding of the issues under investigation.

3. RESULT AND DISCUSSION

3.1. Result

The findings of this study reveal that students encountered a variety of challenges in solving problems related to data representation. These difficulties were identified through the written test administered to the students and were further corroborated by in-depth interviews with selected participants. The purpose of these interviews was to explore the students' thought processes while solving the problems, thereby offering a more comprehensive picture of the sources and forms of the errors made. Based on the analysis, the researcher categorized the students' difficulties into three main types, as presented in Table 1 below.

Table 1. Types of Student Difficulties in Solving Data Representation Problems

No.	Type of Difficulty	Subjects
1.	Difficulty in presenting data in the form of bar charts, line graphs, and pie charts.	S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13
2.	Difficulty in numerical conversion (percentages and degrees).	S1, S3, S4, S5, S6,S7, S8,S9
3.	Difficulty in reading information from diagrams.	S1,S4, S6, S9, S10

The following is an explanation of the types of difficulties students faced in solving problems related to data representation, accompanied by an analysis based on the results of written tests and interviews:

Difficulties in Presenting Data

Based on the analysis of the written test results, it was found that several students still made errors in presenting data in the form of charts, including bar charts, line graphs, and pie charts. In presenting data using bar charts, it was observed that students were not accurate in drawing the chart, particularly in determining the appropriate scale and inputting the data according to the problem requirements. This error was evident in one item that asked students to present data in the form of a bar chart, where approximately 25% of them showed inaccuracies in their presentation. This indicates that a portion of the students had not yet fully grasped the fundamental concept of scale in bar charts. The following is an example of student work on that problem, as shown in Figure 1:

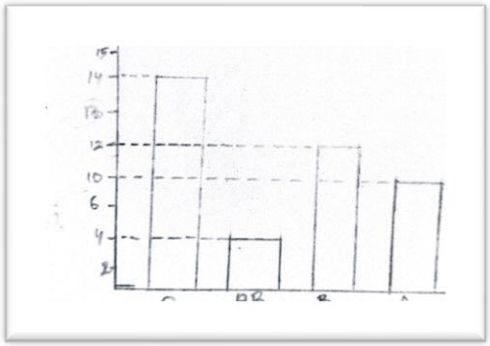

Figure 1. Student Work Demonstrating Difficulties in Presenting Data in Bar Charts

Based on these results, the researcher conducted interviews with the students regarding their work to explore their difficulties in depth and to identify the factors causing these challenges.

Dialog 1

R : Could you explain how you determined the numbers on the vertical axis of this bar chart?
S1 : I started from the number 2, then I continued increasing by twos, ma'am.
R : Okay. But after number 12, here you wrote 13, 15, and 17. Those numbers are not multiples of 2 and are not in the data. What was your reason for writing those numbers?
S1 : Hmm... I didn't have a specific reason, ma'am. I just added those numbers to fill the scale up to the top.
R : Did you prepare the scale numbers up to the upper limit before drawing the bar chart?
S1 : No, ma'am. I added the numbers while drawing the bars.
R : Are you aware that the number 8 is missing from the scale you made?
S1 : Yes, ma'am. I guess I missed that.
R : In your opinion, how should the numbers on the vertical axis be arranged?
S1 : They should be evenly spaced, ma'am... like increasing by twos consistently.
R : Alright. So, what do you think caused you to be less careful in arranging the scale?
S1 : I didn't pay attention to the pattern, ma'am. I was focusing on drawing the bars first, not the numbers.

Based on the interview results with one of the students (S1), difficulties were found in determining a consistent scale on the vertical axis of the bar chart. The student initially used a scale with intervals of 2, but then added numbers inconsistently that did not follow the multiple-of-2 pattern, such as 13, 15, and 17, while also missing important numbers like 8. During the dialogue, the student stated that the addition of these numbers was not based on mathematical reasoning but merely to make the scale appear "full up to the top." This indicates that the student has not yet understood that the scale on the vertical axis must have fixed intervals and be arranged in a consistent numerical order. The student also admitted that they did not plan the scale comprehensively before drawing, but instead adjusted the numbers on the go, focusing more on the bars rather than the accuracy of the scale.

