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An Analysis of Students' Mathematical Literacy Skills Based on Carl Jung's Personality Theory

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Abstract: Mathematical literacy is the individual's ability to formulate, employ, and interpret mathematics including concepts, procedures, and facts, in a variety of contexts. If students possess good mathematical literacy, then they will be able to solve various problems arising in their daily life. Certainly, problems will come up in every human life; therefore, mastering mathematical literacy is very important for students. In relation to students' mathematical literacy, the research aims to analyze students based on Carl Gustav Jung's personality types, which are divided into two types, extrovert and introvert. This mixed-methods research was conducted in a class with 38 students from the eighth grade. The quantitative approach in this study focuses on the validation and reliability test of instruments in the form of questionnaires and mathematical literacy tests. The qualitative approach in this study focuses on the processing and interpretation of interview process data to obtain deeper information about the students' responses to test and non-test instruments. Data collection is done by filling out questionnaires, doing mathematical literacy tests, and conducting interviews. It can be concluded from the results that 65.79% of the participants have a low level of mathematical literacy, while the rest of the participants have a moderate level. It does not find any participants with high mathematical literacy in this study.

Keywords: Mathematical literacy, Personality, PISA, Extrovert, Introvert

Introduction

According to the PISA draft assessment, mathematical literacy refers to an individual's ability to formulate, apply, and interpret mathematics, which includes concepts, procedures, and facts, in various contexts (PISA, 2015). PISA (Programme for International Student Assessment) is an international assessment program that evaluates students starting from 15 years of age to determine their knowledge and skills in reading mathematics, and science, as well as their ability to overcome problems in real life. As stated in a recent study by Gal (2024), mathematical literacy is critical for success in the workplace. PISA's emphasis on mathematical literacy together with Gal's findings have made it inevitable to challenge the students in the classroom learning context to comprehend mathematics concepts, apply reasoning and patterns, and communicate mathematically.

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Related to this fundamental role, understanding the elements of the mathematics learning process, namely understanding mathematical concepts, using reasoning in mathematics, using mathematics as a conceptual communication tool, and using traditional and modern media all align with the Decree of the Head of the Indonesian Ministry of Education, Culture, Research, and Technology's Standards, Curriculum, and Assessment Agency number 032/H/KR/2024 for the implementation of the Merdeka Curriculum (BSKAP Kemedikbudristek, 2024). Although this aligns with the regulations of the Ministry of Education, Culture, Research, and Technology of Indonesia, the level of mathematical literacy skills of students in Indonesia is still in low category. This is in accordance with what international assessments from PISA.

As stated from the National Center for Education Statistics, an official website of the United States government, the largest domain in PISA 2022 was mathematical literacy. Half of the primary examination in PISA 2022 consisted of mathematics literacy activities. The purpose of these items was to assess students' proficiency in the formulation, application, and interpretation of mathematics in various context. Indonesia was ranked 69th out of 80 participating countries in this examination, with an average score of 366. This result reflects Indonesia's position within the assessment framework, as PISA uses a test method differentiated into 6 levels (Noviana & Murtiyasa, 2020). The mathematical literacy test conducted by PISA refers to materials found in mathematics subjects. This material is then broken down into several indicators of mathematical literacy skills. The following table displays the indicators:

Table 1. The indicators of mathematical literacy skills

Mathematical Process	Indicators	
Formulate	A1	Determine key variables and mathematical elements in real-world problem
	A2	Transforming problems into mathematical language or mathematical models that are appropriate in the form of variables, images or diagrams.
Employ	B1	Applying mathematical modelling to find mathematical solutions
Interpret	C1	Analyzing the mathematical outcomes and assessing the potential benefits of mathematical solutions in relation to practical issues

Mathematical literacy is widely recognized as a critical competency for solving real-life problems. Recent international studies emphasize the integration of psychological factors such as personality traits to better understand variations in students' mathematical literacy. De Lange further divides the mathematics material into several mathematical literacy content areas, namely, space and shape, quantity, change and relationships, and uncertainty (Lange, 2006). This study used the topic of the System of Linear Equations in Two Variables, which is found in the Change and Relationships content. This material was selected because it shares conceptual characteristics with mathematical literacy, as both involve extended contextual narratives and are closely related to real-life situations. Furthermore, the majority of the research has mostly concentrated on the content areas of Space and Shape, Data and Uncertainty, and Quantity, according to the literature review done by Kappassova, Abylkassymova, Bulut, Zykrina, Zhumagulova, and Balta (2025), which looked at mathematical literacy and its influencing factors over the past ten years. In reference to this study, the Change and Relationships content was deliberately chosen for the present study, given that it has received relatively limited attention in prior research.

