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Profiles of Students' Numeracy Literacy Based on Wholist-Analytic Cognitive Styles: Implications for Differentiated Learning Strategies

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ABSTRACT

Numeracy literacy is a vital 21st-century competency, yet Indonesian high school students often underperform, especially in data interpretation and contextual reasoning. Individual differences, such as cognitive styles, may influence students' approaches to numeracy tasks. This study explores how Wholist–Analytic cognitive styles relate to students' numeracy literacy and examines the implications for differentiated instruction. This qualitative phenomenological study involved 12 tenth-grade students purposively selected from two public high schools representing different achievement categories. Students were categorized into Wholist or Analytic cognitive styles using the Matching Figure Test and Embedded Figure Test. Each group included students with high, medium, and low numeracy abilities. Data were collected through cognitive style assessments, numeracy literacy tests, interviews, and observations. Analysis was conducted using triangulation and NVivo 12 Plus software. Wholist students demonstrated strengths in understanding global contexts but often overlooked numerical precision, especially among lower-achieving students. In contrast, Analytic students applied systematic problem-solving strategies but struggled to connect results with contextual meaning. High-achieving students in both groups successfully integrated their cognitive tendencies with strong numeracy skills, while lower-achieving students exhibited consistent challenges regardless of style. The findings suggest that cognitive style alone does not determine numeracy success; rather, its interaction with skill level is critical. Differentiated learning strategies—such as problem-based learning, visual scaffolding, and technology integration—can address these differences. Educators should tailor instruction to students' cognitive profiles to enhance numeracy outcomes.

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1. INTRODUCTION

The development of information technology in the 21st century increasingly demands critical, logical, and data-driven thinking skills. This condition makes numeracy literacy one of the essential competencies that students must possess (Muslimah & Ladyawati, 2023; Rachmawati, Lestari, Oktavianingtyas, Trapsilasiwi, & Murtikusuma, 2024). Numeracy literacy goes beyond just arithmetic skills; it also involves applying mathematical concepts in real-life contexts to support reasoning and decision-making (Amelia, Syamsuri, & Novaliyosi, 2020). However, despite a slight improvement in PISA 2022, the numeracy literacy achievement of Indonesian high school students is still below international standards, especially in the application and reasoning indicators (Kemendikbudristek, 2023; Nabilah, Pujiastuti, & Syamsuri, 2023; OCDE, 2023).

Several previous studies have highlighted various challenges faced by students. Son, Talan, Mone, & Jelahu (2023) reported that the numeracy skills of junior high school students tend to decline in the reasoning and communication indicators. Ashri & Pujiastuti (2021) found that many students struggled to interpret numerical word problems, while Utomo, Faruq, Pujiastuti, & Mutaqin (2020) emphasized the influence of cognitive style on mathematical literacy achievement. Riding (2010) and Smith (2002) highlight the Wholist-Analytic cognitive style dimension, which refers to the tendency of Wholist students to process information globally, while Analytic students do so step-by-step, impacting different problem-solving strategies.

In this context, differentiated learning can be implemented as a solution, since it allows teachers to adapt materials and activities based on students' cognitive styles and individual learning needs. The implementation of differentiated learning can be supported by the use of technology to provide various choices of activities and materials suited to students' cognitive styles (Yahya, Erma Suryani, Hermansyah, & Nurhairunnisah, 2024). Furthermore, differentiated learning has been shown to improve learning outcomes, particularly for learners with different cognitive preferences (Priyambudi, 2024).

Although research on numeracy literacy and cognitive styles has been conducted, most of it still focuses on junior high school students or on cognitive style dimensions other than Wholist-Analytic. Studies that explicitly examine the relationship between Wholist-Analytic cognitive style and numeracy literacy skills at the high school level are still very limited. In fact, high school is an important phase in students' transition toward more complex reasoning and decision-making demands.

Based on this gap, this study aims to describe the numeracy literacy skills profile of high school students based on the Wholist-Analytic cognitive style and to identify the implications of implementing differentiated learning that can support the development of these skills.

2. METHODS

2.1. Research Design

This qualitative research uses a phenomenological approach as its methodology, with the focus on uncovering the nature of a phenomenon. According to Tumangkeng & Maramis (2022), phenomenology is used as a qualitative approach that explores human subjective experiences by tracing the hidden meaning behind events directly experienced by individuals. The research design was conducted in four operational stages: (1) preparation stage; (2) implementation stage; (3) data analysis stage; and (4) report writing stage.