In presenting data using line graphs, students still struggled to display data correctly, especially when questions required two types of data to be presented simultaneously. This is evident in one question where students were asked to present two sets of data in a single line graph; however, some students presented them as two separate graphs instead. This mistake indicates a misconception in understanding how to present two datasets in one line graph. Based on the analysis, approximately 25% of the students made this error. Below is an example of one student's answer:

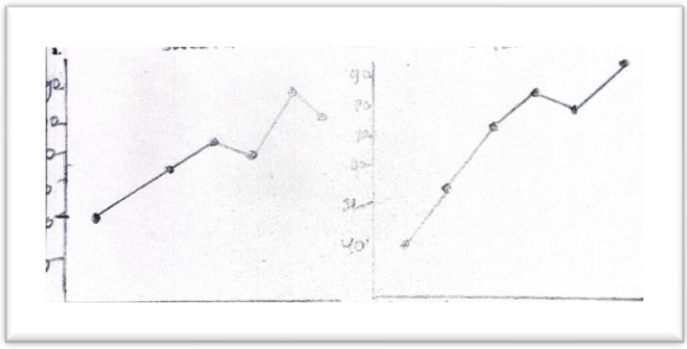

Figure 2. Student Work Results Showing Difficulties in Presenting Data Using Line Graphs

The following is an interview transcript between the researcher and student (S2) to explore the student's difficulties in depth as well as the underlying factors:

Dialog 2

R : *Could you explain how you made this line graph?*
S2 : *I drew two graphs, ma'am. The one on the left is for sweater products, and the one on the right is for pants products.*
R : *Why did you choose to separate the two data sets into two different graphs?*
S2 : *Because I thought if the data are different, they have to be shown in different graphs, ma'am.*
R : *Do you know that two data sets can be presented in the same line graph?*
S2 : *Yes, ma'am, I have seen examples before. But I was afraid the lines would get mixed up, so I separated them to make it clearer.*
R : *In your opinion, what are the advantages if both data sets are presented in one line graph?*
S2 : *They can be directly compared, ma'am. But I'm not sure how to differentiate the lines.*

R : *So you separated them because you were worried about getting confused when distinguishing two lines in one graph?*
S2 : *Yes, ma'am. I was afraid the lines would overlap and it would be hard to see the differences.*

Based on the interview results, it shows that S2 has a misconception regarding the presentation of two data sets in one line graph. The student believes that two data sets must be presented in separate graphs due to category differences (sweaters and pants). Although S2 has seen examples of two lines in one graph, they chose to separate them out of concern for being unable to clearly distinguish the lines. This indicates a lack of understanding of visual functions (such as the use of colors, symbols, or line styles) to differentiate two data sets within a single graph, as well as a lack of confidence in presenting complex data. Furthermore, this finding also shows that students are not yet accustomed to multiple data representations in a single graph, which causes them to take the safer route by separating the graphs.

Meanwhile, many students also showed errors in presenting data in pie charts. Based on the analysis of questions that require data presentation in the form of pie charts, it was found that 62.5% of students were unable to present the data correctly. The difficulties experienced were evident in the incorrect construction of sectors for each category in accordance with the correct angle sizes, even though some students had calculated the angles correctly. Below is an example of a student's (S3) answer on this question:

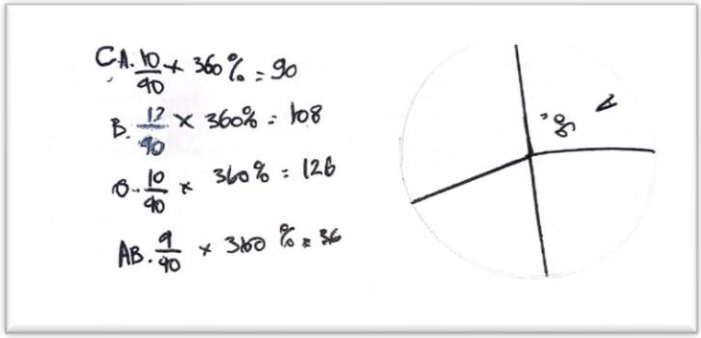

Figure 3. Student Work Results Showing Difficulties in Presenting Data Using Pie Charts

