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Analysis of Junior High School Students' Learning Difficulties in Solving Statistics Problems as a Basis for Developing RME-Based Learning Materials

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ABSTRACT

This study aims to analyze the learning difficulties junior high school students face in solving statistics problems based on Realistic Mathematics Education (RME) principles, to support the development of learning materials. This study used a qualitative, descriptive approach and was conducted at SMPN 1 Pasawahan, Kuningan Regency, West Java, during the even semester of the 2025/2026 academic year. Thirty-five students completed a written test, after which three students were purposively selected to represent high (CA), medium (NN), and low (MR) ability levels. Research instruments included a written essay test comprising six RME-based contextual problems and a semi-structured interview guide. Data were analyzed qualitatively through data reduction, data presentation, and conclusion drawing, utilizing triangulation between written responses and interview results. The findings indicate that students' learning difficulties varied by ability level. High-ability students were able to solve almost all problems but encountered obstacles in understanding the meaning of consistency in statistics and applying the interquartile range (Q_d) formula. Medium-ability students experienced difficulties regarding quartile concepts and time management, as they were unaccustomed to lengthy contextual problems. Low-ability students faced fundamental hurdles in interpreting visual representations (pie charts), grasping basic statistical concepts, and drawing conclusions from data; they also could not complete most problems due to time constraints. These findings underscore the need for RME-based learning materials that integrate real-life contexts, visual aids (scaffolding), and explicit practice in drawing conclusions from data.

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1. INTRODUCTION

Statistics is an important component of junior high school mathematics learning because it enables students to read, process, present, and interpret data in meaningful

contexts. These abilities matter more than ever because students are expected not only to perform mathematical calculations but also to use quantitative information to understand situations and make informed decisions. In contemporary mathematics education, statistical competence is increasingly important because students are expected not only to perform mathematical calculations but also to interpret quantitative information and draw conclusions based on data. However, statistics remains a challenging topic for many junior high school students, particularly when mathematical tasks require them to interpret data representations, connect numerical information with contextual situations, and draw conclusions beyond routine calculations. Ladayya et al. [1] similarly emphasized the importance of statistics in junior high school mathematics learning, particularly in developing students' ability to process, interpret, and present data meaningfully.

The difficulty becomes more apparent when students are confronted with contextual statistics problems. Previous studies report that students have difficulty interpreting data, analyzing information, determining statistical measures, and drawing conclusions. Alpindro et al. [2] found difficulties in data interpretation and conclusion drawing, while [3] reported difficulties in data analysis and determining measures of central tendency. Furthermore, [4] and [5] showed that students' ability to understand and analyze data-based information remains limited when statistical tasks require interpretation beyond routine computation. Irwandi et al. [6] also found that students' statistical literacy in AKM-type items remains limited, particularly in connecting numerical results to conclusions in real-world contexts. Rohmah et al. [7] further confirmed through a bibliometric analysis that numeracy literacy in mathematics learning remains a growing concern, highlighting a persistent gap between students' actual literacy abilities and the demands of contemporary mathematics education.

The problem is also evident in the research site's instructional context. An interview with the mathematics teacher at SMPN 1 Pasawahan indicated that classroom instruction was still largely dominated by lectures and direct formula delivery. At the same time, the problems provided to students tended to be routine and had limited connections to real-life contexts. Consequently, students had limited experience solving contextual problems that require interpretation, reasoning, and higher-order thinking. This condition is consistent with Ate and Lede [8], who reported that students often perform poorly on numeracy literacy tasks because classroom activities provide limited exposure to contextual, story-based problems.

Understanding students' learning difficulties is therefore important before developing instructional materials. A diagnostic analysis can identify specific conceptual, procedural, representational, and contextual obstacles experienced by students and provide an empirical basis for designing more appropriate learning interventions. Kusumaningpuri et al. [9] emphasized the importance of identifying students' specific difficulties in statistics before developing learning interventions. Rohmah dan Sutiarso [10] similarly showed that students' difficulties in solving mathematical problems are related to their ability to understand and interpret contextual information.

One instructional approach that is relevant to this problem is Realistic Mathematics Education (RME). RME emphasizes meaningful real-life situations as starting points for students to construct mathematical knowledge. Through contextual situations, students are

encouraged to develop informal strategies, connect these strategies with mathematical representations, and gradually arrive at more formal mathematical concepts [11].

Previous research has demonstrated RME's potential to support students' mathematical learning. Sutarni and Aryuana [12] showed that RME can improve students' higher-order thinking-oriented problem-solving ability through contextual problems. In statistics learning. Istifadah and Saadah [13] reported that RME contexts can help students develop a more meaningful understanding of data by encouraging them to analyze information from situations relevant to their daily lives. A recent systematic literature review by A'la et al. [14] further indicated that RME consistently supports mathematical literacy and numeracy through conceptual understanding, critical thinking, and contextual problem-solving. At the level of learning materials, Hakim et al. [15] reported positive student responses to structured worksheet-based learning materials.

Despite these findings, an important gap remains. Previous studies have largely focused either on identifying students' difficulties in statistics or on examining the effectiveness of RME as a learning approach or instructional material. However, limited attention has been given to linking a detailed diagnosis of students' statistical learning difficulties across ability levels to the specific requirements for RME-based learning materials. In addition, although RME has been shown to support contextual and meaningful mathematics learning, teachers may still struggle to implement its stages, particularly in guiding students from informal reasoning based on real contexts toward formal mathematical models [16]. Therefore, empirical evidence that identifies students' specific difficulties and translates these findings into considerations for RME-based learning materials is still needed.

This study's originality lies in its diagnostic-to-design perspective. Rather than examining the effectiveness of RME alone, this study first identifies the types and patterns of statistical learning difficulties junior high school students experience across different ability levels. It then uses these findings to inform considerations for RME-based learning materials. The study therefore connects empirical evidence of students' difficulties with the instructional characteristics needed to address those difficulties through contextual mathematics learning.

Based on this gap, this study aims to analyze the learning difficulties junior high school students experience in solving RME-based statistics problems across different ability levels and to identify the implications of these difficulties for developing RME-based learning materials.