2.2. Participants

The research was conducted at two public high schools in Serang Regency, Banten Province, which are pilot schools. The location was chosen based on the numeracy achievement category in the 2024 Education Report, namely School A with a good category and School B with an average category. The research subjects are 10th-grade students from the 2024/2025 academic year, selected using the purposive sampling technique. A total of six students from each school were selected based on a combination of three numeracy literacy ability categories (high, medium, and low), as shown in Table 1, and two cognitive style types (wholist and analytic).

Table 1. Categories of student's numeracy literacy skills

No	Interval	Category
1	≥ 70	High
2	41–70	Medium
3	≤ 40	Low

2.3. Instruments

This research uses three main instruments: a numeracy literacy ability test, a wholist-analytic cognitive style test, and a semi-structured interview guide. The numeracy literacy tests are presented in the form of essay questions on statistical material with three main indicators: the ability to understand the context of the problem, to identify and use numerical information, and to construct reasoning to solve problems mathematically (Liswati, Yuniarti, & Sakinah, 2021). Out of the 11 questions tested, 9 were declared valid and used in the study. The wholist-analytic cognitive style test consists of two subtests: the Matching Figure Test (MFT), which has 15 items and is adapted from Riding (Peterson, Deary, & Austin, 2005), and the Embedded Figure Test (EFT), which also has 15 items and is adapted from Witkin (1950). These two instruments have been validated by psychologists and tested on students to ensure their clarity and reliability.

Cognitive style classification is based on students' performance on both tests. In the MFT, students who are quick and accurate in recognizing global image similarities are categorized as wholists, while in the EFT, students who can quickly and accurately find simple images hidden within complex images are classified as analytic (Davies & Graff, 2006; R. Riding & Sadler Smith, 1992). The assessment considers not only the accuracy of the answers, but also the speed of response, as this reflects students' tendency to process information holistically or in detail. Semi-structured interviews were used as a supplement to delve deeper into students' thinking strategies and the reasons behind their answers, thus providing a comprehensive understanding of the relationship between wholist-analytic cognitive style and students' numeracy literacy abilities.

The Wholist–Analytic cognitive style classification in this study was determined using a combination of Matching Figure Test (MFT) and Embedded Figure Test (EFT) scores. The two tests were not standalone tests but were analyzed in an integrated manner to ensure consistent student thinking style tendencies. The MFT was used to measure students' ability to quickly and accurately identify similar shapes. High scores indicate wholist tendencies because students tend to see similarities in shapes as a whole. The EFT measures the ability to find simple shapes hidden in complex images. High scores indicate analytic tendencies because students are able to process details with focus. The final classification was made by comparing the two scores: if a student excelled on the MFT, they were categorized as wholist; if they excelled on the EFT, they were categorized as analytic. For cases with relatively equal scores, a brief interview regarding the students' understanding of information was used for additional verification.

2.4. Data Collection

In the preparation stage, the researcher developed and validated the instrument, conducted readability tests, and determined the research subjects. The implementation phase includes administering cognitive style tests, numeracy literacy tests, and semi-structured interviews. The analysis phase is conducted through data triangulation, while the final phase involves compiling the research results report.

2.5. Data Analysis

The entire interview process in this study was recorded and analyzed using NVivo 12 Plus software to support data validity. Visual documentation and field notes also complement the observation results to enrich the data. The analysis was conducted inductively and interactively based on the Miles and Huberman model, which includes data reduction, data presentation, and drawing conclusions (Fadli, 2021). The coding process is carried out by organizing interview, observation, and documentation data into categories, explaining important elements, and connecting nodes through the project maps feature. This feature facilitates the exploration of ideas, the identification of key themes, and the mapping of relationships between coding results and cases, while minimizing the potential for errors in manual analysis (Maher, Hadfield, Hutchings, & de Eyto, 2018).

2.6. Data Validity Test

Data validity is maintained through credibility, transferability, dependability, and confirmability tests. Credibility is achieved through source, method, and time triangulation, and is supported by participant review. Transferability is ensured by providing detailed contextual descriptions, while dependability is maintained through research audits conducted by the supervisor. Confirmability is achieved through reflection on the results and external confirmation from academic sources. Thus, NVivo not only serves as an aid for managing, coding, and visualizing qualitative data, but also strengthens the systematic nature and accountability of the analysis conducted by researchers.

