



## Students' analysis literacy and numeracy in linear algebra: A comparison across personality types

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### Abstract:

The imperative drives this research endeavour for educators to comprehend the diverse personality types exhibited by students. It is crucial as each personality type encompasses unique strengths and weaknesses that influence cognitive processes, decision-making, literacy, and numeracy skills. The primary objective of this study is to assess the literacy and numeracy skills of students categorized into sanguine, melancholic, choleric, and phlegmatic personality types within the context of Linear Algebra courses. Employing a descriptive research design with a qualitative approach, the subjects of this investigation comprised 47 students enrolled in the Education Mathematics Major at Malikussaleh University: the research employed personality type tests, literacy and numeracy tests, and interviews as the assessment instruments. The data analysis techniques followed the framework proposed by Miles and Huberman that involved stages such as data collection (including students' personality and literacy numeracy test results), data reduction (highlighting key elements), data presentation (displaying test and interview data), and concluding. The findings revealed that (1) 8 individuals (17.02%) exhibited a choleric personality type, eight individuals (17.02%) demonstrated a melancholic personality type, 16 individuals (34.05%) displayed a phlegmatic personality type, and 15 individuals (31.91%) manifested a sanguine personality type; (2) students' literacy and numeracy skills averaged 78.6%, falling into the high category; (3) The phlegmatic personality type exhibited the lowest literacy and numeracy ability, while the sanguine personality type demonstrated the highest literacy and numeracy ability. Consequently, this underscores the importance of students leveraging their strengths and addressing the weaknesses associated with their respective personality types to refine their literacy and numeracy skills.

**Keywords:** Analysis; Literacy Numeracy Skills; Personality Types

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### Introduction

Indonesia has successfully navigated past the literacy crisis and is recognized as one of the countries that has effectively reduced its illiteracy rate. According to the 2021



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National Socio-Economic Survey (Susesnas), the illiteracy rate in Indonesia is now at 1.56%, which amounts to 2.7 million people. It represents a decline from the 2020 illiteracy data, where the rate was 1.76%, involving approximately 2.9 million people. Beyond reading and writing activities, literacy encompasses how individuals communicate and engage in social relationships related to knowledge, language, and culture in society (Kemendikbud, 2019). Consequently, literacy plays a crucial role in education, particularly for prospective teachers still categorized as having low literacy (Laamena & Laurens, 2021), a trend mirrored in numeracy ability (Lopez-Pedersen et al., 2023).

Numeracy, defined as the ability to apply number concepts and arithmetic operation skills in daily life (Han et al., 2017) and interpret quantitative information, holds practical utility in meeting life's demands and understanding mathematics information that is expressed as graphs, charts, and table (Goos et al., 2023). These skills enable individuals to solve practical problems in various contexts of daily life, analyze information displayed in diverse forms (graphs, tables, charts, etc.), and interpret analysis results to predict and make informed decisions (Han et al., 2017). Literacy and numeracy extend far beyond mathematics learning, impacting practical use in everyday life and even in independent learning at home (homeschooling) (Dewantara et al., 2023). It is imperative to enhance students' literacy and numeracy skills, particularly in Linear Algebra courses where these skills have yet to reach the complete category. Preliminary observations by the researcher reveal that out of the 51 students who underwent the literacy and numeracy test, 34 (66.67%) fall into the incomplete category, while the remaining 17 (33.33%) are in the complete category.

The challenge of low literacy and numeracy skills is further underscored by the 2018 International Program for Student Assessment (PISA) results, indicating that Indonesian students' reading, mathematics, and science skills rank relatively low among 79 countries (OECD, 2019). Additional research supports these findings, indicating that students struggle with PISA problems at levels 1 and 2 (Masfufah & Afriansyah, 2021). Consequently, literacy and numeracy must be prioritized by educators to achieve learning objectives effectively. Moreover, educators should be cognizant of the diverse personality types among students, as each personality type influences the thinking process, decision-making, and the improvement of students' mathematical understanding abilities (Darmayanti et al., 2023). This variation in personality types can also impact literacy and numeracy skills due to differences in character. In alignment with the statement, "Numeracy is braiding together mathematics, language, and thinking" (Pearse, 2011), personality is defined as a dynamic psychophysical system influencing an individual's unique way of adjusting to the environment and making decisions (Herbert et al., 2023).