This study contributes to mathematics education by providing diagnostic evidence of students' statistical learning difficulties across ability levels and translating these findings into specific considerations for designing RME-based learning materials. Practically, the findings can inform teachers and learning material developers in designing statistics learning activities that incorporate meaningful real-life contexts, visual representations, guided mathematical reasoning, and opportunities for students to interpret data and draw evidence-based conclusions.

2. METHOD

2.1 Research Design, Location, and Participants

This study uses a qualitative descriptive approach to analyze the difficulties junior high school students face in solving statistics problems based on RME. The research was conducted at SMPN 1 Pasawahan, Kuningan Regency, West Java, during the even semester of the 2025/2026 academic year. The participants consisted of 35 ninth-grade students who had completed a statistics test. Three students were purposively selected to represent the high-ability (CA), medium-ability (NN), and low-ability (MR) categories based on their test scores. The selection of the three ability categories aimed to obtain a comprehensive picture of students' learning difficulties across different ability levels [17].

2.2 Research Instruments and Data Collection

The research instruments consisted of a written essay test and a semi-structured interview guide. The test comprised six RME-based statistics problems in everyday contexts, including daily spending, gadget usage, sleep patterns, cafeteria food preferences, physical activity, and online gaming. The items were developed based on three numeracy indicators proposed by Liswati et al. [18]: (1) using numbers and mathematical symbols to solve practical problems, (2) analyzing information presented in various data representations, and (3) using analytical results to make predictions, draw conclusions, and make decisions. he instruments were validated by a mathematics education lecturer and a junior high school mathematics teacher and were declared suitable for use.

Table 1. Blueprint of the RME-Based Numeracy Test Instrument

Numeracy Indicator	RME Context	No Item	Statistics Topic
Using various numbers and symbols related to basic mathematics to solve practical problems in everyday life contexts.	Hana's daily step count over 10 days (bar chart)	5	Quartile
	Kill data of 5 Mobile Legend players over 2 weeks (table)	6	Quartile & Interquartile Range
Analyzing information displayed in various forms (graphs, tables, charts, etc.).	Sleep habits of 50 eighth-grade students (frequency table)	3	Mode
	Favorite foods of 44 students in the cafeteria (table)	4	
Using interpretations of analytical results to make predictions and draw conclusions and decisions. Using interpretations of analytical results to make predictions and draw conclusions and decisions.	Ani's daily snack spending (pie chart)	1	Mean
	Raka's phone usage duration over 1 week (line graph)	2	Median, Mode

Data were collected in two stages. First, students completed the written test individually. Second, the researchers conducted semi-structured interviews with the three selected students immediately after the test. The interviews explored students' problem-solving processes, conceptual understanding, difficulties, data interpretation, and experiences learning statistics.

2.3 Data Analysis and Trustworthiness

The data were analyzed qualitatively through data reduction, data display, and conclusion drawing. The researchers organized written responses and interview transcripts by students' ability levels and numeracy indicators. The analysis focused on identifying students' difficulties in understanding statistical concepts, interpreting data representations, solving contextual problems, and drawing conclusions. The study triangulated data by comparing students' written responses with interview results to strengthen the credibility and trustworthiness of the findings.

2.4 Ethical Considerations

Before data collection, the university issued an official research permit letter, which was submitted to SMPN 1 Pasawahan, and the school administration granted permission to conduct the study. The classroom teacher facilitated the research process, and students voluntarily participated in the written test and interview sessions. The researchers maintained participant confidentiality by using codes (CA, NN, and MR) instead of students' real names, and used the data solely for research purposes.

3. RESULTS

This section presents the findings obtained from the analysis of students' written test results and interview data. It begins with a general overview of the three subjects' performance across all test items, followed by an in-depth analysis of each subject's difficulties organized by ability category and numeracy indicator.

3.1 Overview of Test Results

The test was administered to students at SMPN 1 Pasawahan. Based on the results, three subjects were selected to represent each ability category. All three subjects were ninth-grade students: CA (female) represented the high-ability category, NN (female) represented the medium-ability category, and MR (male) represented the low-ability category. Table 2 presents a general overview of the three subjects' performance on each item.

Table 2 shows that students' difficulty levels differ across numeracy indicators. The high-ability subject completed all items well, while the medium-ability subject began experiencing difficulties on items 5 and 6, which relate to quartiles and interquartile range. The low-ability subject had greater difficulty, encountering obstacles on nearly all indicators, particularly in understanding quartiles, interquartile range, and drawing conclusions from data analysis. Item 6 was the only item no subject could complete in full, making it the most universal difficulty in this study.

Table 2. Summary of Students' Problem-Solving Abilities per Subject

No	Indicator	CA (High)	NN (Medium)	MR (Low)
1	Ind. 3	Was able to read the pie chart, identify days with spending above average, and conclude that Ani's spending was not economical with appropriate reasoning.	Did not use pie chart data; only referred to the explicitly stated average of IDR 6,000 and concluded spending was economical without comparative analysis.	Unable to read the pie chart; summed all weekly spending and concluded it was economical because some days had spending of IDR 2,000–5,000, without comparing to the average.
2	Ind. 3	Was able to determine the median and mode from the line graph and identify all corresponding days correctly (Friday: median 4 hours; Monday & Sunday: mode 3 hours; Tuesday & Thursday: mode 5 hours).	Was able to determine the median and mode and identify the corresponding days correctly.	Unable to determine the median and mode due to lack of conceptual understanding.
3	Ind. 2	Was able to conclude that the sleep habits of VIII-A students were insufficient because some students slept less than 8 hours, in accordance with the recommended amount.	Was able to draw the same conclusion as CA that sleep habits were insufficient because some students slept less than 8 hours.	Did not complete the item due to time constraints.
4	Ind. 2	Was able to read the table and identify three foods with the same highest frequency: fried noodles, cireng, and gorengan.	Was able to read the table and identify three foods with the same highest frequency: fried noodles, cireng, and gorengan.	Was able to reconstruct the full frequency table and identify fried noodles, cireng, and gorengan as the most frequent, but accompanied by irrelevant narration about total orders.
5	Ind. 1	Was able to sort the data and determine Q_1, Q_2, and Q_3 by correctly marking their positions in the ordered data.	Did not attempt the item; answer sheet was blank.	Did not complete the item due to time constraints.
6	Ind. 1	Was able to sort the data and determine Q_1, Q_2, and Q_3, but left the conclusion about the most consistent player blank due to not understanding the meaning of consistency in statistics.	Did not attempt the item; answer sheet was blank.	Did not complete the item due to time constraints.