3. FINDINGS AND DISCUSSION

3.1. Findings

From a total of 80 initial students (40 students in School A and 40 students in School B), the following distribution of cognitive styles was obtained:

a. Wholist: 43 students (53.8%)
b. Analytic: 37 students (46.2%)

This distribution indicates that the wholist thinking style is slightly more dominant in the high school student population studied. The selection of 12 research subjects (6 wholist and 6 analytic) proportionally represented both groups based on numeracy literacy skills (high, medium, low).

Based on the results of the embedded figure and matching figure cognitive style tests administered to 40 tenth-grade students from each school, the results shown in Figure 1 were obtained.

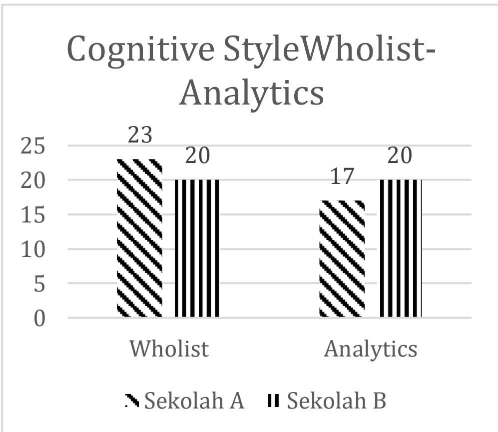


Figure 1. Distribution of students based on cognitive style in two schools.

Numeracy literacy tests were also administered to 40 students from each school. Next, 6 subjects from each cognitive style were selected for in-depth analysis through interviews and cognitive strategy mapping. Table 2 shows the data of research subjects selected from School A and School B.

Table 2. Demographic data of research subjects

School	Subject Code	Literacy Numeracy Ability	Cognitive Style Type
A	A-W1	High	Wholist
	A-W2	Medium	Wholist
	A-W3	Low	Wholist
	A-A1	High	Analytic
	A-A2	Medium	Analytic
	A-A3	Low	Analytic
B	B-W1	High	Wholist
	B-W2	Medium	Wholist
	B-W3	Low	Wholist
	B-A1	High	Analytic
	B-A2	Medium	Analytic
	B-A3	Low	Analytic

The study identified clear differences in numeracy literacy abilities between Wholist and Analytic cognitive styles across varying achievement levels. Three major themes emerged from the analysis:

3.1.1. Global Context Understanding in Wholist Learners

After analyzing the results of the students' numeracy literacy skills tests, the following results were obtained, as shown in Figure 2:

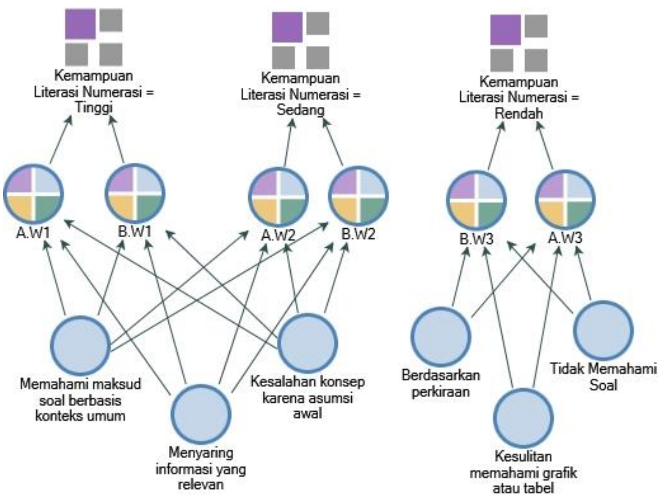
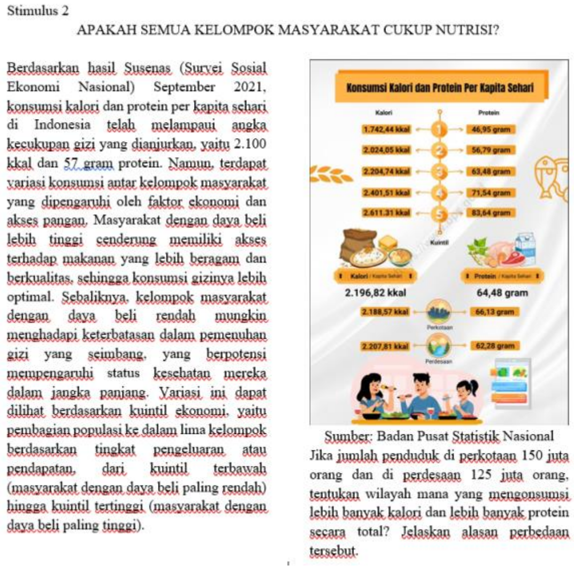