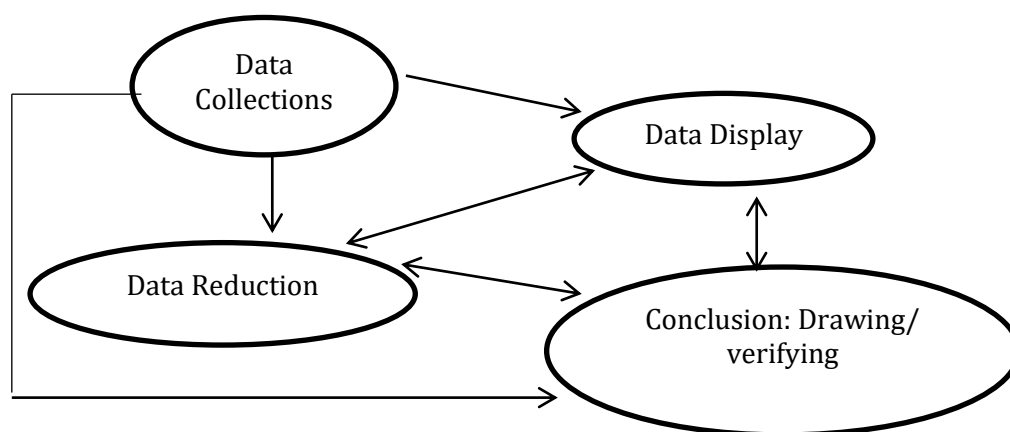
Four fundamental human personality types contribute to an individual's character: (1) Sanguine (extroverts, talkers, optimists); (2) Choleric (extrovert, doer, optimistic); (3) Melancholic (introvert, thinker, pessimistic); and (4) Phlegmatic (peace-loving) (Littauer, 2007). Each personality type has its strengths and weaknesses. Awareness of one's personality type and understanding the associated strengths and weaknesses facilitates the development of individual potential. Research results indicate that students with a sanguine personality type, based on mathematical representation, fulfill two indicators: equation representations and mathematical expressions, and word representations and written text (Thalhah et al., 2020).

Others generally have sanguine personalities, gravitate towards being the center of attention, and enjoy engaging in fun group activities (Purwanto et al., 2021). Choleric personalities thrive in organizing people, relish challenges and adventure, and exhibit assertiveness, strength, speed, and agility. Melancholic personalities typically possess a penchant for organization and attentiveness to detail. On the other hand, phlegmatic personalities are characterized by patience, aversion to conflict, a relaxed demeanour, determination, good listening skills, and a propensity for reserved communication (Littauer, 2007). Given these varied attributes, personality significantly influences each individual's decision-making process, impacting students' literacy and numeracy skills. Based on these considerations, this study analyses literacy numeracy based on students' personality types.

### **Research Methods**

The research activities were conducted from March to July 2023 at the Mathematics Education Study Program of Malikussaleh University, involving 47 students from the Mathematics Education Study Program as research subjects. Four of these 47 individuals were selected for interviews, representing students with sanguine, choleric, phlegmatic, and melancholic personality types. This research adopts a descriptive approach with a qualitative methodology. This research describes literacy and numeracy skills concerning students' personality types. The qualitative approach employed aligns with the framework outlined by Miles and Huberman (Miles & Huberman, 1994), encompassing four interactive and continuous activities: data collection, data reduction, data display, and conclusions.

Data collection involved gathering relevant information from personality type tests and data on students' literacy and numeracy abilities in linear algebra courses. Following data collection, data reduction was undertaken to enhance comprehension, focusing on critical elements and significant aspects. Subsequently, data presentation involved displaying information derived from personality test results, literacy and numeracy ability tests, and interviews, facilitating the formulation of conclusions. These conclusions encompass a qualitative description of literacy and numeracy ability tests concerning students' personality types. For a more detailed depiction of this process, refer to Picture 1.



**Picture 1.** Activities in data analysis

The instruments in this study included literacy and numeracy tests, personality type tests, and interviews. The validator validated the instruments by analyzing the component items and giving an assessment by coding the assessment criteria. The literacy and numeracy test consisted of long answer problems or word problems. The test had three questions, and each item was adjusted to the indicators of literacy and numeracy skills. Furthermore, the scores obtained were converted to obtain the literacy and numeracy test scores. Furthermore, students' literacy and numeracy scores were classified based on the score intervals presented in Table 1 (Pragusti, 2020).

**Table 1.** Interval of Literacy Numeracy

Value Interval	Category
$70 < N \leq 100$	High
$55 < N \leq 69$	Medium
$0 < N \leq 54$	Low

Source: (Pragusti, 2020)

## Results and Discussions

### *Student Personality Type*

Before giving literacy and numeracy skill tests to Mathematics Education Study Program students, a student personality type test was first administered. This personality test has been validated by previous research (Littauer, 2007) and used according to the needs of researchers. The results of the personality test of Malikussaleh University Mathematics Education Study Program students are presented in Table 2.

**Table 2.** The Results of The Student Personality Test

Personality Types	Number of Students	Percentage
Choleric	8	17.02%
Melancholic	8	17.02%
Phlegmatic	16	34.05%
Sanguinis	15	31.91%

Based on the outcomes of the student personality type test, it was found that eight individuals (17.02%) exhibited a choleric personality type, another eight individuals (17.02%) displayed a melancholic personality type, 16 individuals (34.05%) demonstrated a phlegmatic personality type, and 15 individuals (31.91%) manifested a sanguine personality type. The test results indicate that out of the 47 individuals who underwent the personality test questionnaire, the majority, 16 of them, possess a phlegmatic personality type. It suggests that many students in the Malikussaleh University Mathematics Education Study Program exhibit calmness, a dislike for rushing, resistance to external influences, and a preference for maintaining a non-disruptive environment. The tranquil atmosphere in the classroom is further complemented by students with a sad personality type, characterized by qualities such as quietness,

introversion, politeness, pessimism, a preference for solitude, and less popularity. However, individuals with choleric and sanguine personality types still primarily influence class dynamics. It is attributed to choleric students being outspoken, competitive, courageous, argumentative, dominant, and assertive. Similarly, students with a sanguine personality type are known for being friendly, talkative, receptive to praise, and enthusiastic.