Of the six items administered, the following discussion focuses on three items, each representing one numeracy indicator: item 1 for Indicator 1, item 3 for Indicator 2, and item 6 for Indicator 3. This selection was based on the fact that items within the same indicator

(items 1–2, 3–4, and 5–6) showed similar difficulty patterns across subjects, so we selected the most representative item from each group to avoid repetitive discussion.

3.2 Analysis of Students' Difficulties

3.2.1 Analysis of High-Ability Students' Difficulties (CA)

Item No 1

Question:

Ani adalah siswa kelas VIII yang gemar membeli jajan di kantin sekolah. Selama satu minggu, ia mencatat pengeluaran jajan hariannya dan menyajikannya dalam diagram berikut.

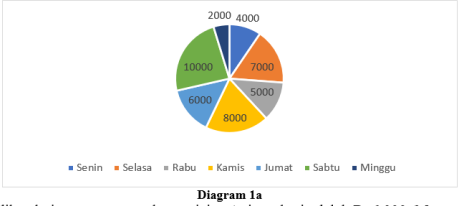


Diagram 1a

Jika diketahui rata-rata pengeluaran jajan Ani per hari adalah Rp6.000. Menurutmu, apakah kebiasaan pengeluaran Ani sudah tergolong hemat? Berikan pendapatmu disertai alasan berdasarkan diagram (1a) di atas.

Ani is an 8th-grade student who enjoys buying snacks at the school canteen. Over the course of one week, she recorded her daily snack expenses and presented them in the following diagram.

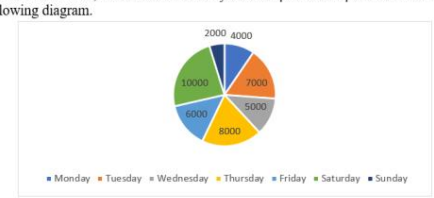
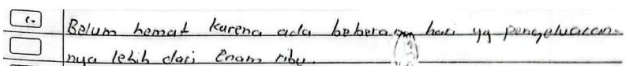


Diagram 1a

Given that Ani's average daily snack expense is IDR 6,000, do you think Ani's spending habits can be considered thrifty? Give your opinion along with reasoning based on Diagram 1a above.

This item asked students to read Ani's daily snack spending presented in a pie chart, then evaluate whether her spending habits were economical by comparing them with the average value.

Student's Answer (CA)

	*Not yet economical because there are several days where spending exceeds six thousand rupiah.*

CA was able to read the value of each segment of the pie chart and concluded that Ani's spending was not economical because there were days when spending exceeded the average of IDR 6,000. Although CA's written answer did not specify which days were intended, based on the interview, CA explained:

MF: Soal nomor 1 tentang pengeluaran Ani di diagram lingkaran. Apakah kamu bisa membaca nilainya? Bagaimana cara menjawab? **CA:** *Ada tiga hari yang di atas rata-rata. Jadi pengeluaran ani saya rasa masih belum hemat, meskipun bisa saya kerjakan. Saya harus baca satu per satu tiap potongannya*	**MF:** Item 1 is about Ani's spending in the pie chart. Were you able to read the values? How did you answer? **CA:** *There are three days that are above average. So I think Ani's spending is not yet economical, even though I could answer it. I had to read each segment one by one*

CA answered correctly and was able to formulate an appropriate justification. Nevertheless, CA acknowledged that the pie chart required more time because each segment had to be read individually.

Item No 3

Question:

Wali kelas VIII-A ingin mengetahui kebiasaan tidur siswanya karena beberapa siswa terlihat mengantuk saat pelajaran berlangsung. Beliau melakukan survei kepada 50 siswa dengan menanyakan berapa jam mereka tidur setiap malam, kemudian menyajikan hasilnya dalam tabel berikut.

Durasi tidur	Jumlah siswa
5 jam	3
6 jam	8
7 jam	14
8 jam	14
9 jam	7
10 jam	4
Total	**50**

Tabel 3c

Berdasarkan tabel di atas, tentukan durasi tidur yang paling banyak dilakukan siswa. Kemudian, berikan kesimpulan kepada wali kelas: apakah kebiasaan tidur siswa kelas VIII-A sudah cukup atau belum? (*Catatan: durasi tidur yang dianjurkan untuk remaja adalah 8–10 jam per malam.*) Jelaskan pendapatmu berdasarkan data

The homeroom teacher of class VIII-A wants to find out the sleeping habits of the students, since several students appeared drowsy during lessons. The teacher surveyed 50 students, asking how many hours they sleep each night, and presented the results in the following table.

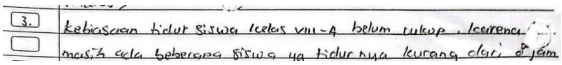
Sleep duration	Number of students
5 hours	3
6 hours	8
7 hours	14
8 hours	14
9 hours	7
10 hours	4
Total	**50**

Table 3c

Based on the table above, determine the sleep duration most commonly reported by students. Then, provide a conclusion for the homeroom teacher: are the sleeping habits of class VIII-A students already sufficient or not? (*Note: the recommended sleep duration for teenagers is 8–10 hours per night.*) Explain your reasoning based on the data.

This item contained survey data on the sleep duration of 50 eighth-grade students and asked students to determine the most frequent sleep duration and evaluate whether the sleeping habit met the recommended 8–10 hours per night.

Student's Answer (CA)

	*The sleep habits of VIII-A students are not yet sufficient, because there are still some students who sleep less than 8 hours.*

CA demonstrated reasonably good analytical ability by concluding that the sleep habits of VIII-A students were inadequate, since some students were found to be sleeping fewer than 8 hours. This reflects the ability to read data qualitatively, although it was not accompanied by explicit proportional calculations or percentages.