The following is an interview transcript with student (S3) to explore the student's difficulties in depth as well as the underlying factors:

Dialog 3

R : *Could you explain how you drew this pie chart?*
S3 : *I first calculated the angles, then divided the circle into several parts, ma'am.*
R : *After calculating the angles, what did you use to divide the circle?*
S3 : *I just used a ruler, ma'am, drawing lines from the center to the edge, then estimated the angles.*
R : *Did you use a protractor to measure the angles?*
S3 : *No, ma'am. I didn't bring it and I'm not really sure how to use it yet.*
R : *In your opinion, are the sectors you drew consistent with the angle measurements you calculated earlier?*

S3 : I don't think they are quite accurate, ma'am... I just drew them roughly.
R : What made you unable to draw the sectors according to your calculations?
S3 : Because I'm not sure how to do it. I'm also confused how to divide the angles from 90° to 108°, 126°, and so on.

Based on the responses obtained from S3 and the subsequent interview, it is evident that S3 experienced difficulty in transforming the calculated angles into accurate visual representations on the pie chart. Although the angle calculations were done correctly, S3 has not yet mastered the skills or the use of tools such as a protractor to draw precise angles. Moreover, a limited understanding of the basic procedures for measuring angles and sequentially arranging the sectors caused the student to draw the chart intuitively or by estimation. This error falls under the category of difficulty in converting numerical representation to visual-spatial representation. This difficulty is suspected to stem from a lack of practical training and limited proficiency in technical skills necessary for systematically drawing pie charts.

The types of difficulties in presenting data using bar charts, line graphs, and pie charts are suspected to arise from insufficient understanding of visual representation concepts, as evidenced from the test results and student interviews. According to Purnama et al. (Purnama et al., 2019) visual representation can be defined as the re-presentation of data or information from a problem into visual forms such as tables, diagrams, or graphs. This representation serves as an aid in problem-solving processes because it facilitates understanding of the presented information. Additionally, the emergence of these difficulties can be traced to students' lack of habitual practice in systematically and structurally drawing diagrams. This condition aligns with the view of Kottmeyer et al. (2020) who stated that students may face obstacles in technical drawing practice due to the challenges posed by the complexity of graphical representations, which must be carefully understood and applied.

Difficulties in Numerical Conversion (Percentages and Angles)

Difficulties in converting data into percentages and angles were experienced by a significant number of students when working on test items related to data presentation. Approximately 50% of students demonstrated inaccuracies in solving problems that required data conversion, as shown in their work. Most of the errors stemmed from miscalculations, which led to incorrect final results, even though the formulas used were actually correct. One example of a student's work on this type of problem is presented below:

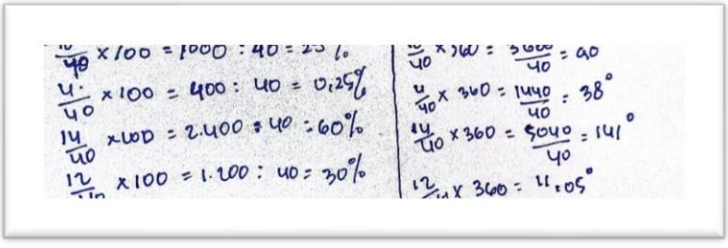

Figure 4.
Student Work Showing Difficulties in Numerical Conversion (Percentages and Angles)

Following this work, an interview was conducted with student (S4) to explore the student's difficulties and the contributing factors. The transcript is as follows:

Dialog 4

R : *You used the formulas* $\frac{data\ amount}{40} \times 100\%$ *for percentages and* $\frac{data\ amount}{40} \times 360°$ *for angles, right?*

S4 : *Yes, ma'am. I saw those formulas in my class notes.*

R : *But here, you wrote the result of* $\frac{4}{40} \times 100\%$ *as 0,25%. Are you sure that's correct?*