Figure 2. Project Maps – Numeracy Literacy Skills of the Wholist Subject

Based on the analysis of project maps from NVivo 12 Pro, Wholist students show the distribution of their numeracy literacy skills based on high, medium, and low levels. The key characteristic of Wholists, which is their tendency to understand the overall context before delving into technical details, is strongly reflected in strategies such as understanding questions based on general context, reading more than once, making estimations, not understanding the question, and misconceptions due to initial assumptions. This pattern aligns with the quote from B.W2: "First, I wanted to know what the story was about. Then I focused on the questions, "which reflects a global approach before delving into the calculation details.

Figure 3 is a numeracy literacy question related to the indicator of interpreting analysis results for prediction and decision-making, where, based on the stimulus and infographics, students are asked to compare which region consumes more calories and protein given the population size.


Stimulus 2

APAKAH SEMUA KELOMPOK MASYARAKAT CUKUP NUTRISI?

Berdasarkan hasil Susenas (Survei Sosial Ekonomi Nasional) September 2021, konsumsi kalori dan protein per kapita sehari di Indonesia telah melampaui angka kecukupan gizi yang dianjurkan, yaitu 2.100 kkal dan 57 gram protein. Namun, terdapat variasi konsumsi antar kelompok masyarakat yang dipengaruhi oleh faktor ekonomi dan akses pangan. Masyarakat dengan daya beli lebih tinggi cenderung memiliki akses terhadap makanan yang lebih beragam dan berkualitas, sehingga konsumsi gizinya lebih optimal. Sebaliknya, kelompok masyarakat dengan daya beli rendah mungkin menghadapi keterbatasan dalam pemenuhan gizi yang seimbang, yang berpotensi mempengaruhi status kesehatan mereka dalam jangka panjang. Variasi ini dapat dilihat berdasarkan kuintil ekonomi, yaitu pembagian populasi ke dalam lima kelompok berdasarkan tingkat pengeluaran atau pendapatan, dari kuintil terbawah (masyarakat dengan daya beli paling rendah) hingga kuintil tertinggi (masyarakat dengan daya beli paling tinggi).

Sumber: Badan Pusat Statistik Nasional

Jika jumlah penduduk di perkotaan 150 juta orang dan di perdesaan 125 juta orang, tentukan wilayah mana yang mengonsumsi lebih banyak kalori dan lebih banyak protein secara total? Jelaskan alasan perbedaan tersebut.

Figure 3. Numeracy Literacy Question

Subjects like A.W1 (wholist style, high ability from school A) provide direct answers to the core issue without first performing numerical calculations, as seen in Figure 4. Although their answers didn't explicitly include data, the direction of their arguments was consistent with the context of the question.

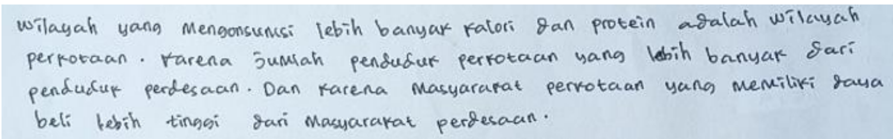


Figure 4. Subject A.W1's answer

This indicates that this student relies on a global and narrative understanding of the reading. A.W1 said, "In my opinion, what's important is who has better access to food. Of course, those who have more access will have more nutrition; you don't even need to count, it's obvious." Similar to the answer from B.W1 (wholist style, high ability from school B) in the following figure 5:

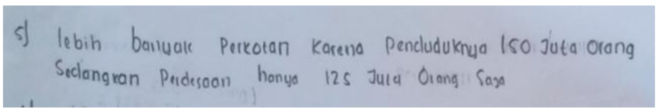


Figure 5. Subject B.W1's answer

This reflects the Wholist style's tendency to assess from the big picture and social context without getting bogged down in details. Unlike A.W1, student B.W2 (wholist style, moderate ability) attempted to calculate calorie consumption in an urban area, but the results of their calculation were incorrect, as shown in Figure 6.