#### *Literacy and Numeracy Skills*

One of the objectives of this study was to determine the literacy and numeracy skills of Malikussaleh University Mathematics Education Study Program students in Linear Algebra courses. The following are the results of the literacy and numeracy skills of Malikussaleh University Mathematics Education students:

**Table 3.** The Results of The Literacy and Numeracy Skills

<b>Indicator</b>	<b>Question No. 1 (%)</b>	<b>Question No. 2 (%)</b>	<b>Question No. 3 (%)</b>	<b>Average (%)</b>
Using mathematical symbols	95.7	87.2	95.7	92.9
Information analysis	69.2	69.2	83	73.8
Making decision	66.0	59.0	82	69

Table 3 illustrates students' literacy and numeracy skills in the Malikussaleh University Mathematics Education Study Program. Specifically, 92.9% of students excel in the high category for using mathematical symbols, 73.8% demonstrate high proficiency in the information analysis indicator, and 69% fall within the medium category for the decision-making indicator. Consequently, students' literacy and numeracy skills in the Malikussaleh University Mathematics Education Study Program are predominantly classified as high. It aligns with research findings that high-ability students generally exhibit commendable mathematical literacy skills (Farida et al., 2021). Similarly, the outcomes of another study (Rezky et al., 2022) revealed that individuals with high abilities effectively apply their mathematical understanding to meet literacy and numeracy indicators. Contrastingly, quantitative research results examining student responses to the Mathematical Literacy Test, involving 254 students, indicate that most fall within the middle and low proficiency groups (Ekawati et al., 2020).

#### *Students' Literacy and numeracy Ability given Personality Type*

After giving personality tests and literacy and numeracy tests to students of Malikussaleh University Mathematics Education Study Program, an analysis will be carried out on students' literacy and numeracy skills in terms of student personality types. The outcomes of literacy and numeracy skills across different student personality types are categorized as low, medium, and high. For the choleric personality type, 2.13% fall into the low literacy and numeracy ability category, and another 2.13% are classified as having moderate literacy and numeracy ability. In comparison, 12.77% exhibit high literacy and numeracy skills. Similarly, the melancholic personality type comprises 2.13% in the low and numeracy categories, 2.13% in the moderate and numeracy

categories, and 12.77% in the high literacy and numeracy categories. The results are as follows in Table 4.

**Table 4.** The Results of The Literacy and Numeracy Skills Based on Student's Personality Types

Personality Types	Literacy and numeracy Skills					
	Low		Medium		High	
	Number of students	Percentages (%)	Number of students	Percentages (%)	Number of students	Percentages (%)
Choleric	1	2.13	1	2.13	6	12.77
Melancholic	1	2.13	1	2.13	6	12.77
Phlegmatic	4	8.51	1	2.13	11	23.40
Sanguinis	1	2.13	2	4.26	12	25.53
<b>Total</b>	<b>7</b>	<b>14.89</b>	<b>5</b>	<b>10.64</b>	<b>35</b>	<b>74.47</b>

Within the phlegmatic personality type, 8.51% demonstrate low literacy and numeracy abilities, 2.13% exhibit moderate proficiency, and 23.40% excel in high literacy and numeracy skills. As for the sanguine personality type, 2.13% of students showcase low literacy and numeracy capabilities, 4.26% (2 people) fall within the moderate proficiency range, and 25.53% demonstrate high literacy and numeracy skills.

### Discussion

#### *Analysis and Discussion of Literacy and Numeracy Skills of Students with Choleric Personality Type*

There are eight subjects with choleric personality types. Of these, one got a low score, one got a medium score, and six got a high score. Subjects with low and high literacy and numeracy skills were interviewed to determine whether the answers given were under the subject's personality type. Picture 2 presents the test results of subjects with low literacy and numeracy skills with a choleric personality type.

