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The Influence of Learning Styles on Mathematical Literacy in Fifth-Grade Students: A Qualitative Study of Unit Measurement

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ABSTRAK

Rendahnya literasi matematika siswa Indonesia menegaskan perlunya strategi pembelajaran yang sesuai dengan karakteristik belajar siswa. Penelitian ini bertujuan menganalisis hubungan gaya belajar dan kemampuan literasi matematika siswa kelas V pada materi pengukuran satuan. Pendekatan deskriptif kualitatif digunakan dengan melibatkan 30 siswa melalui kuesioner gaya belajar, tes literasi matematika, wawancara, dan observasi kelas. Data dianalisis dengan model Miles dan Huberman untuk memastikan validitas dan kedalaman interpretasi. Hasil menunjukkan gaya belajar visual mendominasi (53,3%) dengan nilai rata-rata tertinggi (79,31) dan keunggulan dalam merepresentasikan data. Gaya belajar auditori (13,3%) lebih menonjol dalam penalaran dan komunikasi verbal, sedangkan gaya belajar kinestetik (33,3%) unggul dalam penggunaan alat matematika dan penerapan praktis. Penelitian ini menegaskan pentingnya pembelajaran berdiferensiasi yang menyesuaikan modalitas belajar untuk meningkatkan pemahaman dan kinerja matematika, sekaligus memberikan rekomendasi praktis bagi guru dalam merancang pembelajaran adaptif yang mendukung program Merdeka Belajar.

Kata Kunci: Gaya Belajar; Literasi Matematika; Sekolah Dasar.

ABSTRACT

The low level of mathematical literacy among Indonesian students, highlights the need for teaching strategies tailored to students' learning characteristics. This study aims to analyze the relationship between learning styles and the mathematical literacy skills of fifth-grade students on unit measurement material. A descriptive qualitative approach was employed, involving 30 students through learning style questionnaires, mathematical literacy tests, interviews, and classroom observations. Data were analyzed using the Miles and Huberman model to ensure validity and depth of interpretation. The results show that visual learning styles dominate (53.3%) with the highest average score (79.31) and strengths in data representation. Auditory learning styles (13.3%) are more prominent in reasoning and verbal communication, while kinesthetic learning styles (33.3%) excel in using mathematical tools and practical applications. This study concludes that differentiated instruction that accommodates various learning modalities is crucial for improving mathematical understanding and performance, while providing practical recommendations for teachers to design adaptive learning that supports the Merdeka Belajar program

Keywords: Learning Style; Mathematical Literacy; Elementary School.

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1. INTRODUCTION

Mathematics is a fundamental field of study that plays a crucial role in developing logical, critical, and creative thinking skills from early childhood education. One of the key competencies in current mathematics education is mathematical literacy, which refers to the ability to use mathematical concepts, procedures, facts, and tools to solve problems in real-world contexts (OECD, 2019; Sofyan, Puspitasari, & Maryani, 2025). This form of literacy goes beyond basic arithmetic; it also involves language skills such as reading, understanding, and effectively communicating mathematical information (Cahyani et al., 2023).

The connection between language literacy and mathematical literacy is essential, as understanding mathematical symbols, instructions, and word problems relies heavily on students' ability to comprehend both spoken and written language (Syawahid & Putrawangsa, 2017; Masfufah & Afriansyah, 2022). Language functions not only as a medium of communication but also as a tool to explain concepts, construct arguments, and reason mathematically in an effective manner (Chen, 2023).

Unfortunately, the 2022 PISA assessment revealed a significant decline in the mathematical literacy of Indonesian students compared to 2018, with only 0.1% of students categorized as high performers and 59% falling into the lowest proficiency level (Ozkale & Ozdemir Erdogan, 2022). These findings highlight the need for a more responsive teaching approach that aligns with students' learning needs.

When compared to several ASEAN countries that are also members of PISA, this proves that the mathematical literacy of students in Indonesia is low (Duskri, Afrizal, & Susanti, 2024). This is in line with the research carried out by (Diafatus et al., n.d.; Masfufah & Afriansyah, 2021) that mathematical literacy skills in problem-based learning are also considered to be still low.