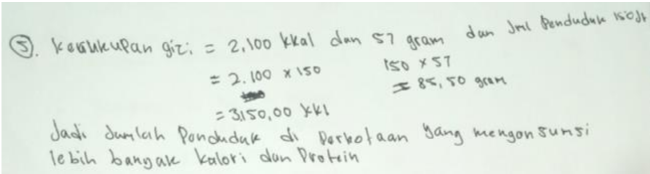


Figure 6. Subject B.W2's Response

Nevertheless, the effort to calculate indicates an awareness of using data, although not yet supported by the correct numerical strategy. He stated, "*I calculated the city first, 150 million times 2,100, and then I compared... but I was also confused when I saw the protein.*" Meanwhile, in Figure 7, subjects A.W3 and B.W3 (wholist style, low ability) provided incorrect answers without logical reasoning.

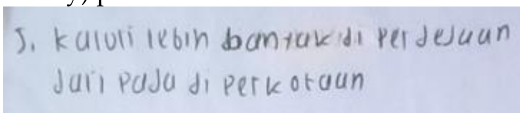


Figure 7. Subject A.W3's answer

They answered directly without elaboration or a strong basis for their arguments. A.W3 said, "Yes, maybe there are more villages because people are stronger physically, so they eat a lot too." This statement indicates that the student is relying on personal assumptions or intuition rather than data information from the stimulus.

Table 3 shows the results of the analysis of six Wholist subjects, indicating that students with high ability (A.W1, B.W1) successfully met all three numeracy literacy indicators: calculation application, visual understanding, and drawing conclusions. They demonstrate a systematic and reflective strategy. Students with average ability (A.W2, B.W2) also met the indicators, although they sometimes fell into incorrect assumptions. Conversely, students with low ability (A.W3, B.W3) failed to meet the indicators because they tended to guess and avoid questions. This indicates that without strong numeracy skills support, a global thinking style becomes ineffective in solving numeracy problems.

Table 3. Achievement of Wholist Subjects

Subject Code	Ability	Indicator		
		1	2	3
A.W1	High	✓	✓	✓
B.W1	High	✓	✓	✓
A.W2	Medium	✓	✓	✓
B.W2	Medium	✓	✓	✓
A.W3	Low	—	—	—
B.W3	Low	—	—	—

3.1.2. Systematic Problem-Solving in Analytic Learners

Unlike subjects with a wholist style, subjects with an analytic cognitive style exhibit a thinking pattern characterized by systematic, logical, and structured processes in solving numeracy literacy problems, as illustrated in Figure 8, which is the result of NVivo 12 Pro data processing.

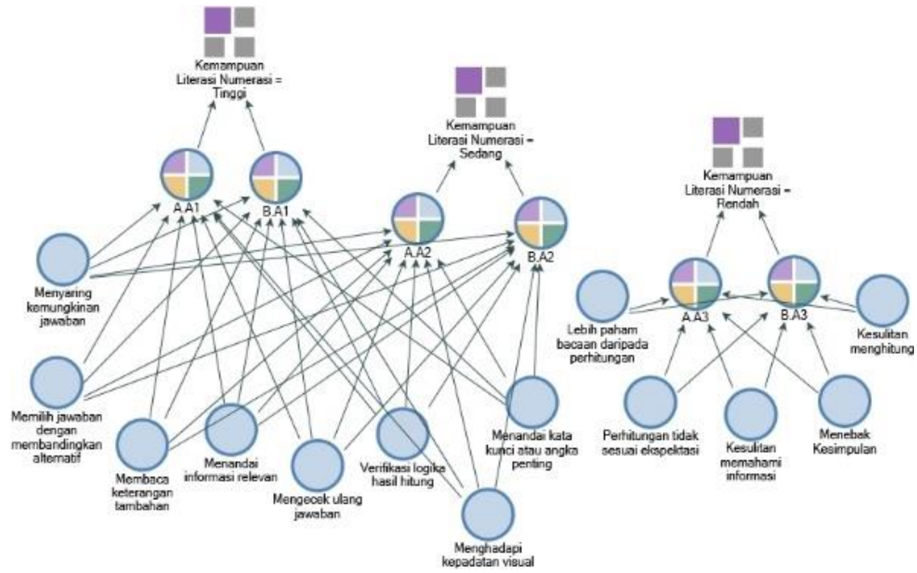


Figure 8. Project Maps – Numeracy Literacy Skills of Subject Analytic

High-ability subjects (A.A1 and B.A1) appeared dominant in seven main cognitive strategies, namely, filtering possible answers, selecting answers based on comparing alternatives, reading additional information, highlighting relevant information, double-checking answers, and verifying the logic of calculation results.