MF: Soal nomor 3 tentang kebiasaan tidur. Apakah kamu menggunakan anjuran 8–10 jam? Bagaimana cara menarik kesimpulan? **CA:** *Saya lihat datanya, yang tidur di atas 8 jam itu ada 25 siswa dari total 50. Berarti setengahnya masih di bawah anjuran. Jadi kesimpulan saya kebiasaan tidur siswa kelas VIII-A belum cukup.*	**MF:** Item 3 is about sleep habits. Did you use the 8–10 hour recommendation? How did you draw the conclusion? **CA:** *I looked at the data; those who sleep more than 8 hours are 25 out of 50 students. That means half of them are still below the recommendation. So my conclusion is that the sleep habits of VIII-A students are not yet sufficient.*

Item No 6

Question:

Dika adalah siswa kelas VIII yang gemar bermain Mobile Legend. Selama dua minggu, Dika beserta empat temannya, yaitu Reza, Bima, Naufal, dan Salsa, mencatat jumlah kemenangan (kill) yang diperoleh setiap sesi bermain.
Berikut data jumlah kemenangan yang mereka kumpulkan selama dua minggu:

Nama	Minggu 1	Minggu 2
Dika	8	7
Reza	5	11
Bima	12	4
Naufal	6	10
Salsa	9	6

Tabel 6f

Mereka ingin mengetahui siapa pemain yang performanya paling konsisten dari minggu ke minggu berdasarkan data yang telah dicatat.
Berdasarkan data pada tabel (5e) diatas, tentukan nilai Q_1, Q_2, Q_3 dan Q_d dari data tersebut.

Dika is an 8th-grade student who enjoys playing Mobile Legends. Over two weeks, Dika and his four friends Reza, Bima, Naufal, and Salsa recorded the number of wins (kills) they achieved in each play session.
Below is the win-count data they collected over two weeks:

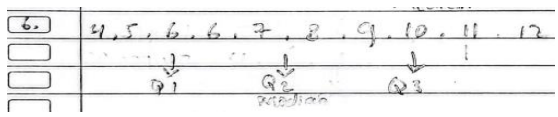
Name	Week 1	Week 2
Dika	8	7
Reza	5	11
Bima	12	4
Naufal	6	10
Salsa	9	6

Table 6f

They want to determine which player performed most consistently from week to week based on the recorded data.
Based on the data in the table above, determine the values of Q_1, Q_2, Q_3 and Q_d from the data.

This item presented kill count data of five Mobile Legend players over two weeks and asked students to determine Q_1, Q_2, Q_3, and Q_d, as well as conclude which player was the most consistent.

Student's Answer (CA)

	*CA sorted the data: 4, 5, 6, 6, 7, 8, 9, 10, 11, 12. Determined Q_1, Q_2 (median), and Q_3 by marking their positions. The interquartile range (Q_d) section and consistency conclusion were left blank.*

CA demonstrated that he could sort the data from smallest to largest and determine the quartile values. However, CA did not proceed to calculate the interquartile range. Based on the interview, CA explained:

MF: Soal nomor 6 tentang Q_d dan pemain paling konsisten. Apakah paham "konsisten" dalam statistika? Apakah tahu rumus Q_d? **CA:** *Saya ga faham untuk yang konsisten. Karena ga yakin, bagian kesimpulan konsistensinya saya kosongkan, takut salah.* **MF:** Materi statistika mana yang paling sulit? Apa penyebabnya? **CA:** *Simpangan kuartil atau Q_d. Q_d yang saya lupa rumusnya karena jarang dilatih. Kedua bagian kesimpulan yang meminta pendapat.* **MF:** Apakah guru sering memberikan soal yang dikaitkan dengan cerita kehidupan sehari-hari? **CA:** *Kadang-kadang.* **MF:** Jika soal seperti kemarin lebih sering diberikan di kelas, apakah akan membantu? **CA:** *Sangat membantu.*	**MF:** Item 6 is about Q_d and the most consistent player. Do you understand what 'consistent' means in statistics? Do you know the Q_d formula? **CA:** *I don't understand the consistent part. Because I wasn't sure, I left the consistency conclusion blank I was afraid of getting it wrong.* **MF:** Which statistics topic is the most difficult? What causes it? **CA:** *Interquartile range or Q_d. I forgot the Qd formula because I rarely practice it. Also the conclusion parts that ask for an opinion.* **MF:** Does the teacher often give problems connected to everyday life stories? **CA:** *Sometimes.* **MF:** If problems like those were given more often in class, would it help? **CA:** *Very much.*

CA's main obstacle on item 6 was a lack of understanding of the meaning of 'consistent' in the statistical context and forgetting the Q_d formula due to infrequent practice. Despite being able to calculate correctly Q_1, Q_2, dan Q_3, CA was unable to proceed to the calculation of Q_d or draw a conclusion about player consistency.

3.2.2 Analysis of Medium-Ability Student's Difficulties (NN)

Item No 1

Question:

Ani adalah siswa kelas VIII yang gemar membeli jajan di kantin sekolah. Selama satu minggu, ia mencatat pengeluaran jajan hariannya dan menyajikannya dalam diagram berikut.

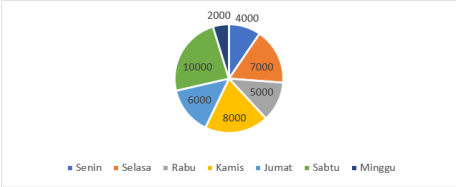


Diagram 1a

Jika diketahui rata-rata pengeluaran jajan Ani per hari adalah Rp6.000. Menurutmu, apakah kebiasaan pengeluaran Ani sudah tergolong hemat? Berikan pendapatmu disertai alasan berdasarkan diagram (1a) di atas.

Ani is an 8th-grade student who enjoys buying snacks at the school canteen. Over the course of one week, she recorded her daily snack expenses and presented them in the following diagram.

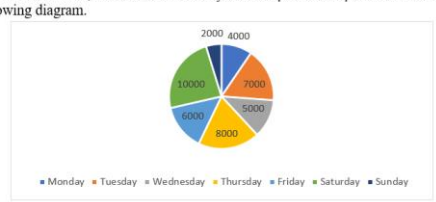
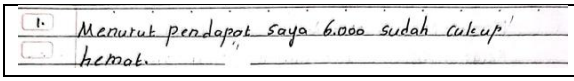


Diagram 1a

Given that Ani's average daily snack expense is IDR 6,000, do you think Ani's spending habits can be considered thrifty? Give your opinion along with reasoning based on Diagram 1a above.