One underexplored aspect in improving mathematical literacy is the role of students' learning styles. Learning styles influence how students receive and process information. Adapting teaching methods to match students' learning preferences—whether visual, auditory, or kinesthetic can enhance concept comprehension and mathematical literacy (Fernanda et al., 2024). However, most elementary school teachers still apply uniform teaching methods without considering the individual learning preferences of their students (Edriati et al., 2016; Siregar, Siagian, & Syahlan, 2024).

This study offers a unique contribution compared to previous research by examining the relationship between learning styles and students' mathematical literacy in the topic of unit measurement area closely related to daily life but still commonly found to be challenging (Permatasari & Amir, 2023). Employing a descriptive qualitative approach, this research focuses on how students with different learning styles solve mathematical literacy tasks.

SDN Susukan 04 Pagi was selected as the case study site because it represents the characteristics of urban public elementary schools with diverse student backgrounds. Preliminary observations revealed that many students struggled to understand the context of word problems, formulate them mathematically, and present solutions using appropriate representations. These conditions underscore the urgency of implementing adaptive teaching strategies tailored to students' learning styles in order to enhance their mathematical literacy.

2. METHOD

This study employed a qualitative descriptive design, aiming to explore the relationship between learning styles and students' mathematical literacy abilities in the context of unit measurement topics. The research was conducted at SDN Susukan 04 Pagi in the academic year 2024/2025, involving a total of 30 fifth-grade students.

A purposive sampling technique was used to select the participants, representing a sufficient number to reach data saturation, as recommended in qualitative studies with homogeneous groups (Guest et al., 2017). The sample size was considered adequate for ensuring diverse yet manageable data across the three dominant learning styles (visual, auditory, kinesthetic), while allowing for in-depth exploration.

The research began by compiling learning style instruments. The step taken was to compile a learning style instrument which was adopted from the original version of Chislett & Chapman. The questionnaire is presented in three types of learning styles with 10 statements for visual learning styles, 10 statements for audio learning styles and 10 statements for kinesthetic learning styles. Students must answer statements according to the conditions of each individual. If statement a is in accordance with the condition, then the student will cross "a", if statement b is in accordance with the condition, then the student will cross "b" and vice versa. With the criteria that if the dominant student chooses answer a indicates visual learning style, the choicest b means auditorial learning style, and the choicest c means kinesthetic learning style. If the number of answers a, b and c is found to be the same, then the conclusion used is the type of visual learning style because the absorption of the sense of sight is the greatest, followed by the sense of hearing, followed by the sense of touch, followed by the sense of taste as well as the sense of smell.

Furthermore, a mathematical literacy ability test that has been validated by experts is given to measure the level of students' ability to reason mathematically. The number of question items in the mathematical literacy ability test is 15 questions. The assessment procedure in this test is for description questions with 10 points for each question with complete and correct answers, 5 points for correct but incomplete answers, and 0 points for incorrect answers. Then the score is divided by 15 to get the final score. Description questions with measurement material

per unit quantity which includes mathematical literacy indicators namely communication; mathematics literacy; representation; reasoning and argument; strategies for solving problems; use mathematical symbols, language, and operations; and use of mathematical tools.

After the material assessment process is carried out by the material expert, an analysis is carried out to measure the validity of the mathematical kiteration test questions using a likert scale with the following provisions and formula.

Table 1. Likert Scale Validation Criteria

Score	Criteria
5	Highly Appropiate
4	Appropriate
3	Quite Approppriate
2	Inappropriate
1	Very Unsuitable

The formula is as follows:

$$P = \frac{f}{n} \times 100\%$$

Information:

P = Presentation Validation

F = Total Score Obtained

N = Maximum Score Sum

The data obtained from the validity results is calculated using the Likert Scale, the score assessment is applied as follows.