3. Siomay = x  
 batagor = y  
 otak-otak = z

$$\left[ \begin{array}{ccc|c} 1 & 1 & 0 & 30.000 \\ 1 & 0 & 1 & 2.000 \\ 1 & 1 & 1 & 50.000 \end{array} \right] \xrightarrow{R_2 - R_1} \left[ \begin{array}{ccc|c} 1 & 1 & 0 & 30.000 \\ 0 & -1 & 1 & -28.000 \\ 0 & 0 & 1 & 20.000 \end{array} \right] \xrightarrow{R_3 - R_1} \left[ \begin{array}{ccc|c} 1 & 1 & 0 & 30.000 \\ 0 & -1 & 1 & -28.000 \\ 0 & 0 & 1 & 20.000 \end{array} \right] \xrightarrow{R_2 \times (-1)} \left[ \begin{array}{ccc|c} 1 & 1 & 0 & 30.000 \\ 0 & 1 & -1 & 28.000 \\ 0 & 0 & 1 & 20.000 \end{array} \right]$$

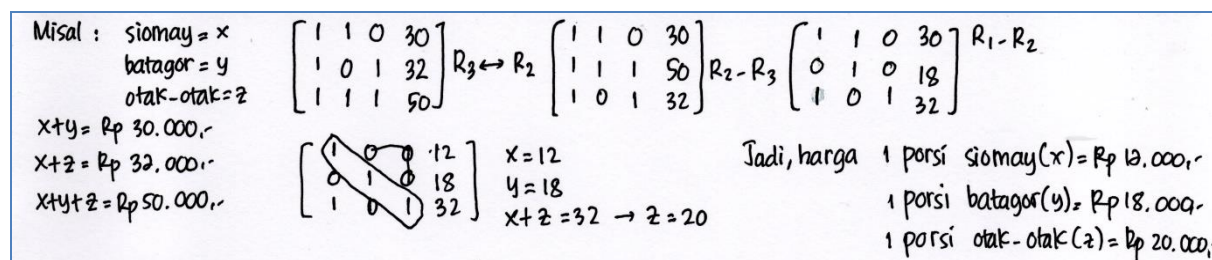
$x = 12.000$        $y = 18.000$        $z = 20.000$   
 1 porsi siomay      1 porsi batagor      1 porsi otak-otak

**Picture 2.** Answers of Choleric Personality Type Students With Low Literacy and Numeracy Skills

From the answer shown, it can be seen that the subject did not write the answer using the right mathematical symbol, could not analyze the information provided by the problem, and could not solve the answer using Gauss-Jordan elimination, so the conclusion was incorrect. Thus, the subject is in the low literacy and numeracy category. The following is an excerpt of an interview with a choleric personality type subject with low literacy and numeracy skills.

- Researcher : "Do you understand this question?"  
 Subject A : "Yes. I understand".  
 Researcher : "Why don't you write the equation as a mathematical model?"  
 Subject A : "I didn't write the math model because I immediately changed it into matrix form."  
 Researcher : "That's ok. Are you sure about the answer you wrote?"  
 Subject A : "I'm not sure."  
 Researcher : "Then, do you understand the elementary row operations in Gauss Jordan elimination?"  
 Subject A : "I understand."  
 Researcher : "But your answer is not right. And the operation you did is also not correct."  
 Subject A : "Yes."  
 Researcher : "Well, why don't you ask questions when we are learning?"  
 Subject A : "I don't ask questions because I believe I can learn by myself. When it's being explained, I can understand. But when it comes to the exam, I'm desperate with my answers".  
 Researcher : "Yes, in the exam, don't just be desperate in answering. You have to study more carefully."  
 Subject A : "Yes."

Based on the test and interview results, it can be seen that the subject did not understand the solution technique with Jordan's Gauss elimination. However, the subject seemed confident in his answer even though he knew that his answer was incorrect. It is by the choleric personality traits of being determined, stubborn, argumentative, and slightly arrogant. Furthermore, the test results of the choleric personality type subject with high literacy and numeracy skills are displayed in Picture 3.



Misal : siomay = x  
 batagor = y  
 otak-otak = z

$$\begin{bmatrix} 1 & 1 & 0 & 30 \\ 1 & 0 & 1 & 32 \\ 1 & 1 & 1 & 50 \end{bmatrix} R_3 \leftrightarrow R_2 \quad \begin{bmatrix} 1 & 1 & 0 & 30 \\ 1 & 1 & 1 & 50 \\ 1 & 0 & 1 & 32 \end{bmatrix} R_2 - R_3 \quad \begin{bmatrix} 1 & 1 & 0 & 30 \\ 0 & 1 & 0 & 18 \\ 1 & 0 & 1 & 32 \end{bmatrix} R_1 - R_2$$

$$\begin{bmatrix} 1 & 0 & 0 & 12 \\ 0 & 1 & 0 & 18 \\ 1 & 0 & 1 & 32 \end{bmatrix} \quad \begin{matrix} x = 12 \\ y = 18 \\ x + z = 32 \rightarrow z = 20 \end{matrix}$$

Jadi, harga 1 porsi siomay (x) = Rp 12.000,-  
 1 porsi batagor (y) = Rp 18.000,-  
 1 porsi otak-otak (z) = Rp 20.000,-