On the same item about Ani's snack spending presented in a pie chart, NN was asked to evaluate the spending habit against the average of IDR 6,000.

Student's Answer (NN)

	*In my opinion, 6,000 is already economical enough.*

NN answered that Ani's spending was 'economical enough'. Based on the interview, NN explained:

MF: Soal nomor 1 tentang pengeluaran Ani. Apakah kamu bisa membaca nilainya? Bagaimana cara menjawab? **NN:** *Didalam soal kan sudah ada rata ratanya 6000 jadi saya kira untuk pengeluarana ni dalam satu minggu cukup hemat*	**MF:** Item 1 is about Ani's spending. Could you read the values? How did you answer? **NN:** *The problem already states the average is 6,000, so I think Ani's spending for the whole week is economical enough.*

NN answered that Ani's spending was 'economical enough' on the grounds that the average spending of IDR 6,000 was already stated in the problem.

Item No 3

Question:

Wali kelas VIII-A ingin mengetahui kebiasaan tidur siswanya karena beberapa siswa terlihat mengantuk saat pelajaran berlangsung. Beliau melakukan survei kepada 50 siswa dengan menanyakan berapa jam mereka tidur setiap malam, kemudian menyajikan hasilnya dalam tabel berikut.

Durasi tidur	Jumlah siswa
5 jam	3
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7 jam	14
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9 jam	7
10 jam	4
Total	**50**

Tabel 3c

Berdasarkan tabel di atas, tentukan durasi tidur yang paling banyak dilakukan siswa. Kemudian, berikan kesimpulan kepada wali kelas: apakah kebiasaan tidur siswa kelas VIII-A sudah cukup atau belum? (*Catatan: durasi tidur yang dianjurkan untuk remaja adalah 8–10 jam per malam.*) Jelaskan pendapatmu berdasarkan data

The homeroom teacher of class VIII-A wants to find out the sleeping habits of the students, since several students appeared drowsy during lessons. The teacher surveyed 50 students, asking how many hours they sleep each night, and presented the results in the following table.

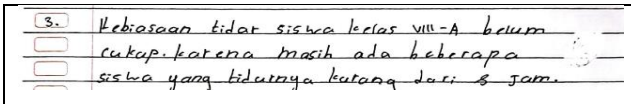
Sleep duration	Number of students
5 hours	3
6 hours	8
7 hours	14
8 hours	14
9 hours	7
10 hours	4
Total	**50**

Table 3c

Based on the table above, determine the sleep duration most commonly reported by students. Then, provide a conclusion for the homeroom teacher: are the sleeping habits of class VIII-A students already sufficient or not? (*Note: the recommended sleep duration for teenagers is 8–10 hours per night.*) Explain your reasoning based on the data.

In the sleep habits problem involving 50 eighth-grade students of class VIII-A, NN was asked to determine the most frequently occurring sleep duration and evaluate the adequacy of sleep based on the recommended 8–10 hours per night.

Student's Answer (NN)

	*The sleep habits of VIII-A students are not yet sufficient, because there are still some students who sleep less than 8 hours.*

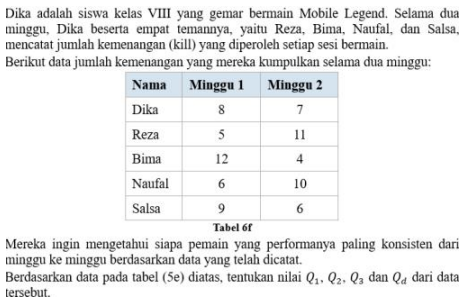
NN provided an answer stating that the students' sleep habits were not yet sufficient. Based on the interview, NN explained:

MF: Soal nomor 3 tentang kebiasaan tidur. Bagaimana cara menarik kesimpulan? **NN:** *Saya lihat yang paling banyak itu 7 jam dan 8 jam. Terus saya simpulkan belum cukup karena masih banyak yang tidur 7 jam, di bawah anjuran.*	**MF:** Item 3 is about sleep habits. How did you draw the conclusion? **NN:** *I saw that the most common was 7 hours and 8 hours. Then I concluded it was insufficient because many students sleep 7 hours, which is below the recommendation.*

NN completed this item well. NN used the 8–10 hour recommendation as a reference in drawing conclusions about the adequacy of students' sleep.

Item No 6

Question:

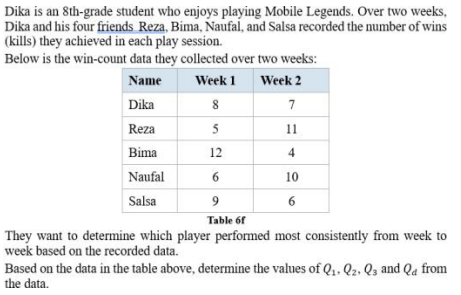


Dika adalah siswa kelas VIII yang gemar bermain Mobile Legend. Selama dua minggu, Dika beserta empat temannya, yaitu Reza, Bima, Naufal, dan Salsa, mencatat jumlah kemenangan (kill) yang diperoleh setiap sesi bermain.
Berikut data jumlah kemenangan yang mereka kumpulkan selama dua minggu:

Nama	Minggu 1	Minggu 2
Dika	8	7
Reza	5	11
Bima	12	4
Naufal	6	10
Salsa	9	6

Tabel 6f

Mereka ingin mengetahui siapa pemain yang performanya paling konsisten dari minggu ke minggu berdasarkan data yang telah dicatat.
Berdasarkan data pada tabel (5e) diatas, tentukan nilai Q_1, Q_2, Q_3 dan Q_d dari data tersebut.