Table 2. Likert Scale Validation Criteria

Achievement Rate	Grade Point Average
81% - 100%	Very Valid
61% - 80%	Valid
41% - 60%	Quite Valid
21% - 40%	Less Valid
0% - 20%	Invalid

For the qualitative data analysis, the Miles and Huberman model was used, including three stages: data reduction, data display, and conclusion drawing (Sugiyono, 2016).

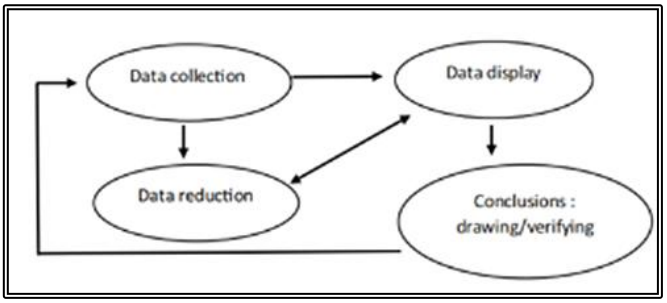


Figure 1. Data Analysis Techniques According to Miles and Huberman

Interview responses were transcribed verbatim and analyzed using thematic analysis. Themes were derived inductively by coding responses line by line, followed by clustering similar codes into categories. Two coders conducted independent coding to ensure inter-rater reliability, and disagreements were resolved through discussion to enhance credibility.

To ensure data triangulation, findings from the learning style questionnaire, mathematical literacy test, and interviews were cross-referenced. Additionally, member checking was conducted with selected students to confirm the accuracy of interpretations and enhance trustworthiness.

3. RESULT AND DISCUSSION

a. Research Findings

The filling out of the learning style questionnaire was held on Monday, May 5, 2025 at SDN Susukan 04 Morning with the number of subjects in one class V, namely 30 children. Based on filling out the learning style questionnaire, Figure 2 shows the results were obtained.

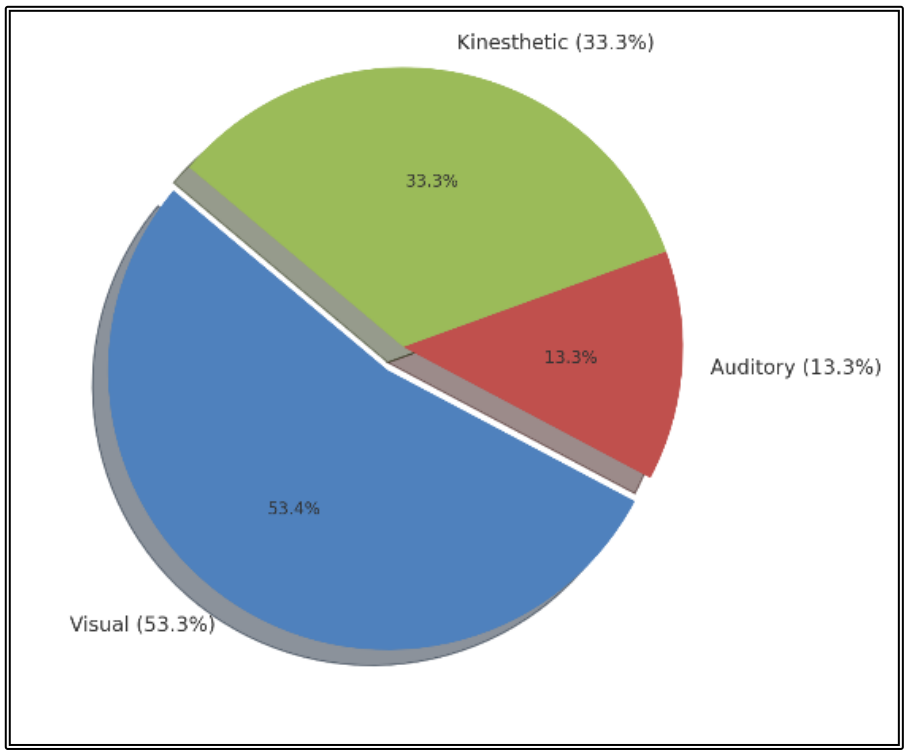


Figure 2. Distribution of Students Learning Styles (n=30) SDN Susukan 04 Pagi

From the results of filling out the questionnaire, it was known that 16 students (53.3%) had a tendency to visual learning style, 4 students (13.3%) had a tendency to audio learning style and 10 students (33.3%) had a tendency to a kinesthetic learning style. Thus, it can be known that the visual teaching style is the learning style that most students in grade V of SDN Susukan 04 Pagi have.