The national PISA outcomes have shown nothing but low mathematical literacy for Indonesian students but concentrating on alternative areas like change and relationships may open up fresh perspectives that lead to better student performance. Nevertheless, this low national standard might not be the case in the narrower space. If the focus is only on a particular district, then the findings might be different from the national average. Consequently, this research investigates one local context in Indonesia, specifically the Kudus area in Jawa Tengah, where the mathematical literacy research is still quite small.

Students' proficiency in mathematical literacy can be influenced by a number of things. After that, these factors are separated into internal and external factors. External factors that affect students' mathematical literacy skills are school environment, parental support, and socio-economic background; while internal factors that can affect mathematical literacy skills are students' motivation, self-efficacy, and personality (Rahmawati & Nusantara, 2021). Among the existing factors, there are two dominant factors or main factors that influence students' mathematical literacy skills level, namely personality and socio-cultural conditions. Because personality is one of the two dominant factors influencing mathematical literacy ability, research related to personality factors in mathematical literacy is important to conduct. So, this research will also be reviewed based on personality aspect.

The Latin term *persona*, which meaning a mask or disguise, is where the word “personality” originates, referring to the depiction of a human's character or behavior (Qomara, Ratnaningsih, & Santika, 2022). In line with this, the Greeks also considered the word *persona* to be how an individual is seen from the perspective or viewpoint of another individual (Rudianti et al., 2021). Pervin (2013) described personality as something that represents human characteristics that generally have consistent behavioral patterns. Meanwhile, Jesse stated that personality types are defined based on four divisions of mental functions or a person's viewpoint on something, including when perceiving information, when making a judgment or decision, when utilizing time and energy, and the basis of a person's lifestyle in their environment (Maya, 2018).

Personality itself has various different types according to the theories of several experts. Experts who put forward personality theories include Sigmund Freud with psychoanalytic personality theory, Erik Erikson with contemporary psychoanalytic theory, Raymond Bernard Cattell with factor analysis personality theory, Carl Gustav Jung with analytical psychology theory, and many more (Yusuf, 2007). In this study, Carl Gustav Jung's analytical psychology theory is used. Carl Jung was a Swiss psychologist. The reason for choosing Carl Gustav Jung's personality type theory in this study is because this theory is the most widely known by the general public today. In addition, Jung's theory has also been used as the basis for subsequent personality theory. In his theory, Jung divided a person's personality type into 2 basic types, namely extraverted and introverted (Jung, 1971).

According to Carl Jung, extraverted or an extrovert is a personality type whose life orientation is directed towards objective psychic content, while introverted or an introvert is a personality type whose life orientation is directed towards subjective psychic content (Jung, 1971). In line with this theory, Eysenck argues that introverts, with their characteristics of being calm, quiet, solitary, contemplative, and risk-averse, represent one end of the introverted-extraverted personality dimension (Matthews, Deary, & Whiteman, 2009). An extrovert prefers socializing, is not stiff or awkward, quick responding, being adaptable and enjoys social activities, while an introvert is generally quieter, less warm towards others, prefers solitude, does not talk much, is more easily offended, lacks self-confidence, is less fond of socializing, hesitant, reflective, and cautious (Angraeni, Mujiyanto, & Suwandi, 2023).

Experts who have put forward various personality theories certainly have different views, because the resulting theories also have some differences. Regarding these differences, several factors that can influence the differences in personality theories including certain cultural dimensions, namely: precisely, masculinity, power distance, individualism, and uncertainty avoidance (Rocha, 2025). According to Eminarti and Nasution (2025), these variations in personality types have an impact on how students approach and solve problems, particularly those involving by mathematics.