S4 : *I thought it was, ma'am… I just multiplied 4 by 100 and divided by 40.*

R : *Okay, do you know what the actual result of* $\frac{4}{40} \times 100\%$ *should be?*

S4 : *It should be 10%, right, ma'am?*

R : *Correct. So, where do you think the mistake was?*

S4 : *I wasn't careful enough in my calculation, ma'am. Sometimes I'm in a rush*

R : *And for the angle conversion, you wrote* $\frac{12}{40} \times 360° = 11{,}05°$. *Are you sure that aligns with your calculation steps?*

S4 : *Yes, I calculated it using my phone calculator, ma'am… but I might've typed something wrong. I just wrote down the result directly.*

Based on the interview with S4, it was found that although the student correctly applied the formulas for converting data to percentages and degrees, they still made errors in the final computation. These errors were due to a lack of carefulness during the arithmetic process, such as writing $\frac{4}{40} \times 100\%$ as 0,25% and $\frac{4}{40} \times 360°$ as 11,05°. During the interview, S4 admitted to copying the calculator's result directly without checking whether it was reasonable or contextually appropriate. This indicates that the student's difficulty lies not in understanding the formulas or concepts but in the execution of numerical calculations.

The suspected causes of this difficulty include low attention to detail, limited mathematical estimation skills, and a tendency to rely on calculator outputs without critical evaluation. These findings are consistent with research by Subekti and Zuhrotunnisa (2021), which found that many students make errors in the calculation process, typically due to a lack of precision in attending to details. This leads to procedural mistakes in problem-solving. Moreover, heavy reliance on calculators to obtain correct answers also hinders the development of estimation skills and reduces flexibility in problem-solving strategies (Andrews et al., 2021). Therefore, this difficulty falls under the category of numerical conversion difficulties, referring to failures in transforming data into other forms of representation due to weaknesses in arithmetic calculation, even when the formulas are well understood.

Difficulties in Interpreting Information from Diagrams

Based on the results of the test on data presentation, it was found that several students still experienced difficulties in understanding information presented in the form of diagrams whether bar charts, line graphs, or pie charts. In items that required students to read and interpret information from bar and pie charts, many students gave answers that reflected a misunderstanding of the data. Instead of interpreting or comparing the data displayed, they tended to respond based on the general purpose or shape of the diagram. Approximately 30% of students made this type of error. The following is an example of a student's work on this question:

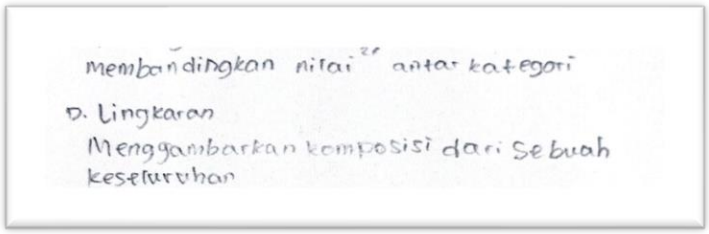

Figure 5. Student Work Demonstrating Difficulty Interpreting Information from Bar and Pie Charts

The following is an excerpt from an interview conducted with student S5 to investigate the difficulty and its underlying causes:

Dialog 5

R : In this question, you were asked to draw a conclusion from a bar chart and a pie chart. Can you explain why you wrote this answer?
S5 : I thought the question was asking for the function of the diagram, ma'am…
R : So, you didn't look at or read the data from the diagram first?
S5 : No, ma'am. I just answered based on what I know about bar charts and pie charts
R : In your opinion, how should you draw a conclusion from a diagram?
S5 : I guess I should've read the data first, ma'am… but I wasn't sure what to write, so I just wrote down the function.
R : For example, if you look at the data in a bar chart, what could you conclude from the height of the bars?
S5 : You could tell which category is the most or least, ma'am. But I didn't think about that at the time.