The material is developed and validated by experts. The purpose of this validation is to assess the feasibility of the material and provide recommendations to correct the deficiencies in the material presented. To assess the level of validity of the material produced before it is continued to the filling stage by students, validation activities are carried out by showing learning materials in the form of questions to be used and validation sheets.

Table 3. Result of Material Expert Validation

Score	Validator		
	V1	V2	V3
Overall Total	138		
Total Maximum	165		
Present	83,6%		
Category	Highly Valid		

Instruments were validated by experts in mathematics education, and test items achieved a validity index of 83.6%, categorized as "very valid" based on Likert-scale scoring criteria.

Furthermore, the mathematical literacy test is carried out to assess students' ability to perform mathematical reasoning. Through the implementation of this test, researchers can evaluate the extent to which students have mathematical literacy skills, especially in applying mathematical concepts, facts, tools and symbols to describe, explain, and estimate solutions to given problems. These findings are in line with research conducted by (Tarusu & Makawawa, 2024), the AKM (Minimum Competency Assessment) Test can measure how far students understand math material, apply mathematical logic, and respond to real situations with problem-solving.

From the results of the students' mathematical literacy ability test, it is known that the average score of the test results achieved by class V students with a total of 30 students is 77.97, with details as many as 21 students (70%) getting above average scores and as many as 9 students (30%) getting scores below or equal to the average. The results of mathematical literacy skills are reviewed from the learning styles of grade V students of SDN Susukan 04 Pagi are very diverse and can be seen in the following table.

Table 4. Average Results of the Mathematical Literacy Test Reviewed from Learning Style

Learning Style	Grade Point Average	Standard Deviation	N
Visual	79,31	12,08	16
Audio	77,97	5,03	4
Kinaesthetic	77,97	6,75	10

Based on the data analysis results, it was found that students with a visual learning style achieved an average score of 79.31, while students with kinesthetic and auditory learning styles had equal average scores of 77.97. Students with a visual learning style obtained the highest average mathematical literacy score, although the difference was not statistically significant. However, qualitative findings from interviews indicated a preference for specific learning methods aligned with their respective learning styles.

Table 5. Learning Style Code

Student	Subject Code	Learning Style	Score
Student no. 11	P11	Visual	96
Student no. 13	P13	Kinestheteic	93
Student no. 16	P16	Audio	90

To strengthen the findings and provide deeper context, this study includes direct quotes from participant interviews. the researcher selected 3 students with the highest scores in each learning style as research subjects. The researcher provides a code to each research participant to make it easier to write and protect the anonymity of the students. Their voices not only reflect the data but also bring the narrative behind the numbers to life.

To support the quantitative findings, this study incorporates direct excerpts from interviews with three students who achieved the highest scores in each learning style category. Their responses provide rich, qualitative insights into how learning preferences influence mathematical understanding.

P11, a student with a visual learning style, shared: "I like questions that use pictures or tables. They' re easier for me to understand." This reflects the tendency of visual learners to engage more effectively with visual representations in problem-solving. In line with research (Khan et al., 2024) that students with visual learning styles are superior in the use of formal symbols than students with auditory or kinesthetic learning styles in solving mathematical literacy problems. Visual learners are better able to interpret and use mathematical representations effectively. P13, representing the kinesthetic learning style, remarked: "When I can hold measuring tools or practice directly, I understand more quickly." This highlights the importance of hands-on activities for kinesthetic learners in grasping abstract concepts. Meanwhile, P16, an auditory learner, explained: "I understand better when the teacher explains things slowly and clearly." This emphasizes the value of verbal instruction and auditory processing in facilitating comprehension for students with this learning preference.