**Picture 3.** Answers of Choleric Personality Type Students With High Literacy and Numeracy Skills

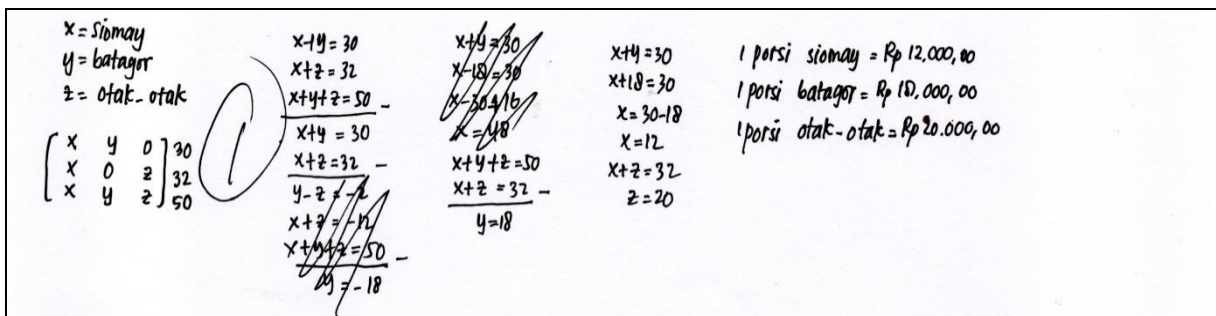
From the answer shown, it can be seen that the subject wrote the answer using mathematical symbols correctly, was able to analyze the information provided by the problem, and could solve the answer using Gauss-Jordan elimination so that the conclusion obtained was correct. Thus, the subject is in the high literacy and numeracy category. The following is an excerpt from an interview with a choleric personality type subject with high literacy and numeracy skills.

Researcher : "Are you sure about your answer?"  
 Subject B : "Insya allah I am sure."  
 Researcher : "The operation you did is not pure Gauss Jordan elimination because you combined it with the substitution method. Can you explain?"  
 Subject B : "Yes. Because the exam time is not much, I think if we get the x and y values, we can get the z value."  
 Researcher : "Right, and I don't blame your answer; the important thing is that you understand the problem you are working on."  
 Subject B : "Yes."  
 Researcher : "Thank you."  
 Subject B : "My pleasure."

Based on the test results and interviews, it can be seen that the subject is confident in the answers he wrote, even though the method used is slightly different from what the question asks for. It is by the choleric personality traits of being confident, assertive, courageous, having clear and strong goals, and daring to face challenges. This result is supported by research that states that choleric have good spatial abilities (Listiwikono, 2022).

*Analysis and Discussion of Literacy and Numeracy Skills of Students with Melancholic Personality Type*

There are eight subjects with melancholic personality types. Of these, one person got a low score, one got a medium score, and six got a high score. The following are the test results of low literacy and numeracy subjects with melancholic personality types.



**Picture 4.** Answers of Melancholic Personality Type Students With Low Literacy and Numeracy Skills

From the answer shown, it can be seen that the subject can correctly write the answer using mathematical symbols but cannot analyze the information the problem gave into a matrix form. It cannot correctly solve the answer using Gauss-Jordan elimination but uses ordinary elimination. Thus, the subject is in the low literacy and



numeracy category. The following is an excerpt of an interview with a sad personality type subject with low literacy and numeracy skills.

- Researcher : "Do you understand this problem?"  
 Subject C : "Sorry, I don't understand."  
 Researcher : "If you don't understand, why don't you ask questions during class?"  
 Subject C : "I'm reluctant. I'm afraid of getting angry."  
 Researcher : "Why are you afraid of getting angry? Did anyone scold you when you asked?"  
 Subject C : "Yes, I got angry when I asked a question in high school, Mom."  
 Researcher : "Hmmm... Ok. Do you understand the solution using Gauss Jordan elimination?"  
 Subject C : "I understand. But I was confused about how to use it during the exam."  
 Researcher : "If you don't understand, ask immediately next time. Don't stay silent."  
 Subject C : "Yes."

Based on the test and interview results, it can be seen that the subject did not understand the solution technique with Gauss Jordan elimination, but the subject was reluctant to ask because he felt awkward. It is to the character's melancholy personality, which is easily awkward, easily suspects others, feels depressed, and easily remembers negative things. Furthermore, the test results of subjects with high literacy and numeracy ability with melancholic personality type are as follows.

Misal:  $x = \text{Siomay}$   
 $y = \text{batagor}$   
 $z = \text{otak-otak}$

Jadi:  $x+y = 30.000$   
 $x+z = 32.000$   
 $x+y+z = 50.000$

$$\begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 1 & 0 & 1 & | & 32 \\ 1 & 1 & 1 & | & 50 \end{bmatrix} \begin{matrix} b_2 - b_1 \\ b_3 - b_1 \end{matrix} \rightarrow \begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 0 & -1 & 1 & | & 2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} -b_2 \rightarrow \begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 0 & 1 & -1 & | & -2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} b_1 - b_2$$

$$\begin{bmatrix} 1 & 0 & 1 & | & 32 \\ 0 & 1 & -1 & | & -2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} \begin{matrix} b_1 - b_3 \\ b_2 + b_3 \end{matrix} \rightarrow \begin{bmatrix} 1 & 0 & 0 & | & 12 \\ 0 & 1 & 0 & | & 18 \\ 0 & 0 & 1 & | & 20 \end{bmatrix}$$

harga persatuan adalah:  
 Siomay : Rp 12.000  
 batagor : Rp 18.000  
 otak-otak : Rp 20.000

**Picture 5.** Answers of Melancholic Personality Type Students With High Literacy and Numeracy Skills

From the answer shown, it can be seen that the subject can correctly write the answer using mathematical symbols, analyze the information given by the problem in a matrix form, and solve the answer using Gauss-Jordan elimination correctly. Thus, the subject is in the high literacy and numeracy category. The following are excerpts of interviews with subjects with melancholic personality types with high literacy and numeracy skills.