In Figure 9, for example, student B.A1 demonstrates a very detailed mathematical working process. He highlighted important words like "calories per capita" and "population size," then multiplied those values and compared them across groups.

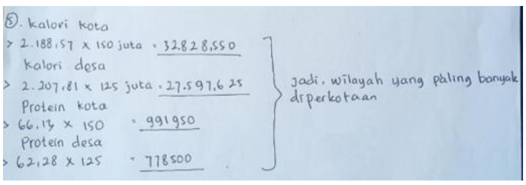


Figure 9. Subject B.A1's answer

Meanwhile, students A.A2 and B.A2, who are classified as having moderate abilities, also demonstrated many similar strategies, although with less accurate final results. For example, A.A2 showed maturity in reading additional information, but calculation errors occurred due to inaccurate interpretation of numbers, as seen in Figure 10. He said, "I thought the 2,100 was for everyone, not per capita, so the total might be wrong. But I've already tried to calculate all the data.

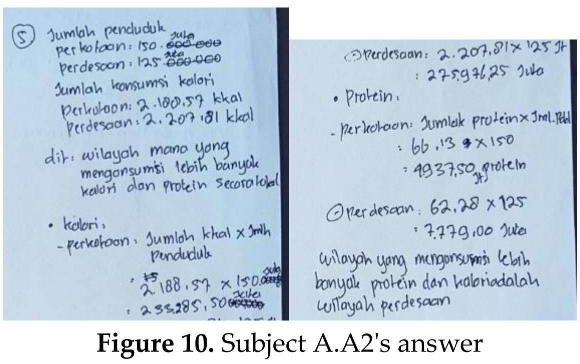


Figure 10. Subject A.A2's answer

Figure 11 also shows that analytic subjects with moderate numeracy literacy skills at school B exhibited challenges when faced with visual density in the stimulus, finding the information overwhelming or confusing if not managed well.

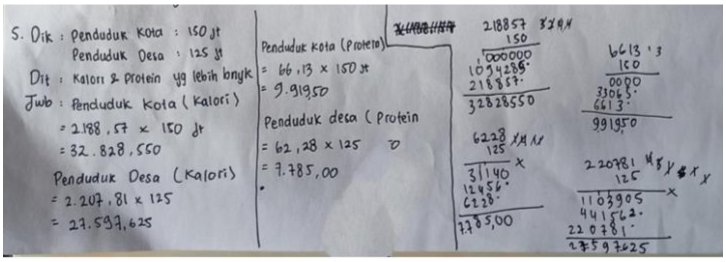


Figure 11. Subject B.A2's answer

Students with low abilities (A.A3 and B.A3) tend to demonstrate more limited strategy use. They are better at understanding the general content of reading material but struggle with constructing mathematical logic. For example, in line with answer B.A3 in Figure 12, the subject also mentioned, "I understand the question, but I get confused when I start calculating. So I'm just guessing the final result".

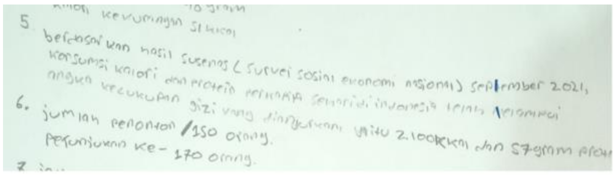


Figure 12. Subject B.A3's answer

Tendencies such as calculations not meeting expectations, difficulty understanding information, and guessing conclusions are common patterns among subjects in this group. This indicates that although analytic students tend to think in detail, without good numerical proficiency and visual understanding, these strategies cannot be executed optimally.

Table 4 shows that high-ability analytic students achieved all numeracy indicators: contextual calculation, graph interpretation, and logical conclusion. They are able to verify answers and selectively choose information. The student is demonstrating a similar strategy but with less depth and confidence. Meanwhile, students with low abilities have not yet demonstrated achievement of the indicators due to difficulties in executing calculations and connecting narratives with numbers.