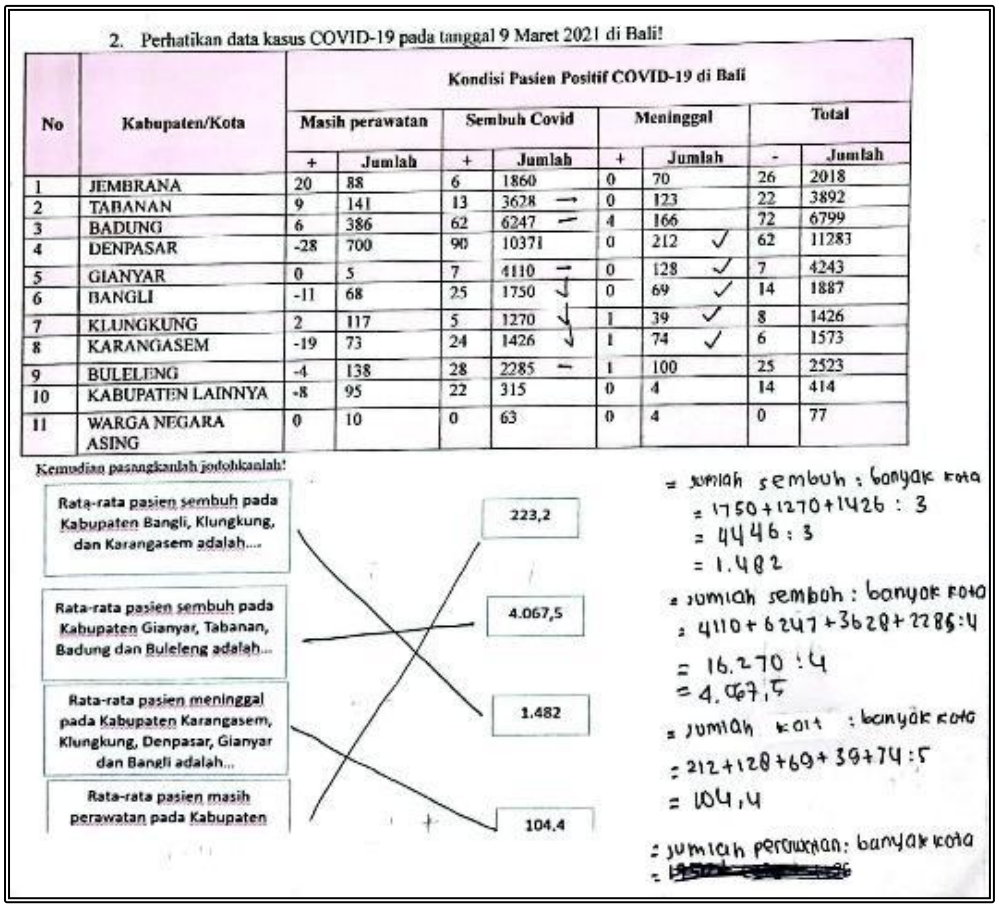
These qualitative insights complement the numerical data, illustrating how learning styles manifest in students' experiences and perceptions, although the mean scores for each

learning style were not statistically significant. However, qualitative findings from the interviews indicated a preference for specific learning methods that aligned with individual learning styles.

b. Discussion

By using data tringulation, namely from data on learning styles, students' literacy abilities, and the results of interviews with students, it is known that there are differences in characteristics in answering mathematics literacy questions.