- Researcher : "Are you sure about your answer?"  
 Subject D : "Yes, I'm sure."  
 Researcher : "I see your work is excellent. The Gauss Jordan Elimination that you did is also correct; your analysis is also good."  
 Subject D : "Thank you."  
 Researcher : "Were there any obstacles during the learning process?"

Subject D : "Alhamdulillah, No."  
 Researcher : "Good. Thank you then."  
 Subject D : "Yes. You're welcome".

Based on the test and interview results, it can be seen that the subject can use mathematical symbols appropriately, has understood the solution technique with Gauss Jordan elimination very well, and his writing is also neat and orderly. It is by the strengths of melancholic personality traits: analytical, respectful, detailed, perfectionist, and critical. This result is supported by research that states that melancholics have high creative thinking abilities (Arumningsih et al., 2023).

*Analysis and Discussion of Literacy and Numeracy Skills of Students with Phlegmatic Personality Type*

There are 16 subjects with phlegmatic personality types. Of these, four people got low scores, 1 got a medium score, and 11 got high scores. The following are the test results of low literacy and numeracy subjects with phlegmatic personality types.

Dik: batagor = x  
 total = y  
 sioman = z

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ gauss jordan}$$

$$\begin{bmatrix} 1 & 0 & 0 & | & 30 \\ 0 & 1 & 0 & | & 2 \\ 0 & 0 & 1 & | & 50 \end{bmatrix} \xrightarrow{R_2 - R_1} \begin{bmatrix} 1 & 0 & 0 & | & 30 \\ 0 & 1 & 0 & | & 2 \\ 0 & 0 & 1 & | & 50 \end{bmatrix} \xrightarrow{R_3 - R_2} \begin{bmatrix} 1 & 0 & 0 & | & 30 \\ 0 & 1 & 0 & | & 2 \\ 0 & 0 & 1 & | & 48 \end{bmatrix} \xrightarrow{R_3 - R_1} \begin{bmatrix} 1 & 0 & 0 & | & 30 \\ 0 & 1 & 0 & | & 2 \\ 0 & 0 & 1 & | & 18 \end{bmatrix} \xrightarrow{R_1 - R_3} \begin{bmatrix} 1 & 0 & 0 & | & 28 \\ 0 & 1 & 0 & | & 2 \\ 0 & 0 & 1 & | & 18 \end{bmatrix}$$

x = 28 (batagor) = 28.000  
 y = 2 (total) = 2.000  
 z = 2 (sioman) = 2.000

**Picture 6.** Answers of Phlegmatic Personality Type Students With Low Literacy and numeracy Skills

From the answer shown, it can be seen that the subject has not correctly written the answer using mathematical symbols correctly, cannot accurately analyze the information given by the problem into a matrix form, and cannot correctly solve the answer using Gauss-Jordan elimination. Thus, the subject is in the low literacy and numeracy category. The following are excerpts of interviews with subjects with phlegmatic personality types with low literacy and numeracy skills.

Researcher : "Do you understand this problem?"  
 Subject E : "I understand, but I have doubts."  
 Researcher : "Ok, do you know where you went wrong?"  
 Subject E : "I know."  
 Researcher : "To make it easier to work, you first make a mathematical model of the known information."  
 Subject E : "Yes."  
 Researcher : "From the matrix you made, you still haven't put the elements correctly, so the elementary row operation you did is incorrect."  
 Subject E : "Yes."

Researcher : "Hmmm... Ok. Do you understand the solution using Gauss Jordan elimination?"  
 Subject E : "I understand, but I'm not sure."  
 Researcher : "Next time, if you are unsure, ask immediately. Don't just stay silent."  
 Subject E : "Yes. I like to doubt."  
 Researcher : "Well, that's that. If you still have doubts, you don't understand Jordan's gauss elimination."  
 Subject E : "Yes"  
 Researcher : "Practice more at home."  
 Subject E : "Yes. Thank you."  
 Researcher : "You're welcome."

Based on the test and interview results, it can be seen that the subject does not understand the solution technique with Gauss Jordan elimination, but the subject is embarrassed to ask. It is due to the weaknesses of phlegmatic personality traits, namely being shy, hesitant, and lazy. Furthermore, the test results of subjects with high literacy and numeracy ability with phlegmatic personality types are presented in Picture 7.