Table 4. Achievement of Analytic Subjects

Subject Code	Ability	Indicator		
		1	2	3
A.A1	High	✓	✓	✓
B.A1	High	✓	✓	✓
A.A2	Medium	✓	✓	✓
B.A2	Medium	✓	✓	✓
A.A3	Low	–	–	–
B.A3	Low	–	–	–

3.1.3. Challenges Across Ability Levels

In the high-ability category, Wholist students tend to understand the context of the problem thoroughly first. They see the big picture and can identify the relationships between parts of the narrative before starting numerical calculations. Conversely, analytic students demonstrate a more structured approach, breaking down problems into smaller parts, connecting data to context, and ultimately constructing logical solutions and conclusions. Both are effective, but with different lines of thinking.

At the intermediate skill level, these strategic differences begin to reveal their respective challenges. Wholist students still understand the general context of a problem but sometimes overlook important numerical details, which can lead to less accurate answers. Meanwhile, analytic students are able to perform calculation procedures systematically but often struggle when they need to relate calculation results to a narrative context or when asked to draw conclusions from implicit information.

In the low-ability category, the weaknesses of each style become more apparent. Wholist students only grasp the general idea without being able to detail the necessary mathematical steps, thus failing to draw numerical conclusions correctly. Conversely, analytic students get bogged down in numerical details and procedures, losing sight of the overall meaning of the problem. They tend to fail to synthesize information into a complete and contextual conclusion.

Table 5. Numeracy Literacy Ability Profile Based on Wholist and Analytic Cognitive Styles

Numeracy Literacy	Wholist	Analytic
High	Able to understand the problem context holistically before processing numerical data	Able to break down the problem systematically, connect data to the context and construct logical solutions and conclusions
Medium	Understands the problem context, but sometimes frequently misses important numerical details	Able to follow calculation procedures but struggles to connect results to the context or draw implicit information
Low	Focuses on the overall picture without being able to construct mathematical solutions or draw correct numerical conclusions	Focuses on numerical details but fails to construct overall meaning or draw appropriate numerical conclusions

Thus, Table 5 shows that both the Wholist and Analytic styles have their respective strengths and challenges in the context of numeracy literacy. The ideal learning approach in the context of numeracy literacy must be able to balance between two dominant thinking styles: Wholist and Analytic. The Wholist style is characterized by a tendency to understand the big picture and the overall narrative context before delving into technical or numerical aspects. Conversely, the analytical style is more focused on processing information in a structured and logical manner, step by step. Both of these styles are equally important, and therefore, effective learning needs to harmoniously combine the two.

3.2. Discussion

High-achieving students demonstrated that cognitive style can be an asset when supported by strong numeracy skills. Wholist learners were able to grasp the overall context of problems and derive logical conclusions, even if they did not always present detailed calculations. Meanwhile, Analytic learners highlighted key information, followed systematic procedures, and verified results accurately. These findings support Utomo, Faruq, Pujiastuti, & Mutaqin (2020), who emphasized that cognitive style significantly influences students' mathematical literacy performance. They are also consistent with Syafina & Pujiastuti (2020), who showed that students with analytic tendencies exhibit stronger mathematical communication skills, and with Gumalangit & Achmad (2023) who linked cognitive style to students' mathematical creativity.

Medium-ability students displayed distinctive limitations depending on their cognitive style. Wholist learners understood the global context but often neglected critical numerical details, resulting in inaccurate answers. In contrast, Analytic learners followed procedures systematically but failed to connect the results to the contextual meaning of the problem. This resonates with Susandi, Sa'dijah, As'ari, & Susiswo, (2019), who found that students' critical mathematical thinking varies by cognitive style, especially in logical reasoning. It also echoes Zohar & Peled (2008), who argued that without metacognitive regulation, students often miss essential connections. These tendencies are also reflected in cognitive psychology findings: only Analytic individuals demonstrate object-based attentional effects, whereas Wholist individuals tend to integrate objects into a single gestalt (Hu, Liu, Wang, & Zhao, 2020).

In low-achieving groups, weaknesses were more pronounced. Wholist learners tended to guess answers based on intuition or assumptions without processing numerical data, while Analytic learners became stuck in calculation details without reaching comprehensive conclusions. This highlights how limited numeracy skills constrain the effectiveness of both cognitive styles. Similar concerns are raised by Nabilah, Pujiastuti, & Syamsuri (2023) in their systematic literature review, which revealed persistent weaknesses in Indonesian students' numeracy literacy.