1) Exposure to Mathematics Literacy Data P1



2. Perhatikan data kasus COVID-19 pada tanggal 9 Maret 2021 di Bali!

No	Kabupaten/Kota	Kondisi Pasien Positif COVID-19 di Bali							
		Masih perawatan		Sembuh Covid		Meninggal		Total	
		+	Jumlah	+	Jumlah	+	Jumlah	-	Jumlah
1	JEMBRANA	20	88	6	1860	0	70	26	2018
2	TABANAN	9	141	13	3628	0	123	22	3892
3	BADUNG	6	386	62	6247	4	166	72	6799
4	DENPASAR	-28	700	90	10371	0	212	62	11283
5	GIANYAR	0	5	7	4110	0	128	7	4243
6	BANGLI	-11	68	25	1750	0	69	14	1887
7	KLUNGKUNG	2	117	5	1270	1	39	8	1426
8	KARANGASEM	-19	73	24	1426	1	74	6	1573
9	BULELENG	-4	138	28	2285	1	100	25	2523
10	KABUPATEN LAINNYA	-8	95	22	315	0	4	14	414
11	WARGA NEGARA ASING	0	10	0	63	0	4	0	77

Kemudian pasangkanlah jodohkanlah!

Rata-rata pasien sembuh pada Kabupaten Bangli, Klungkung, dan Karangasem adalah....

Rata-rata pasien sembuh pada Kabupaten Gianyar, Tabanan, Badung dan Buleleng adalah...

Rata-rata pasien meninggal pada Kabupaten Karangasem, Klungkung, Denpasar, Gianyar dan Bangli adalah...

Rata-rata pasien masih perawatan pada Kabupaten

223,2

4.067,5

1.482

104.4

= jumlah sembuh : banyak kota
= 1750+1270+1426 : 3
= 4446 : 3
= 1.482

= jumlah sembuh : banyak kota
= 4110+6247+3628+2285:4
= 16.270 :4
= 4.067,5

= jumlah kota : banyak kota
= 212+128+69+39+74:5
= 104,4

= jumlah perawatan: banyak kota

Figure 3. P11 Subject Test Results

In line with the researcher (Yatsky, 2020), using images, posters, and other visual tools is very helpful for visual students to understand and absorb information. This explanation is in line with the results of interviews and literacy tests on question no2. Students with visual learning styles do not have difficulty translating questions in the form of pictures. Presented with data in the form of a table, students are able to represent the data presented correctly from the table and then calculate it for the final result (Utami & Masduki, 2023). After that, students are able to match the final results of their calculations into the problem correctly and logically. From the results of the test and interview, this P11 subject will consider

everything he decides in solving the problem. The results of the interview also mentioned that students with this visual learning style always double-check the answers they answered, this indicates that the P11 subject is very structured in working on problems and solving problems. Thus it will be possible to create better problem-solving skills in mathematics. This P11 subject is also able to meet the criteria of almost all mathematical literacy indicators well. It's just that in the question that requires explanation, the P11 subject has difficulty choosing the right word to pour into the answer.