Dika is an 8th-grade student who enjoys playing Mobile Legends. Over two weeks, Dika and his four friends Reza, Bima, Naufal, and Salsa recorded the number of wins (kills) they achieved in each play session.
Below is the win-count data they collected over two weeks:

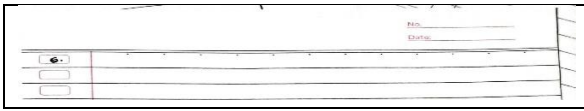
Name	Week 1	Week 2
Dika	8	7
Reza	5	11
Bima	12	4
Naufal	6	10
Salsa	9	6

Table 6f

They want to determine which player performed most consistently from week to week based on the recorded data.
Based on the data in the table above, determine the values of Q_1, Q_2, Q_3 and Q_d from the data.

In the item on the interquartile range (Q_d) nd the consistency analysis of the kill data of five Mobile Legends players, NN was asked to determine the values of Q_1, Q_2, Q_3, Q_d and Q_d, and identify the most consistent player.

Student's Answer (NN)

	*NOT ATTEMPTED*

MF: Soal nomor 6 tentang Q_d dan pemain paling konsisten. Apakah paham konsepnya? **NN:** *Kurang paham arti konsisten dalam statistika. Saya kira cuma ngitung Q_1, Q_2, Q_3 nya aja, soal siapa yang paling konsisten saya nggak tau cara ngaitinnya. Q_d juga nggak tau.* **MF:** Apa faktor utama yang menyebabkan kesulitan kemarin? **NN:** *Waktunya kurang, soalnya banyak dan panjang-panjang jadi saya kelamaan di soal-soal awal, waktu sampai soal 5 dan 6 sudah mepet.*	**MF:** Item 6 is about Qd and the most consistent player. Do you understand the concept? **NN:** *I don't quite understand what consistent means in statistics. I thought I only needed to calculate ngitung Q_1, Q_2, Q_3. For who the most consistent player is, I don't know how to connect it. Q_d I don't know either.* **MF:** What was the main factor causing your difficulties? **NN:** *Time was limited; the problems were many and long, so I spent too much time on the earlier*

MF: Apakah guru sering memberikan soal yang dikaitkan dengan cerita kehidupan sehari-hari? **NN:** *Jarang. Biasanya langsung soal angka, dikasih data terus disuruh hitung mean median modus.* **MF:** Jika soal seperti kemarin lebih sering diberikan di kelas, apakah akan membantu? **NN:** *Iya, pasti membantu. Jadi lebih terbiasa baca soal panjang dan nggak panik duluan.*	*problems, and by items 5 and 6, time was already tight.* **MF:** Does the teacher often give problems connected to everyday life stories? **NN:** *Rarely. Usually it's direct number problems we're given data and told to calculate mean, median, mode.* **MF:** If problems like those were given more often in class, would it help? **NN:** *Yes, definitely. So I would be more used to reading long problems and wouldn't panic.*

In addition to a lack of understanding of the Q_d concept, , time management was a genuine obstacle for NN. Unfamiliarity with lengthy contextual problems caused NN to spend excessive time on earlier items.

3.2.3 Analysis of Low-Ability Student's Difficulties (MR)

Item No 1

Question:

Ani adalah siswa kelas VIII yang gemar membeli jajan di kantin sekolah. Selama satu minggu, ia mencatat pengeluaran jajan hariannya dan menyajikannya dalam diagram berikut.

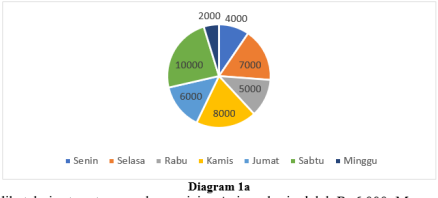


Diagram 1a

Jika diketahui rata-rata pengeluaran jajan Ani per hari adalah Rp6.000. Menurutmu, apakah kebiasaan pengeluaran Ani sudah tergolong hemat? Berikan pendapatmu disertai alasan berdasarkan diagram (1a) di atas.

Ani is an 8th-grade student who enjoys buying snacks at the school canteen. Over the course of one week, she recorded her daily snack expenses and presented them in the following diagram.

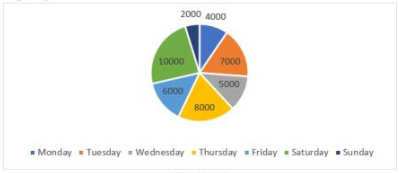
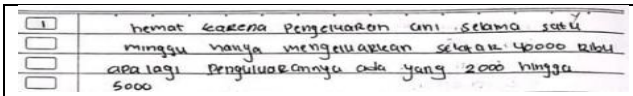


Diagram 1a

Given that Ani's average daily snack expense is IDR 6,000, do you think Ani's spending habits can be considered thrifty? Give your opinion along with reasoning based on Diagram 1a above.

On the same item about Ani's snack spending based on the pie chart, MR was asked to evaluate whether the spending habit was economical compared to the average of IDR 6,000.

Student's Answer (MR)

	*Economical because Ani's total spending over one week only amounted to 4,000 rupiah. There were also days with spending of 2,000 to 5,000.*

MR summed all of Ani's spending over the course of one week and concluded that it was economical because the total expenditure was considered small, and there were days with low spending ranging from IDR 2,000 to IDR 5,000. MR did not compare the daily spending against the average of IDR 6,000 as required by the problem. Based on the interview, MR explained:

MF: Soal nomor 1 tentang pengeluaran Ani di diagram lingkaran. Apakah kamu bisa membaca nilainya? **MR:** *Saya lihat diagramnya tapi nggak tau cara bacanya. Akhirnya saya cuma nulis pengeluaran dalam satu minggu Rp 4.000 terus bilang hemat, karena saya kira Rp 4.000 itu kecil jadi hemat.*	**MF:** Item 1 is about Ani's spending in the pie chart. Were you able to read the values? **MR:** *I looked at the chart but didn't know how to read it. In the end, I just wrote the total weekly spending as IDR 4,000 and said it was economical, because I thought IDR 4,000 was a small amount.*

MR did not use information from the pie chart as the basis for drawing conclusions. Instead, MR summed all of Ani's weekly spending and concluded it was economical because the total and some daily values seemed small.

Item No 3

Question:

Wali kelas VIII-A ingin mengetahui kebiasaan tidur siswanya karena beberapa siswa terlihat mengantuk saat pelajaran berlangsung. Beliau melakukan survei kepada 50 siswa dengan menanyakan berapa jam mereka tidur setiap malam, kemudian menyajikan hasilnya dalam tabel berikut.