3). Misal :  $x = \text{somay}$   
 $y = \text{batagor}$   
 $z = \text{otak-otak}$

$$\begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 1 & 0 & 1 & | & 32 \\ 1 & 1 & 1 & | & 50 \end{bmatrix} \xrightarrow{b_2 - b_1} \begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 0 & -1 & 1 & | & 2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} \xrightarrow{b_2 \cdot (-1)} \begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 0 & 1 & -1 & | & -2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} \xrightarrow{b_1 - b_2} \begin{bmatrix} 1 & 0 & 1 & | & 32 \\ 0 & 1 & -1 & | & -2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} \xrightarrow{b_1 - b_3} \begin{bmatrix} 1 & 0 & 0 & | & 12 \\ 0 & 1 & -1 & | & -2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} \xrightarrow{b_2 + b_3} \begin{bmatrix} 1 & 0 & 0 & | & 12 \\ 0 & 1 & 0 & | & 18 \\ 0 & 0 & 1 & | & 20 \end{bmatrix}$$

Jadi :  $x + y = 30.000$   
 $x + z = 32.000$   
 $x + y + z = 50.000$

Jadi harga per satuan yaitu :  
 somay = Rp 12.000  
 batagor = Rp 10.000  
 otak-otak = Rp 20.000

**Picture 7.** Answers of Phlegmatic Personality Type Students With High Literacy and Numeracy Skills

From the answer shown, it can be seen that the subject can correctly write the answer using mathematical symbols, analyze the information given by the problem in a matrix form, and solve the answer using Gauss-Jordan elimination correctly. Thus, the subject is in the high literacy and numeracy category. The following are excerpts of interviews with subjects with phlegmatic personality types with high literacy and numeracy skills.

Researcher : "Are you sure about your answer?"  
 Subject F : "Yes, I'm sure."  
 Researcher : "I see your work is excellent. The Gauss Jordan Elimination that you did is also correct."  
 Subject F : "Alhamdulillah."  
 Researcher : "Were there any obstacles during the learning process?"  
 Subject F : "No."  
 Researcher : "Ok. Thank you then."  
 Subject F : "You're welcome."

Based on the test and interview results above, it can be seen that the subject can use mathematical symbols appropriately, has understood the solution technique with Gauss Jordan elimination very well, and his writing is also neat and orderly. Another study stated that a phlegmatic has been able to fulfill the five steps of problem-solving ability (Cahyani & Susanah, 2022).

*Analysis and Discussion of Literacy and Numeracy Skills of Sanguinis Personality Type Students*

There were 15 subjects with sanguine personality types. Of these, one person got a low score, 2 got a medium score, and 12 got a high score. The following are the test results of low literacy and numeracy subjects with the sanguine personality type.

③. 
$$\begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 1 & 0 & 1 & | & 32 \\ 1 & 1 & 1 & | & 50 \end{bmatrix} \xrightarrow{B_2 - B_1, B_3 - B_1} \begin{bmatrix} 1 & 1 & 0 & | & 32 \\ 0 & -1 & 1 & | & 2 \\ 0 & 0 & 1 & | & 20 \end{bmatrix} \xrightarrow{B_2 / -1} \begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 0 & 1 & -1 & | & -2 \\ 0 & 0 & -1 & | & 20 \end{bmatrix} \xrightarrow{-1 \cdot B_2} \begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 0 & 1 & -1 & | & -2 \\ 0 & 0 & 1 & | & -20 \end{bmatrix} \xrightarrow{B_2 - B_1} \begin{bmatrix} 1 & 1 & 0 & | & 30 \\ 0 & 1 & 0 & | & -60 \\ 0 & 0 & 1 & | & -20 \end{bmatrix}$$

$X_1 + X_2 = 30$   
 $X_2 = -60$   
 $X_3 = -20$

$X_1 + X_2 = 30 - X_2$   
 $= 30 - (-60)$   
 $= 30 + 60$   
 $X_1 = 90$

**Picture 8.** Answers Of Sanguinis Personality Type Students With Low Literacy and Numeracy Skills

From the answer shown, it can be seen that the subject has not correctly written the answer using mathematical symbols correctly, cannot accurately analyze the information given by the problem into a matrix form, and cannot correctly solve the answer using Gauss-Jordan elimination. Thus, the subject is in the low literacy and numeracy category. The following is an excerpt of an interview with a sanguine personality type subject with low literacy and numeracy skills.

Researcher : "Do you understand this test?"  
 Subject G : "Hehe, I don't understand."  
 Researcher : "Hm..if you don't understand, why didn't you ask me?"  
 Subject G : "That's alright."  
 Researcher: "To make it easier to work, you first make a mathematical model of the known information."  
 Subject G : "Yes"  
 Researcher : "From the matrix you made, you still haven't placed the elements correctly, so the elementary row operation you did is incorrect."  
 Subject G : "Yes"  
 Researcher : "Hmmm... Ok. Do you understand the solution using Gauss Jordan elimination?"  
 Subject G : "Yes, hehe, I forgot."  
 Researcher : "Next time, if you don't understand, ask immediately."  
 Subject G : "Yes."  
 Researcher : "Practice more at home."  
 Subject G : "Ok. Thank you".  
 Researcher: "You're welcome".