Based on the interview with S5, it was found that the student had difficulty reading and interpreting information from diagrams, especially bar and pie charts. S5 did not base their answer on the data presented but rather on the general function of the diagram. In the interview, S5 explained that they misunderstood the question, thinking it only asked for the function of the diagram, not for a conclusion drawn from the data. The student also admitted to not reading the diagram beforehand and simply recalling general information from prior lessons. This error suggests that the student had not developed reflective and analytical data reading habits and was unfamiliar with questions that require data interpretation rather than simple reproduction of factual knowledge. The possible causes of this difficulty include a lack of practice in extracting information from visual representations and instruction that focuses too much on the form and definition of diagrams rather than their role as tools for communicating data. This highlights the need for instructional practices in data presentation to emphasize the interpretation and meaning of data, not just the construction of its visual form.

In the context of interpreting information from line graphs, 25% of students were found to have difficulties in answering questions related to this aspect. Based on their written responses, the errors stemmed from a misunderstanding in which the numerical values in the problem were interpreted as percentages. As a result, students responded using percentage terms, even though the question merely asked for identification of the highest data value. This indicates a misconception regarding the context of data usage in line graphs. Below is an example of a student's response to a related question:

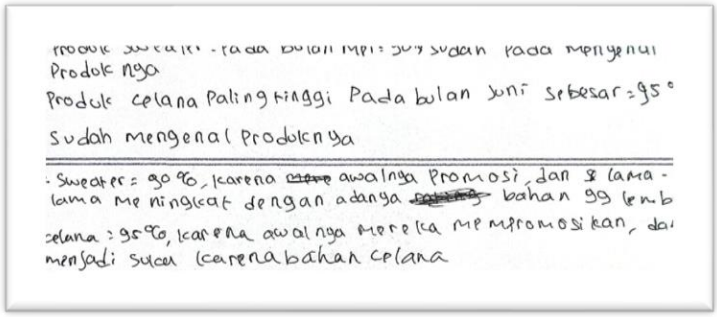

Figure 6. Student Work Demonstrating Difficulty in Interpreting Line Graph Data

The following is an excerpt from an interview with student S2 regarding their work:

Dialog 6

R : Can you explain how you arrived at the answers 90% for sweaters and 95% for trousers?
S2 : I saw the highest values, so I wrote 90% and 95%, ma'am.
R : How did you know that those were percentages and not quantities of sales?
S2 : I just assumed they were percentages, ma'am...
R : Did you read the label on the vertical axis of the line graph?
S2 : Not really, ma'am. I just looked at the highest points.
R : What information do you think the points on the line graph are actually showing?
S2 : I realize now, ma'am... They should represent amounts, not percentages.

Based on the interview with student S2, it was revealed that the student struggled to understand the meaning of numerical data in line graphs, particularly in identifying the highest value represented. The student interpreted the highest points on the graph as "90%" and "95%," despite no percentage indicators being present. This suggests that the student misconstrued the numerical values as percentages rather than actual quantities (e.g., sales figures). Upon further questioning, the student admitted to not reading the vertical axis label and assumed that the fluctuating pattern of the graph automatically implied percentages. This error highlights a misconception regarding the context of data, where students tend to generalize the visual form of a graph especially a line graph as a representation of percentages, likely due to frequent exposure to similar problems.

Possible causes of this difficulty include students' lack of attention to key visual details such as axis labels, and insufficient practice in interpreting data within its full visual and contextual framework. As stated by Backer et al. (2023) students often overlook important visual elements such as axis labels, which leads to misinterpretations of data, and tend to focus on less relevant parts of the graph rather than the essential information. Furthermore, a study by Fatimah (2023) showed that only 21.8% of students were able to correctly answer questions requiring graph interpretation, indicating that students still need more exposure to tasks involving the reading and understanding of real-world data presentations.