In order to improve learning in the future by taking this internal influencing element into account, it is crucial to ascertain the impact of personality on students' mathematical literacy skills. Thus, the purpose of this study is to analyze students' mathematical literacy ability based on Carl Jung's personality theory, with the research questions: (1) What is the level of students' mathematical literacy skills? (2) How do Carl Jung's personality types related to student mathematical literacy skills?

Method

This study drew upon mixed methods which integrated the qualitative and quantitative perspectives. According to Johnson, Onwuegbuzie, and Turner (2007), mixed methods research is a type of study where a researcher or group of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, and inference techniques) with the overall goals of corroboration, breadth and depth of understanding. The quantitative component in this study focused on validating and testing the reliability instruments, namely questionnaires and mathematical literacy test. Meanwhile, the qualitative component concentrated on processing and interpreting data from the interview process in order to gain deeper insights about student's responses to test and non-test instruments.

For qualitative research there are research targets or subjects, as for the quantitative research that needed sample-population. Furthermore, the technique of obtaining subjects for qualitative research or the sampling technique for quantitative research also necessary to be written in this section (Yusnidar, Fuldiartman, & Chaw, 2024). The technique of obtaining subjects in this study used purposive sampling. Purposive sampling is a technique for selecting subjects or sources based on specific considerations and objectives (Sugiyono, 2022). Subject in this research was 38 students grade VIII in one of the Islamic Junior Highschool in Kudus that filled

the mathematical literacy test and questionnaire, from whom 4 students were selected for interviews with some consideration, including:

- The selected students provided unique and insightful responses, which offer potential for further in-depth exploration during qualitative analysis.
- Their answers represent a range of test responses and varying levels of mathematical literacy observed among all subjects in this study.
- The chosen sample also reflects the diversity of personality types present in the full group of research participants, thus enabling a comprehensive investigation of the relationship between mathematical literacy and personality.

Data in this article were collected using a test and non-test instruments. The test instrument was a mathematical literacy test adapted by PISA, and the non-test instruments were a personality questionnaire adapted by some questionnaire with the Jung's personality indicators and interviews. The questionnaire used in this study employed a Likert scale. In this questionnaire, five response options were used: always, often, sometimes, hardly ever, and never. The product-moment correlation formula and Cronbach's alpha were used to verify the questionnaire's validity and reliability prior to its usage as a research instrument. The mathematical literacy test that used in this research was adapted by PISA's mathematical literacy test in content change and relationships. Before being used as a research instrument, Cronbach's alpha and the product-moment correlation formula were used to assess the test's validity and reliability. In addition to validity and reliability tests, this test instrument also underwent tests to determine its level of difficulty and discriminatory power.

The interview technique used in this study was a semi-structured interview based on interview guidelines. The interviews were used to gain a deeper understanding of students' mathematical literacy levels based on their personalities. Triangulation technique was used to test the validity of the qualitative data and for the data analysis, the technique used by the researcher was the Miles and Huberman model.

Results and Discussion

The Level of Students' Mathematical Literacy Skills

The findings of a mathematical literacy test were used to determine the students' mathematical literacy skills in this study. Following data processing and analysis of the mathematical literacy test findings, the researchers classified each research subject's literacy level. This classification is based on Azwar's (2016) use of mean and standard deviation. The following table displays the classification:

Table 2. Categorization of students' mathematical literacy levels

Category	Interval
Low	$\bar{X} < (\mu - 1\sigma)$
Moderate	$(\mu - 1\sigma) \leq \bar{X} < (\mu + 1\sigma)$
High	$(\mu + 1\sigma) \leq \bar{X}$

There were 38 students who completed the mathematical literacy test consisting of 4 questions. According to the categorization in table 2, the results can be seen in Table 3:

Table 3. Students' mathematical literacy levels

No	Category	Total of Students	Percentage
1	Low	25	65.79%
2	Moderate	13	34.21%
3	High	0	0.00%

As indicated in table 3, in this study, no students with high mathematical literacy skills were found. Meanwhile, this study found that 13 students had moderate level of mathematical literacy skills, or 34.21%. Additionally, 25 students or 65.79% of the research subjects had low levels of mathematics literacy.