Durasi tidur	Jumlah siswa
5 jam	3
6 jam	8
7 jam	14
8 jam	14
9 jam	7
10 jam	4
Total	**50**

Tabel 3c

Berdasarkan tabel di atas, tentukan durasi tidur yang paling banyak dilakukan siswa. Kemudian, berikan kesimpulan kepada wali kelas: apakah kebiasaan tidur siswa kelas VIII-A sudah cukup atau belum? (*Catatan: durasi tidur yang dianjurkan untuk remaja adalah 8–10 jam per malam.*) Jelaskan pendapatmu berdasarkan data

The homeroom teacher of class VIII-A wants to find out the sleeping habits of the students, since several students appeared drowsy during lessons. The teacher surveyed 50 students, asking how many hours they sleep each night, and presented the results in the following table.

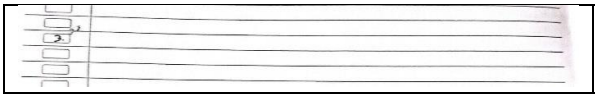
Sleep duration	Number of students
5 hours	3
6 hours	8
7 hours	14
8 hours	14
9 hours	7
10 hours	4
Total	**50**

Table 3c

Based on the table above, determine the sleep duration most commonly reported by students. Then, provide a conclusion for the homeroom teacher: are the sleeping habits of class VIII-A students already sufficient or not? (*Note: the recommended sleep duration for teenagers is 8–10 hours per night.*) Explain your reasoning based on the data.

On the sleep habits problem involving 50 eighth-grade students of class VIII-A, MR was asked to determine the most frequently occurring sleep duration and evaluate the adequacy of sleep based on the recommended 8–10 hours per night.

Student's Answer (MR)

	*NOT ATTEMPTED*

MF: Soal nomor 3 tentang kebiasaan tidur. Kenapa jawaban kamu kosong ? **MR:** *Saya tidak sempat mengerjakannya karena waktunya sudah habis. Saya terlalu lama membaca soal ceritanya dan memahami perintah pada soalnya.*	**MF:** Item 3 is about sleep habits. Why was your answer blank? **MR:** *I didn't have time to finish it — the time was up. I spent too long reading the story context and understanding the instructions*

Item No 6

Question:

Dika adalah siswa kelas VIII yang gemar bermain Mobile Legend. Selama dua minggu, Dika beserta empat temannya, yaitu Reza, Bima, Naufal, dan Salsa, mencatat jumlah kemenangan (kill) yang diperoleh setiap sesi bermain.
Berikut data jumlah kemenangan yang mereka kumpulkan selama dua minggu:

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Dika is an 8th-grade student who enjoys playing Mobile Legends. Over two weeks, Dika and his four friends Reza, Bima, Naufal, and Salsa recorded the number of wins (kills) they achieved in each play session.
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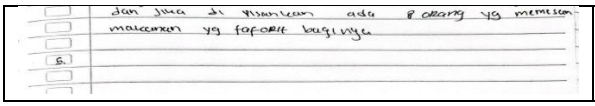
Table 6f

They want to determine which player performed most consistently from week to week based on the recorded data.
Based on the data in the table above, determine the values of Q_1, Q_2, Q_3 and Q_d from the data.

	*NOT ATTEMPTED*

MF: Soal nomor 6 tentang Q_d dan pemain paling konsisten. Apakah paham konsepnya?	**MF:** Item 6 is about Q_d and the most consistent player. Do you understand the concept?
MR: *Nggak tau dua-duanya. Soal 6 juga nggak saya kerjain, sama kayak soal 3 dan 5.*	**MR:** *I don't know either of those. I didn't attempt item 6 either, same as items 3 and 5.*
MF: Apa faktor utama yang menyebabkan kesulitan kemarin?	**MF:** What was the main factor causing your difficulties?
MR: *Soalnya panjang jadi capek bacanya duluan. Terus banyak istilah yang saya lupa artinya.*	**MR:** *The problems were long, so I got tired just from reading them. And there were many terms I forgot the meaning of.*
MF: Jika soal seperti kemarin lebih sering diberikan di kelas, apakah akan membantu?	**MF:** If problems like those were given more often in class, would it help?
MR: *Mungkin iya kalau sering diajarin dari awal.*	**MR:** *Maybe, if they were taught from the beginning.*

MR provided no answers for items 3 and 6 (blank). MR acknowledged spending a considerable amount of time reading and understanding the story context and item instructions, leaving no time to write answers.

Taken together, these findings indicate that learning difficulties become more pronounced as ability level decreases, with quartile and interquartile range concepts (Item 6) representing the most persistent obstacle across all three subjects. High-ability students mainly struggled with efficiency in reading visual representations and applying specific formulas; medium-ability students faced additional time-management barriers when confronted with lengthy contextual problems; and low-ability students experienced fundamental difficulties in reading data representations and constructing data-based conclusions. These patterns form the basis for the interpretation and implications discussed in the following section.

4. DISCUSSION

4.1 Interpretation of Findings

This section interprets the difficulty patterns identified in the previous section by numeracy indicator, drawing on findings across the three subjects and situating them within relevant literature.

Quartile and Interquartile Range (Item 6). Difficulties on this indicator were evident across all three subjects, though the underlying causes differed by ability level. CA was able to determine Q_1, Q_2, and Q_3 correctly but did not understand the meaning of "consistency" in a statistical context and had forgotten the Q_d formula due to infrequent practice, reflecting how limited exposure to contextual problems constrains the ability to interpret computational results rather than merely to produce them. This aligns with Marweli and Meiliasari [19], who found that fear of making mistakes is a recurring manifestation of mathematics anxiety among students, which may explain why CA left the consistency conclusion blank rather than risk an incorrect answer. For NN, in addition to a lack of understanding of the Q_d concept, time management was a genuine obstacle, as unfamiliarity with lengthy contextual problems caused NN to spend excessive time on earlier items. This confirms the importance of regularly practicing contextual problems in regular instruction, as recommended by Patri dan Heswari [20]. This finding also aligns with Siregar [21], who found that time management significantly predicts students' mathematics achievement, suggesting that

NN's difficulty stemmed as much from pacing as from conceptual gaps. MR, meanwhile, did not attempt Item 6 at all, spending considerable time reading and understanding the story context and item instructions. This finding is consistent with Islamiati and Putra [22], who found that difficulty understanding problem content is the most dominant obstacle students face in solving mathematical word problems, partly due to low mathematical literacy. This also aligns with Sianipar et al. [23], who found that reading errors remain common among junior high school students who do not understand terms and units in problems, preventing them from moving to problem comprehension or constructing mathematical solutions. Taken together, these findings suggest that the interquartile range concept itself, combined with limited exposure to lengthy contextual problems, constitutes the most persistent barrier across ability levels.