3.2. Discussion

Based on the research findings, several students still experienced difficulties in presenting data using various types of diagrams, such as bar charts, line graphs, and pie charts. These difficulties reflect obstacles in transforming numerical data into appropriate visual representations. Students often face challenges both in the technical aspects of diagram construction and in data interpretation, indicating their weak ability to convert quantitative information into informative and accurate visual formats (Ruf et al., 2024). To

address these obstacles, more active and contextual learning strategies are required. One such strategy is the implementation of problem-based learning, which has been proven effective in improving students' skills in constructing bar charts (Suprihatin, 2022). Moreover, the use of interactive learning media that fosters active student engagement also plays a crucial role in strengthening their understanding of data representation concepts (Lestrari et al., 2024). Therefore, a synergy between relevant instructional approaches and the appropriate use of educational media can offer effective solutions to overcome students' difficulties in presenting data in the form of diagrams.

Students' struggles in converting numerical data such as percentages and degrees highlight a weakness in computational skills, especially when dealing with values on a scale of hundreds. While some students were able to accurately perform calculations related to angles and percentages, they often encountered difficulties in transforming these results into accurate visual representations. This situation points to a gap between students' mastery of numerical concepts and their visual–spatial skills. Sundari et al. (2022), explained that such difficulties may stem from limited conceptual understanding, lack of accuracy, poor problem-solving abilities, and insufficient student involvement during learning activities. To overcome these issues, learning strategies must become more interactive and directly engage students. One recommended approach involves the use of models, media, and interactive methods that aim to strengthen students' conceptual understanding. Additionally, providing diverse problem sets and involving students in the process of constructing formulas are believed to enhance their comprehension. Tobgay (2024) also emphasized the importance of the teacher's role in motivating students and collaborating with parents to create a supportive and conducive learning environment.

Students frequently experience difficulties in interpreting information from diagrams. Many tend to focus solely on the visual appearance of a diagram without understanding the meaning or context of the data presented, which often leads to misinterpretation. Wulandari et al. (2023) stated that this issue arises due to students' unfamiliarity with visual data representations and their limited practice in reading and interpreting information from various types of diagrams. To address this problem, a more interactive and context-based learning approach is needed. Contextual learning has been shown to help students relate mathematical material to real-life situations, thereby fostering creativity and more applicable understanding (Wijayanti et al., 2025). Thus, the implementation of instructional methods that emphasize active student participation and the use of authentic contexts can serve as an effective strategy to improve students' ability to read and interpret data from different types of diagrams.

The difficulties students face in presenting and interpreting data through various types of diagrams such as bar charts, line graphs, and pie charts are influenced by a combination of internal and external factors. Internally, the primary barriers include a lack of fundamental mathematical understanding, weak arithmetic skills, low accuracy, and poor learning motivation. These findings align with those of Nahak et al. (2023), who noted that many students struggle with understanding data presentation concepts, applying mathematical principles, and solving word problems, often due to poor memory and ineffective study habits. Externally, limitations in the use of interactive teaching methods and insufficient utilization of engaging learning media also contribute to students' low numeracy literacy. Sundari et al. (2022), emphasized that passive instructional approaches that do not directly involve students can hinder understanding particularly in the context of data presentation. To overcome these challenges, a more active and contextual learning design is needed, where students are involved in exploring data relevant to real-life situations. As Toheri et al. (2020) suggested, contextual learning approaches can increase student engagement and understanding by connecting classroom content to real-world situations and encouraging practical application of knowledge. Therefore, teachers are

encouraged to adopt active, context-based teaching strategies that prioritize conceptual understanding rather than mere procedural knowledge.

4. CONCLUSION

Based on the findings of this study, it can be concluded that learning activities related to data presentation still encounter various challenges experienced by students. These difficulties can be classified into three main categories. First, students struggle to present data in the form of diagrams such as bar charts, line graphs, and pie charts which is generally caused by a limited understanding of visual representations and underdeveloped technical skills. Second, students face difficulties in converting data into percentage and degree units, particularly in constructing pie charts. These challenges are influenced by inaccuracy during calculations and limited numerical ability. Third, students experience difficulties in reading and interpreting information from diagrams, which indicates a lack of ability to comprehend the meaning of visually presented data. To address these challenges, learning should be designed using active and contextual approaches that encourage students' direct involvement in exploring and making sense of data relevant to real-life situations. Through this approach, students are expected not only to acquire procedural knowledge, but also to internalize mathematical concepts in a meaningful and applicable manner.

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