Students' Mathematical Literacy Skills Related to Personality Types According to Carl Jung

The students' personality types in this study were obtained through the results of personality questionnaire. After processing the data and analyzing the results of the questionnaire, the researchers then categorized the personality type of each student. This categorization is based on Azwar (2016) using mean and standard deviation. The categorization can be seen in the table below:

Table 4. Categorization of students' personality types

Category	Interval
Extrovert	$\bar{X} \leq \mu$
Introvert	$\bar{X} > \mu$

There were 38 students who completed the questionnaires consisting of 20 questions. The results are displayed in the table below, which is based on the classification in Table 4:

Table 5. Students' personality types

No	Category	Total of Students	Percentage
1	Extrovert	17	44.74%
2	Introvert	21	55.26%

Table 5 shows that for the personality types; there were 21 students with introverted personalities and 17 students with extroverted personalities. Furthermore, the level of mathematical literacy based on personality type can be seen in the table below:

Table 6. Students' mathematical literacy levels based on their personality

No	Type of Personality	Category	Total of Students	Percentage
1	Extrovert	Moderate	5	13.16%
		Low	12	31.58%
2	Introvert	Moderate	8	21.05%
		Low	13	34.21%

Table 7. Achievement of student mathematical literacy indicators

Personality Types	Mathematical Literacy Ability	Subject	Process Components	Indicators	Achievement
Extrovert	Moderate	S ₂	Formulate	A1	-
				A2	-
			Employ	B1	√
	Low	S ₃	Interpret	C1	-
			Formulate	A1	-
				A2	-
Introvert	Moderate	S ₁	Employ	B1	-
				C1	-
			Interpret	C1	√
	Low	S ₄	Formulate	A1	√
				A2	√
			Employ	B1	√
			Interpret	C1	√
			Formulate	A1	-
				A2	-
			Employ	B1	-
			Interpret	C1	-

Explanation:

√: Research subjects are able to meet mathematical literacy indicators.

- : Research subjects are unable to meet mathematical literacy indicators.

The results indicate that students with introverted personalities tend to have different problem-solving approaches than extroverted students. These findings align with previous research showing that personality traits significantly affect learning strategies and academic performance in mathematics. So that, from the 38 research

subjects, four subjects were selected for interviews. Those who participated were coded as S₁, S₂, S₃, and S₄ after being chosen based on the outcomes of questionnaires and test of mathematical literacy. The following are the findings of the analysis of each indicator's achievement based on the participants' responses to the questions, supported by the result of the interviews.

Analysis of the Answer to Question Number 1

Pada perayaan hari raya tahun ini keluarga Anisa ingin membuat sebuah seragam yang bermotif batik dengan kombinasi kain polos yang berwarna senada. Anisa akan membuatnya menjadi sebuah gaun yang membutuhkan kain batik sebanyak 1 meter dan kain polos 2 meter yang dibeli pada toko kain langganan keluarganya dengan harga Rp.350.000. Sementara itu kakak anisa membutuhkan 1,5 meter kain batik dan 2 meter kain polos untuk gaunnya, di toko yang sama harga seluruh kain yang dibeli oleh kakak anisa adalah Rp.425.000. pada toko tersebut pula ibu anisa membeli 2 meter kain batik dan 3 meter kain polos untuk membuat seragam ibu dan ayah. Berapa harga yang harus dibayarkan oleh ibu anisa?

Figure 1. Question number 1

Figure 1 shows question number 1, the following is the question in English. For Eid al-Fitr this year, Anisa's family wants to make batik-patterned uniforms with a combination of plain fabric in matching colors. Anisa will make them into dresses that require 1 meter of batik fabric and 2 meters of plain fabric, which she will buy from her family's regular fabric shop for 350,000 rupiah. Meanwhile, Anisa's sister needs 1.5 meters of batik fabric and 2 meters of plain fabric for her dress. At the same shop, the total price of the fabric purchased by Anisa's sister is 425,000 rupiah. At the same shop, Anisa's mother also bought 2 meters of batik fabric and 3 meters of plain fabric to make uniforms for herself and Anisa's father. How much does Anisa's mother have to pay?. The answers provided by S₁ can be seen in Figure 2 below.