These findings reinforce Riding (2010) cognitive style theory, which distinguishes Wholist (big-picture) from Analytic (step-by-step detail) processing. From a developmental perspective, Wholist tendencies reflect the Piagetian transition from concrete to formal operations, while Analytic strategies align with the formal operational stage and the deductive stage of Van Hiele's model. Local studies also support this perspective: Utomo, Faruq, Pujiastuti, & Mutaqin (2020) and Gumalangit & Achmad (2023) both highlight the interaction between cognitive style and mathematical performance. However, both Wholist and Analytic learners also reveal limitations consistent with Zohar & Peled (2008): without effective metacognitive regulation, students struggle to connect context and procedures.

The findings of this study confirm the importance of implementing differentiated instruction that considers students' cognitive styles. One relevant model is Problem-Based Learning (PBL), as it provides an open yet systematic framework that can accommodate both Wholist and Analytic learners (Djadir, Upu, & Sulfianti, 2018; Hermansyah, Pujiastuti, & Fathurrohman, 2024; Imaroh, Cahyani, & Anggito, 2025). For Wholist students, PBL is effective if it begins with a global context in the form of a macro scenario or real-world problem to strengthen conceptual understanding (Mohamed, Tasir, & Aris, 2014). Conversely, Analytic students require more explicit guidance thru step-by-step explanations, scaffolding-based worksheets, and tasks that emphasize logical reasoning (Akmalia, Pujiastuti, & Setiani, 2016; Hayati, Pratiwi, Hasan, & Pujiastuti, 2024)

Besides instructional strategies, the integration of digital media also plays a crucial role in supporting numeracy literacy. Digital tools such as concept maps, e-books, narrative videos, and numerical simulations have been shown to enhance students' comprehension. Wholist learners tend to benefit more from narrative and visual contexts, whereas Analytic learners gain greater advantage from repeated exploration features and systematic structures (Atasoy & Konyalıhatipoğlu, 2019; Pujiastuti & Haryadi, 2023; Hasibah, Sama, & Jamilah, 2025). In this regard, technology serves as an effective means of differentiated learning by allowing teachers to tailor instruction to students' cognitive styles, thereby making the learning process more optimal (Yahya, Erma Suryani, Hermansyah, & Nurhairunnisah, 2024).

In conclusion, differentiated learning provides a comprehensive pathway for supporting elementary students' diverse cognitive styles and academic needs. By aligning Wholist-Analytic tendencies with contextual and procedural tasks, teachers can maximize students' numeracy development while fostering collaboration between learners with different strengths. At the same time, by tailoring instruction to students' needs and interests, differentiated activities also significantly enhance literacy skills, creating a more meaningful and engaging learning environment (Pitta-Pantazi & Christou, 2009; Nirmala, Firdaus, Ramdhani, & Hidayat, 2025)

4. CONCLUSION

This study shows that cognitive style plays a crucial role in shaping students' numeracy literacy skills. Holistic learners tend to emphasize understanding the overall context, while analytic learners are stronger in systematic, step-by-step procedures. However, these tendencies are strongly influenced by students' ability levels. High-achieving students are able to effectively leverage their cognitive style to solve numeracy tasks, whereas medium- and low-achieving students still face significant challenges. Medium achievers display partial weaknesses—holistic learners often lack precision in numerical details, while analytic learners struggle to connect calculations with context. Among low-achieving students, these weaknesses are even more pronounced, preventing the development of strong numeracy literacy.

These findings provide important insights for educational policy and curriculum development, particularly in mathematics learning. Numeracy literacy cannot be taught with a one-size-fits-all approach but requires differentiated strategies. Teachers need to be equipped to design adaptive learning that accommodates the needs of students with different cognitive styles. This includes the application of problem-based learning, the integration of interactive media and technology, and collaborative learning that combines the contextual mapping strengths of holistic learners with the analytical precision of analytic learners. Through such strategies, numeracy literacy achievement can be improved while also supporting alignment with higher educational standards.

For future research, cross-school comparative studies are recommended to explore variations in numeracy literacy profiles across different contexts. Experimental intervention studies should also be developed to directly test the effectiveness of differentiated learning strategies in enhancing numeracy literacy. In addition, large-scale quantitative research could strengthen the generalizability of findings, while studies focusing on teacher practices would be valuable for understanding how teachers perceive and implement differentiated learning based on cognitive diversity. Taken together, these directions move research beyond merely profiling students toward developing instructional models that can be applied more widely in schools and contribute meaningfully to curriculum improvement at the national level.

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