Analyzing Data Displayed in Various Forms (Item 3). Both CA and NN correctly determined the sleep-adequacy conclusion using the 8–10 hour recommendation, indicating that reading and interpreting straightforward frequency data was not a major obstacle for higher- and medium-ability students. MR, however, left this item blank for the same reason observed on Item 6, namely insufficient time caused by lengthy reading of the story context. This reinforces the pattern noted above: MR's central obstacle was less about statistical reasoning itself and more about the time and literacy demands of contextual, story-based problems.

Using Numbers and Symbols to Solve Practical Problems (Item 1). Performance on this indicator diverged sharply by ability level. CA answered correctly but needed additional time to read each segment of the pie chart individually, suggesting that reading visual data representations can still be improved through practice. Murtiyasa et al. [24] reported similar findings, concluding that low accuracy contributes to students' difficulties reading pie charts and recommending varied practice problems as a solution. NN, by contrast, did not read or interpret the pie chart as the primary data source at all, relying instead on the average value already stated in the problem text. This finding is consistent with Puspita et al. [25], who concluded that students do not yet fully understand the interrelationship between information in the problem, data context, and its visual representation, and that this gap tends to push them toward shortcuts that bypass the visual representation altogether. MR showed the most fundamental gap: rather than reading the pie chart at all, MR simply summed the weekly spending values and judged the total to be small, indicating that MR does not yet understand the function of visual diagram representations as tools for per-category data analysis. This finding is consistent with Misnawati et al. [26], who stated that students tend to experience confusion when required to divide data proportionally into diagram segments. Furthermore, Sandra et al. [27] described an epistemological obstacle among junior high school students in data presentation topics, where students tend to sum the values shown in a diagram rather than reading and interpreting each segment according to the context of the problem.

4.2 Theoretical Explanation

These patterns can be explained through the lens of Realistic Mathematics Education, which holds that mathematical understanding should be built progressively from informal, context-based reasoning toward formal mathematical models, as discussed in the

Introduction. The difficulties observed in this study largely occurred at the transition point between these two stages: students such as NN and MR were able to engage with the everyday context of the problems (e.g., spending, sleep habits) but struggled to translate that contextual understanding into the formal statistical procedures required, such as computing the interquartile range or correctly reading a proportional diagram, echoing the broader RME implementation challenge already outlined earlier in this article. CA's difficulties, by contrast, occurred at a more advanced stage, involving statistical terminology (consistency) and procedural fluency (the Q_d formula) rather than contextual comprehension itself, suggesting that even high-ability students require more structured opportunities to practice the formal stages of RME-based reasoning.

4.3 Implications of the Study

The findings of this study carry both theoretical and practical implications. Theoretically, the results extend the existing literature on RME implementation by showing that the specific point at which students struggle within the informal-to-formal reasoning trajectory differs systematically by ability level, providing an additional perspective on RME-based statistics learning. Practically, the results of this analysis can serve as an empirical basis for developing RME-based learning materials that explicitly incorporate: (1) real-life contexts relevant to students' daily lives to build meaningful conceptual understanding; (2) visual scaffolding to train students in efficiently reading various forms of data representation; and (3) regular data-based conclusion-drawing activities to help students become accustomed to connecting analytical results with the given problem context. These considerations can help teachers design instruction that more deliberately bridges the gap between contextual understanding and formal statistical procedures.

5. CONCLUSION

This study analyzed the learning difficulties of three ninth-grade students at SMPN 1 Pasawahan in solving RME-based statistics problems across three numeracy indicators. The findings show that students' difficulties varied by ability level. High-ability students generally demonstrated adequate data interpretation and statistical procedures but still struggled to understand statistical consistency and apply the interquartile range. Medium-ability students struggled with quartiles and the interquartile range, as well as managing time when solving lengthy contextual problems. Low-ability students faced more fundamental difficulties in interpreting visual representations, understanding statistical concepts, and drawing conclusions from data. Across the three ability levels, interquartile range and statistical consistency emerged as the most common difficulties.

Overall, item 6 on interquartile range and data consistency was the most universal point of difficulty, as no single subject was able to complete it in full. These findings suggest that classroom statistics instruction remains overly oriented toward formula memorization and routine problems, leaving students insufficiently practiced in interpreting data analysis results contextually. Therefore, the results of this analysis can serve as an empirical basis for developing RME based learning materials that explicitly incorporate: (1) real-life contexts relevant to students' daily lives to build meaningful conceptual understanding; (2) visual scaffolding to train students in efficiently reading various forms of data representation; and

(3) regular data-based conclusion-drawing activities to help students become accustomed to connecting analytical results with the given problem context.

This study has several limitations that should be acknowledged. First, the research included only three subjects representing high, medium, and low ability categories from a single school, so the findings cannot be generalized to a broader population of junior high school students. Second, the data collection relied on a single set of six test items and one round of interviews, which may not fully capture the range of difficulties students experience across different statistical topics or over an extended period of instruction. Third, as a qualitative descriptive study, the analysis is inherently interpretive and may be influenced by the researcher's subjectivity, although triangulation between written answers and interview data was employed to strengthen the credibility of the findings.

Future research should involve a larger, more diverse sample across multiple schools to provide a more comprehensive picture of students' learning difficulties in statistics. Further studies could also examine other statistical topics beyond quartiles and interquartile range, and investigate the effectiveness of the RME-based learning materials developed from this study's findings through classroom implementation and quasi-experimental designs. In addition, future research may explore the role of mathematics anxiety in students' reluctance to answer open-ended interpretive questions, as observed in this study.

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