$$\begin{array}{l}
 2.5 \text{ Diket: } 1 \text{ m kain batik dan kain polos } 2 \text{ m} = 350.000 \\
 1,5 \text{ m} \text{ ————— dan ————— } 2 \text{ m} = 425.000 \\
 \text{Ditanya: } 2 \text{ m kain batik dan } 3 \text{ m kain polos berharga?} \\
 \text{Jawab:} \\
 \begin{array}{|l|l|}
 \hline
 \text{Harga 1 m kain batik } x & \text{Model Mtk: } 1x + 2y = 350.000 \\
 \hline
 \text{" 1 m kain polos } y & 1,5x + 2y = 425.000 \\
 \hline
 \text{Eliminasi } y & \text{Substitusi } x = 150.000 \\
 \hline
 1x + 2y = 350.000 & 1x + 2y = 350.000 \\
 1,5x + 2y = 425.000 - & 1(150.000 + 2y) = 350.000 \\
 -0,5x = -75.000 & 150.000 + 2y = 350.000 \\
 x = 150.000 & 2y = 350.000 - 150.000 \\
 & 2y = 200.000 \\
 \hline
 \text{Harga 1 m kain batik} = 150.000 & y = 200.000 = 100.000 \\
 \text{" 1 m kain polos} = 100.000 & 2 \\
 \hline
 \text{Harga } 2x + 3y = 2(150.000) + 3(100.000) & \\
 = 300.000 + 300.000 & \\
 \hline
 \text{Harga yang dibayarkan} = \text{Rp } 600.000 &
 \end{array}
 \end{array}$$

Figure 2. Answer to question number 1 given by S₁

It can be seen from Figure 2 that S₁ answered this question correctly and accompanied by the correct steps in accordance with the solution intended by the researcher. The solution provided by subject S₁ covered all components of the mathematical literacy problem-solving process, namely formulating the context mathematically; using mathematical concepts, facts, and procedures; and applying and evaluating the solution to the problem.

From the answer obtained, the researcher then conducted interviews with S₁. Based on the interview result, subject S₁ revealed that what was known in the question was the price of 1 meter of batik fabric and 2 meters of plain fabric, as well as 1.5 meters of batik fabric and 2 meters of plain fabric. In addition, the subject was also able to mention what was asked in the question, namely how much 2 meters of batik fabric and 3 meters of plain fabric cost. According to the subject, question number 2 was a question with a moderate level of difficulty. Furthermore, the subject was also able to explain the methods and steps used in solving question number 1. The subject also revealed several obstacles encountered in the process of solving question number 1, namely in dividing fractions.

From the results of interview, it can be noticed that the S_1 subject answered the researcher's questions fluently and clearly. It was evident that the subject knew exactly what facts were presented in the question and what was meant in the question. Furthermore, it was also evident that the subject S_1 experienced a slight difficulty in working on the question in the section on division with fractions. From the questions asked by the researcher, it was also confirmed that question number 1, according to subject S_1 , was a question with a moderate level of difficulty.

Analysis of the Answer to Question Number 2

Indah, Ani, dan Sinta adalah siswi kelas 8 pada salah satu Madrasah Tsanawiyah di kota Kudus. Hari ini salah seorang guru menginformasikan bahwa minggu depan pada mata pelajaran kesenian akan diadakan kegiatan melukis. Untuk itu seluruh siswa diharapkan membawa alat lukis sendiri berupa sebuah kuas dan sekotak cat air, sedangkan untuk kanvas telah disediakan oleh pihak sekolah. Sepulang sekolah Indah akan membeli kuas dan cat air tersebut, namun dikarenakan Ani dan Sinta tidak dapat ikut membelinya maka mereka berdua meminta tolong kepada Indah untuk membelikan alat lukis tersebut. Ani ingin membeli kuas dan cat air, sedangkan Sinta hanya ingin membeli cat air karena ia sudah memiliki kuas. Harga sebuah kuas adalah Rp.5.000 dan harga sekotak cat air adalah Rp.20.000. Jika Indah akan membeli peralatan lukis untuk dia, Ani, dan Sinta maka berapakah uang yang harus dibayarkan Indah?