Based on the test and interview results, it can be seen that the subject does not understand the solution technique using Gauss Jordan elimination, but the subject is embarrassed to ask. It is to the weaknesses of sanguine personality traits: funny, cheerful, lack of discipline, and forgetfulness. Sanguines also tend to answer questions without understanding the questions (Kamilia et al., 2018). Furthermore, the test results of subjects with high literacy and numeracy ability with sanguine personality type are displayed in Picture 9.

3). Misal  $x = \text{Siomay}$   
 $y = \text{Batagor}$   
 $z = \text{otak-otak}$

$$\begin{cases} x + y = 30.000 \\ x + z = 32.000 \\ x + y + z = 50.000 \end{cases}$$

$$\left[ \begin{array}{ccc|c} 1 & 1 & 0 & 30.000 \\ 1 & 0 & 1 & 32.000 \\ 1 & 1 & 1 & 50.000 \end{array} \right] \xrightarrow{\substack{R_2 - R_1 \\ R_3 - R_1}} \left[ \begin{array}{ccc|c} 1 & 1 & 0 & 30.000 \\ 0 & -1 & 1 & 2.000 \\ 0 & 0 & 1 & 20.000 \end{array} \right] \xrightarrow{(-1)(R_2)} \left[ \begin{array}{ccc|c} 1 & 1 & 0 & 30.000 \\ 0 & 1 & -1 & -2.000 \\ 0 & 0 & 1 & 20.000 \end{array} \right] \xrightarrow{\substack{R_1 - R_2 \\ R_2 + R_3}} \left[ \begin{array}{ccc|c} 1 & 0 & 1 & 32.000 \\ 0 & 1 & 0 & 18.000 \\ 0 & 0 & 1 & 20.000 \end{array} \right] \xrightarrow{R_1 - R_3} \left[ \begin{array}{ccc|c} 1 & 0 & 0 & 12.000 \\ 0 & 1 & 0 & 18.000 \\ 0 & 0 & 1 & 20.000 \end{array} \right]$$

Jadi, harga 1 porsi Siomay = Rp 12.000  
 batagor = Rp 18.000  
 otak-otak = Rp 20.000

$x = 12.000$   
 $y = 18.000$   
 $z = 20.000$

Picture 9. Answers of Sanguinis Personality Type Students With High Literacy and Numeracy Skills

The following are excerpts of interviews with subjects with sanguine personality types with high literacy and numeracy skills.

Researcher : "Are you sure about your answer?"

Subject H : "Yes, I'm sure."

Researcher : "I see your work is excellent. The Gauss Jordan Elimination that you did is also correct."

Subject H : "Alhamdulillah."

Researcher : "Were there any obstacles during the learning process?"

Subject H : "No."

Researcher : "Ok. Thank you then."

Subject H : "You're welcome."

Based on the test and interview outcomes, it is evident that the subject adeptly employs mathematical symbols, demonstrates a keen understanding of the Gauss-Jordan elimination technique, and accurately formulates conclusions. These competencies align with the strengths of the sanguine personality type, characterized by a penchant for performance, enthusiasm, expressiveness, ease in making friends, creativity, a fun-loving nature, a willingness to assist others, and an active speaking style. From the discussion of the research findings, the literacy numeracy data were gleaned for each personality type—choleric, melancholic, phlegmatic, and sanguine. Recognizing students' personality types is crucial for educators, as it facilitates the learning process and effective group task allocation. Pairing a dominant choleric individual with a calm

and submissive phlegmatic one is advisable, fostering mutual understanding and tolerance (Faiz et al., 2022).

Similarly, a lively, optimistic individual complements a quiet and analytical melancholic counterpart. Additional research underscores the importance of positive support from the family, particularly parents, for students. At the same time, schools, especially teachers, must identify and provide tailored approaches for addressing students' diverse personality types (Avandri et al., 2023)(Cerni et al., 2021) to support the learning process (Harahap et al., 2023).

### Conclusions and Suggestions

The personality test administered to 47 students enrolled in the Malikussaleh University Mathematics Education study program yielded the following results: 8 individuals (17.02%) exhibited a choleric personality type, eight individuals (17.02%) displayed a melancholic personality type, 16 individuals (34.05%) demonstrated a phlegmatic personality type, and 15 individuals (31.91%) manifested a sanguine personality type. The assessment of students' literacy and numeracy skills in utilizing mathematical symbols yielded an average of 92.9%, while the indicators for analyzing information and making decisions scored 73.8% and 69%, respectively. Notably, the lowest literacy and numeracy proficiency, at 8.51%, was observed in individuals with a phlegmatic personality, whereas the highest proficiency, at 25.53%, was found among those with a sanguine personality type. It is essential to acknowledge the limitations of this research, which is confined to students within the Malikussaleh University mathematics education major. To enhance the generalizability of findings, researchers recommend incorporating a broader spectrum of subjects. Furthermore, the literacy and numeracy questions are specific to linear algebra courses. Researchers propose diversifying the courses in future studies to obtain a more comprehensive understanding of student's literacy and numeracy skills based on their personality types.

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