2) Exposure to Mathematics Literacy Data P13

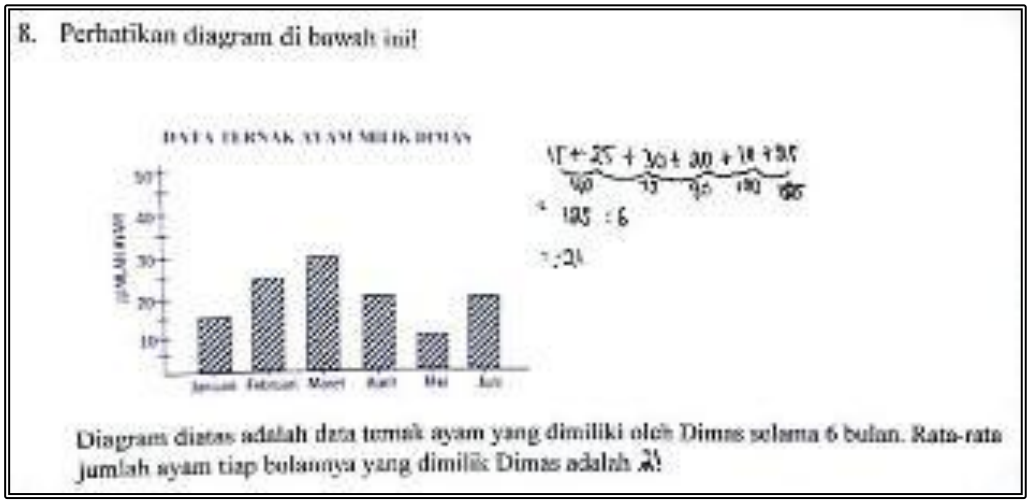
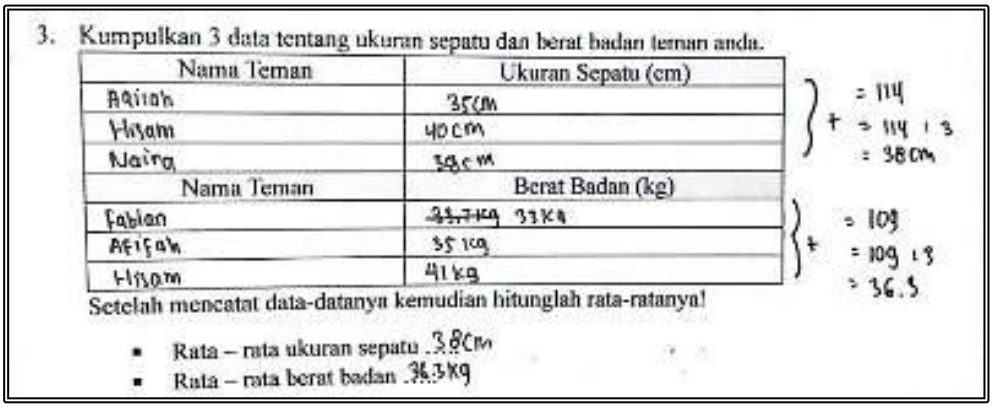


Figure 4. P13 Subject Test Results

The results of the researcher's interviews with audio learning style students obtained the fact that students had difficulty in visualizing the data from the shape of the image or bar diagram. The answers given by students are in line with the results of their mathematical literacy ability test in question no. 8. Presented with data in the form of diagrams, students still have difficulty representing the data so it is still not appropriate to answer it. (Astini Ni & Rini Purwati, 2020) that learners with an audio learning style prefer learning with group discussions, verbal Q&A, and verbal teacher explanations can increase auditory student engagement and help them understand abstract concepts in mathematics. This is in line with the results of tests and interviews, students with this learning style are able to answer and string words without experiencing difficulties in questions that require oral explanation. This also happens in the question-and-answer process during interviews, this P13 subject show' s active ability when answering interview questions. For the provisions in the mathematics literacy indicator, students with this visual learning style are enough to achieve it. Although it is still difficult in several indicators, it is very superior in the ability to reason and give reasons.

3) Exposure to Mathematics Literacy Data P16


3. Kumpulkan 3 data tentang ukuran sepatu dan berat badan teman anda.

Nama Teman	Ukuran Sepatu (cm)
Aqilah	35cm
Hisam	40cm
Naing	38cm
Nama Teman	Berat Badan (kg)
Fabian	~~33,7kg~~ 33kg
Afifah	35 kg
Hisam	41 kg

= 114
÷ = 114 : 3
= 38cm

= 109
= 109 : 3
= 36,3

Setelah mencatat data-datanya kemudian hitunglah rata-ratanya!

- Rata – rata ukuran sepatu : 38cm
- Rata – rata berat badan : 36,3kg

Figure 5. P16 Subject Test Results

Students with kinesthetic learning styles love learning with the use of concrete tools and hand activities such as foldables, manipulating objects, or physically arranging numbers help kinesthetic students understand math concepts better, while increasing their confidence and engagement (Sylvestri & Arlt, 2023). This is in line with the results of tests and interviews where the subject of P16 likes to learn using concrete tools, namely measuring the height and size of the shoes of their peers as in the question in no.3. Not only that, students with kinesthetic learning styles show active behavior during the implementation of this literacy ability test activity, precisely like in question no. 3. Based on the results of the interview, it was also explained that students with kinesthetic learning styles admitted that they felt bored and bored during mathematics learning activities that were only fixated on monotonous activities. Students expressed that they prefer learning activities that involve physical activities such as physical movements. Students in this learning style are quite good and are able to answer questions using mathematical literacy indicators. And of course, students with this kinesthetic learning style are very superior in the use of mathematical tools (Journals et al., 2024)