Figure 3. Question number 2

Figure 3 shows question number 2, the following is the question in English. Indah, Ani, and Sinta are eighth grade students in the city of Kudus. Today, one of their teachers informed them that next week, they will have an art class where they will be painting. For this class, all students are expected to bring their own painting tools, namely a brush and a box of watercolors, while the canvas will be provided by the school. After school, Indah will buy the brushes and watercolors, but because Ani and Sinta cannot go with her to buy them, they both ask Indah to buy the painting equipment for them. Ani wants to buy brushes and watercolors, while Sinta only wants to buy watercolors because she already has a brush. The price of a paintbrush is 5,000 rupiah and the price of a box of watercolors is 20,000 rupiah. If Indah is going to buy painting supplies for herself, Ani, and Sinta, how much money does Indah have to pay?. The answers provided by S_3 can be seen in Figure 4 below.

$$\begin{array}{r}
 2 \times 5.000 + 3 \times 20.000 \\
 10.000 + 60.000 \\
 = 70.000
 \end{array}$$

Figure 4. Answer to question number 2 given by S_2

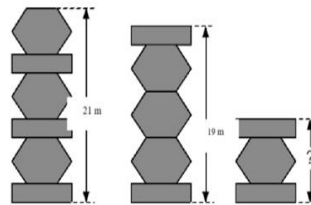
It can be seen from Figure 4 that S_2 answered this question correctly but only included the calculation and did not include other steps such as how S_2 found the mathematical model in question. The answer given by subject S_2 only covers one of the three components of the mathematical literacy problem-solving process. This answer only covered the process components using mathematical concepts, facts, and procedures.

Based on the interview results, subject S_2 revealed that the only information known in the question was the price of one brush and a box of watercolors. As for what was asked in question, the subject only answered the amount of money that had to be paid. According to the subject, question number 2 was difficult to answer. In addition, the subject was unable to describe the methods and steps used in solving question number 2. However, the subject was able to mention the conclusion of the answer requested in the question. The subject said that during the process of solving the question, the obstacle encountered was the lengthy narrative in the question. From the summary of the interview results, it can be seen that subject S_2 answered the researcher's questions somewhat awkwardly. It appears that the subject was not fully aware of the facts presented in the questions, as the subject

only answered the price when the researcher asked what was known in the question. Furthermore, it can also be seen that subject S₂ experienced difficulties in completing the questions, as evidenced by the fact that subject S₂ was unable to answer the researcher's questions about the steps taken to complete the questions, citing forgetfulness as the reason. Subject S₂ also experienced difficulties related to time and the amount of narrative in the question. From the questions asked by the researcher, it was also confirmed that question number 2, according to subject S₂, was a difficult question.

Analysis of the Answer to Question Number 3

Perhatikan gambar berikut!



Gambar diatas adalah 3 buah gedung yang memiliki tinggi berbeda dan tersusun dari dua jenis bangun yaitu bangun segienam dan persegi panjang.

Berapa tinggi gedung yang paling pendek?

Figure 5. Question number 3

Figure 5 shows question number 3, the following is the question in English. Observe the following image! (Given are images of three buildings with their respective sizes). The image above shows three buildings of different heights, consisting of two types of shapes: hexagons and rectangles. What is the height of the shortest building?. The answers provided by S₃ can be seen in Figure 6 below.

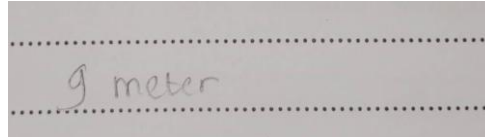


Figure 6. Answer to question number 3 given by S₃

It can be noticed from Figure 6 that S₃ answered this question correctly in accordance with the answer intended by the researcher. However, it is unfortunate that the subject did not write down any explanations or steps in their work. The answer provided did not cover all components of the process in solving mathematical literacy problems.

From the answer obtained, the researcher then conducted interviews with S₃. Based on the interview result, subject S₃ revealed that the question in the problem was the height of the shortest building. However, the subject was unable to mention what was known in the question. Instead, the subject explained the steps used during the process of working on the question. According to the subject, question number 3 was a question of moderate difficulty. The subject was able to mention the conclusion of the answer referred to in the question. The subject also said that no obstacles were encountered during the process of working on the question.

From the summary of the interview results, it can be seen that subject S₃ answered the researcher's questions quite fluently, but the subject still needed a better understanding of how to manage the information obtained from the question. It appears that the subject understood what the question was asking but experienced some confusion when explaining the information they understood. This was evident when subject S₃ explained to the researcher what they knew and the steps they had used to solve question number 3.

Analysis of the Answer to Question Number 4

Andre memiliki perusahaan rental kendaraan yang terdiri dari mobil sedan dan mobil van. Poster dibawah ini menunjukkan biaya sewa per hari untuk kendaraan di perusahaannya.

Biaya Sewa Kendaraan	
Sedan Rp. 400.000/hari	
Van Rp. 600.000/hari	

Jika pada suatu hari total pendapatan perusahaan Andre sebesar Rp.17.000.000 dengan menyewakan 36 kendaraan, berapa banyak mobil sedan dan mobil van yang disewakan pada hari itu?

Figure 7. Question number 4

Figure 7 shows question number 4, the following is the question in English. Andre owns a vehicle rental company consisting of saloon cars and vans. The poster below shows the daily rental costs for vehicles at his company. (A poster was provided showing the types of cars and their rental prices: the rental price for a saloon car is 400,000 per day and for a van is 600,000 per day). If on a certain day Andre's company earned a total income of Rp.17,000,000 from renting out 36 vehicles, how many saloon cars and vans were rented out on that day?. The answers provided by S₅ can be seen in Figure 8 below.

480.4 mobil yg di keluarkan oleh perusahaan andre

Figure 8. Answer to question number 4 given by S₄

It can be seen from Figure 8 that S₄ answered this question incorrectly according to the researcher's intended answer. The answer given did not cover all components of the process in solving mathematical literacy problems. In the interview, subject S₄ revealed that in working on question number 4, the subject was not thorough. As a result, the subject answered question number 4 randomly. The subject was unable to explain the methods and steps used in solving this question. According to the subject, question number 4 was a difficult question to answer.

From the summary of the interview results, it can be seen that subject S₄ experienced considerable difficulty in solving question number 4. This was confirmed by the researcher's question about the level of difficulty of question number 4 according to subject S₄, where according to the subject, this question was quite difficult. Subject S₄ also did not know the steps to solve question number 4.

According to the research's data, the study's conclusions showed that the participants in the current study had only moderate to low levels of mathematical literacy. This study used Carl Jung's personality theory to examine students' mathematical literacy skills from the standpoint of their personality. The extroverted students did not indicate high levels of mathematical literacy, nor did their introverted counterparts. This finding supports another study by Muzaki and Masjudin (2019), which claimed that in its research subjects, grade XI students, regardless of whether they had high, medium, or low initial mathematical abilities, all showed low levels of mathematical literacy. These findings also support the findings from the PISA test in Indonesia (2022), which assessed mathematical literacy skills and found Indonesian students tend to have low mathematical literacy skills. One of the reasons for such low skills could be due to the low level of focus among Indonesian students (Fauzan Harisman, Boriboon, Syaputra, & Hafizatunnisa, 2025).

Overall, in this study participants with extroverted personality types were unable to meet several of the expected indicators in the mathematical literacy assessment. This result also supported the study by Yuzianah, Darmono, Fatkhiyah (2023) and Hatadi, Kamarudin, Ermawati (2021) which stated that students' with the extroverted personality also meet only 2 out of 4 mathematical reasoning and numeracy skills indicators in solving PISA questions on space and shape content. Students who were classified as extroverted with moderate levels of mathematical literacy were unable to achieve the formulate and interpret aspects of mathematical literacy, despite having succeeded in the employ aspect. This would indicate that those students were capable of using mathematical models to obtain expected solutions but were not yet able to formulate or identify relevant aspects of the problems or to interpret their solutions in written form. In addition, extroverted students with low levels of mathematical literacy also failed to meet all of the expected indicators in completing the test items.

These findings support those by Rudianti, Aripin, and Muhtadi (2021), who mentioned that extroverted students may solve problems faster than introverted students but are not as thorough in exploring the problems, often use incorrect concepts to draw conclusions, and commit errors in linking information regarding the problem with previously acquired knowledge. Furthermore, Susanti, Budiarto, Khabibah, Hodiyo, and Fenyvesi (2026) revealed that during the use of relational reasoning and problem solving in mathematics, extroverted students tend to choose quick methods, while introverted students elaborate their answers and apply comprehensive methods.