This study demonstrates that differences in students' mathematical literacy are associated with their preferred learning styles, aligning with prior research indicating that instructional approaches tailored to VAK (Visual, Auditory, Kinesthetic) modalities can improve engagement and comprehension in mathematics (Cuevas, 2015). Visual learners excelled in representing and interpreting data, auditory learners demonstrated strengths in verbal reasoning, and kinesthetic learners showed proficiency when applying mathematical tools and hands-on activities. These findings contribute to advancing VAK theory by providing empirical evidence in the specific context of mathematical literacy on unit measurement among Indonesian primary school students, an area that remains underexplored.

However, several limitations must be acknowledged. First, the sample size of only 30 fifth-grade students from a single school limits the statistical power and diversity of findings. A larger and more heterogeneous sample is needed to verify whether these patterns hold across different grade levels, schools, and socio-cultural backgrounds. Second, the measurement of learning styles relied on self-reported questionnaires, which are susceptible to response biases and may not fully capture the dynamic and context-dependent nature of students' learning preferences (Cuevas, 2015). Future studies could incorporate mixed methods, including behavioral observations and teacher assessments, to improve validity.

Third, the findings' generalizability is constrained, as they may not reflect the experiences of all elementary students in Indonesia or in other educational systems. Replication in diverse contexts and with longitudinal designs would provide stronger evidence of the stability and predictive value of learning styles in mathematical literacy development.

Despite these limitations, this research enriches VAK theory by illustrating how differentiated learning strategies can foster mathematical literacy in measurement topics, potentially offering practical implications for designing inclusive and engaging math instruction. By emphasizing the interplay between learning styles and mathematical literacy, this study encourages educators to implement flexible teaching methods such as visual aids, collaborative discussions, and hands-on activities that accommodate diverse learner profiles.

4. CONCLUSION

The research findings indicate that 70% of fifth-grade students at SDN Susukan 04 Pagi scored above average on the mathematical literacy test covering unit measurement material. Visual learners dominated (53.3%) and excelled in representing data through tables and mathematical symbols. Auditory learners (13.3%) stood out in verbal reasoning and communication, while kinesthetic learners (33.3%) demonstrated the best performance when using mathematical tools and engaging in hands-on activities. These findings highlight the importance of differentiated instructional approaches that align with students' learning preferences and can enhance their overall understanding of mathematical concepts.

The ability of students in this learning style is clearly seen from their success in working on problems on literacy indicators, namely students are able to represent a mathematical object and situation through the activity of choosing, interpreting and using various forms of representation in the form of tables. This is clearly seen in the results of the literacy test, students with visual learning styles are better at solving difficulties in representing an object. In line with (Khaerun Nisa & Zaenal, 2023) research, it was concluded that students with a visual learning style have high mathematical representation abilities, while students with an auditory and kinesthetic style are mostly in the moderate category.

However, to ensure these results have a broader impact, longitudinal research is needed to examine the consistency of the influence of learning styles on mathematical literacy over time. Additionally, intervention studies based on differentiated instruction should be conducted to assess the effectiveness of teaching strategies that utilize visual, auditory, and kinesthetic modalities within the context of primary school mathematics education in Indonesia. This approach is in line with the "Merdeka Belajar" (Freedom to Learn) initiative launched by the Ministry of Education, Culture, Research, and Technology, which promotes adaptive, student-centered learning and aims to strengthen literacy and numeracy skills to meet the challenges of the 21st century (Kemendikbudristek, 2022).

Practically, the findings of this study support teachers' efforts to employ a variety of media and methods—such as visual aids, group discussions, and hands-on activities—to bridge gaps in mathematical literacy skills among students with different learning styles. Implementing such flexible teaching strategies is expected to contribute to achieving Indonesia's national education goals, particularly improving the country's PISA mathematics performance.

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