In this study, students of introverted personality types and with moderate levels of mathematical literacy were generally able to arrive at the interpretation stage, suggesting that they have successfully satisfied all of the stage of mathematical literacy. Similar to their extroverted peers, introverted students who demonstrate low mathematical literacy levels failed to satisfy the necessary indicators in solving the given problems. However, a comparison of the students who emerged with a moderate level of mathematical literacy shows that introverted students demonstrate a higher level of mathematical literacy compared to their extroverted counterparts.

The study results are consistent with those of Sari, Munawaroh, and Raharjo (2020), who demonstrated that students with extroverted personality types have less mathematical creative thinking skills than introverted students, skills that significantly contribute to mathematical literacy. In accordance with this, Padlya, Zulyadaini, and Dewi (2025) pointed out that the introverted Grade XI students are more mathematically literate than the extroverted ones. In support of these findings, Ayuwanditya and Murwaningtyas (2024) also stated that in both pre- and post-test stages the introverted students were getting the highest mathematical literacy scores against the extroverted ones. Such findings are agreement with those obtained in the previous studies indicating that introverted students can fulfill all the numeracy literacy indicators while extroverted ones can only meet one (Suistiani, Suastika, & Haryani, 2025; Azis, Sudargo, & Endahwuri, 2025).

It is crucial to recognize the limitations of this study, such as the comparatively small sample size and the concentration on a single educational situation, even though it provides insightful information about the connection between personality type and mathematical literacy. Consequently, the findings may have limited generalizability to broader student populations.

Conclusion

This study found that students' mathematical literacy skills in Kudus, Jawa Tengah province are still generally low, in line with the national PISA results for Indonesia. Based on an analysis of student performance, it was shown that only students with moderate and low mathematical literacy levels participated in this study, with the majority classified as having lower proficiency levels.

Furthermore, the findings indicate that mathematical literacy skills are related to students' personality types as described by Carl Jung. Among students, the introverts' group managed to perform better in mathematical literacy tests than the extroverts' group. Implicitly, this reveals that personality characteristics are a major factor in determining the nature of student interaction with mathematical tasks and their comprehension as well.

Looking ahead, the future research is suggested to have a bigger sample size and include more schools with diverse characteristics to make the whole student population better represented by the result. Besides, the research could combine other influences like learning motivation, learning style, or socio-emotional factors, which could interact with personality type to determine the level of mathematical literacy.

Recommendations

Based on the findings of this study, several recommendations are proposed for teachers, curriculum developers, and future researchers. For mathematics teachers, instructional strategies should be tailored to accommodate students' personality differences, particularly in developing the formulate and interpret components of mathematical literacy, which were shown to be the weakest aspects among extroverted students. Teachers are encouraged to design learning activities that require students to articulate their problem-solving steps explicitly, such as through structured worksheets or guided reflection tasks, rather than allowing students to rely solely on quick, procedural calculations. For extroverted students in particular, teachers may need to reinforce habits of careful reading, identifying known information, and connecting problems to relevant mathematical concepts before proceeding to computation, in order to reduce the tendency toward hasty and incomplete responses. For

introverted students, although they generally demonstrated stronger performance in formulating and interpreting mathematical problems, teachers should continue to provide opportunities that build their confidence in applying solutions efficiently, so that their comprehensive reasoning style is complemented by adequate speed and fluency in problem-solving.

For curriculum developers and school policymakers, these findings suggest the importance of incorporating differentiated learning approaches that consider students' personality types as one factor influencing mathematical literacy outcomes. Professional development programs for teachers could include training on recognizing personality-based learning tendencies and adapting assessment methods accordingly.

For future researchers, given the limitations of this study in terms of sample size and its focus on a single educational context, it is recommended that subsequent studies involve larger and more diverse samples across multiple schools or regions to improve the generalizability of the findings. Future studies may also consider examining additional personality dimensions beyond the extrovert-introvert continuum, or exploring the interaction between personality type and other variables such as gender, socioeconomic background, or prior mathematical achievement, to provide a more comprehensive understanding of the factors contributing to students' mathematical literacy.

Scientific Ethics Declaration

* The authors declare that the scientific ethical and legal responsibility of this article published in EPES Journal belongs to the authors.

Conflict of Interest

* The authors declare that they have no conflicts of interest.

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