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Students' Numeracy Literacy Skills Based on Severe Mathematics Anxiety and Gender-Role Attributes (Masculine/Feminine): A Qualitative Case Study

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Abstract

This study aims to describe in depth the students' numeracy literacy abilities with severe mathematical anxiety from a masculine and feminine gender perspective. Severe mathematical anxiety can affect how students think, understand problems, and make decisions in solving mathematical problems. In addition, factors that influence mathematical performance are cognitive and affective patterns. Both of which are more related to gender-role than biological aspects (sex). This study considers gender perspectives, especially masculine and feminine, and it is expected to provide a more comprehensive picture of the diversity of students' numeracy literacy abilities. This study used a qualitative approach with a case study type. The research subjects were selected through purposive sampling, utilizing a case study approach involving two individuals with severe levels of mathematics anxiety, specifically representing masculine (BM) and feminine (BF) gender characteristics. The data collection was carried out through questionnaires, numeracy literacy tests, and in-depth interviews. These data were analyzed using data condensation techniques, data display, and conclusion drawing. The case study results indicate that subjects BM and BF are capable of identifying essential information and understanding the problem context. However, there were differences in the stages of problem solving. BM tends to be able to evaluate the reasonableness of calculation results, while BF is better able to convey logical conclusions and relate the results to the problem context. This finding shows the importance of implementing learning strategies that accommodate differences in student characteristics to improve numeracy literacy skills in the aspect of using mathematical concepts, facts, and procedures.

Keywords: Numeracy literacy; Mathematical anxiety; Gender-role attributes; Qualitative study

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INTRODUCTION

Mathematics is a subject that trains students' problem-solving skills. This problem-solving ability is crucial because students will face various challenges in their daily lives that require logical and systematic solutions. This is in line with the opinion of Saputri et al (2025) that mathematics is a science that equips students with logical and systematic thinking skills. Therefore, problem-solving skills need to be intensively practiced in the learning process, particularly in mathematics. This aligns with research findings that show that the most important part of mathematics learning is developing students' problem-solving skills. (Pathuddin et al., 2023; Widiastuti et al., 2024). Good problem-solving skills must be supported by strong numeracy literacy. This aligns with the research findings of Mulbar et al. (2023) that individuals with good numeracy literacy can clearly convey arguments when solving problems. Numeracy literacy is a person's ability to understand, interpret and apply mathematical concepts in the context of everyday life (Deda et al., 2023; Singh et al., 2023). Numeracy literacy is essential to prepare students to face the industrial era 4.0. Proficiency in numeracy literacy is very necessary so that students can adapt and overcome various challenges in the future (Saha et al., 2020). Apart from that, numeracy literacy is an indicator that serves as a reference for the quality of national education which is reflected in student learning outcomes (Kemdikbud, 2025).

The importance of numeracy literacy is inversely proportional to the numeracy skills possessed by students in Indonesia, which have not yet fully exceeded the minimum threshold. This can be seen from the Indonesian Education Report Card data for Senior High Schools (SMA), which is based on the results of the National Assessment (AN) conducted by the Ministry of Education, Culture, Research, and Technology in 2024. The data shows that only 70.31% of high school students have numeracy skills above the minimum threshold. (Kemdikbud, 2025). Teachers need to pay attention to this condition in order to increase students' numeracy literacy through implementing appropriate learning strategies. Before determining an appropriate learning strategy, an analysis of the factors causing low numeracy literacy of students is needed.

Several studies have shown that various factors influence students' numeracy literacy achievement, one of which is mathematical anxiety. This finding aligns with several studies showing that mathematical anxiety has a significant negative impact on students' mathematical performance, particularly in more complex tasks (Daker et al., 2023; Demedts et al., 2022; Moscoso et al., 2020; Orbach et al., 2020; Skagerlund et al., 2019). This anxiety often hinders students in learning mathematics, especially in solving more complex problems such as analyzing information and applying mathematical concepts in real-world contexts. Research conducted by Lunardon et al. (2022) showed that mathematical anxiety negatively impacts self-confidence and accuracy in calculations. Meanwhile, research by Ismaimuza et al. (2024) showed that students with severe anxiety made various types of errors in solving problems, while students with moderate anxiety made errors in the transformation stage, process skills, and answer writing. Students' negative perceptions of mathematics and boring learning methods contributed to increased anxiety, which significantly affected numeracy literacy skills. The more severe a student's level of mathematical anxiety, the lower their numeracy literacy skills (Gabriel et al., 2020).

This study focuses on students with severe mathematical anxiety because this condition significantly impacts their numeracy literacy skills. Students with severe mathematical anxiety tend to avoid mathematics learning, lose motivation to learn, and experience a drastic decline in achievement (Barroso et al., 2021; Jameson, 2020). This condition ultimately interferes with students' ability to perform calculations and understand numerical concepts necessary in everyday life (Hiller et al., 2022; Starling-Alves et al., 2022). Therefore, this study aims to explore in depth how severe mathematical anxiety hinders students' numerical thinking processes so that more appropriate management strategies can be formulated.

Several previous studies have examined the relationship between mathematical anxiety and mathematics learning performance. These findings generally indicate that mathematical anxiety is negatively correlated with students' problem-solving ability, mathematics achievement, and self-confidence in learning mathematics (Commodari et al., 2021; Demedts et al., 2022; Gabriel et al., 2020; Hiller et al., 2022; Li et al., 2023). Furthermore, several studies have also shown that mathematical anxiety affects students' cognitive processes, such as working memory capacity and the ability to process numerical information (Pelegrina et al., 2020; Skagerlund et al., 2019). Several other studies have linked mathematical anxiety to affective and social factors, including self-perception, supportive learning environments, and prior learning experiences. However, most of these studies have focused on the general relationship between mathematical anxiety and learning achievement and have primarily used quantitative approaches. These studies generally haven't explored in depth how math anxiety affects students' thinking processes when they face contextual numeracy tasks. Furthermore, studies specifically examining the learning experiences of students with severe math anxiety using a qualitative approach are still relatively limited.

In addition to mathematical anxiety, gender is also often associated with differences in students' numeracy literacy abilities. This is in line with Nurlu's (2025) opinion that what influences mathematical performance are cognitive and affective patterns, both of which are more related to gender than biological aspects (sex). A person's gender can be categorized into several types. According to Henra (2024), gender can be divided into four: masculine, feminine, androgynous, and undifferentiated. The results of research by Suningsih & Budayasa (2024) stated that masculine and feminine students have different abilities in solving problems, including problems involving numeracy literacy. This is supported by research results showing that masculine students are superior in literacy abilities because they are supported by good mathematical reasoning skills (Romadhon et al., 2024)

Existing research generally only compares mathematics performance by gender or only examines the relationship between mathematics anxiety and learning outcomes without considering the gender dimension as a factor influencing how students experience and express anxiety (Getenet, 2023; Iraola-real & Carvalho, 2025; Justicia-Galiano et al., 2023; Lunardon et al., 2022; Milovanović, 2020). Therefore, this study uses the concepts of masculine and feminine gender as an analytical framework, rather than biological sex. Sex refers to biological characteristics that are relatively fixed from birth, while gender relates to patterns of role, identity, and expression shaped by social and cultural constructs (Beltz et al., 2021; Kim et al., 2024). Research that addresses gender differences is better able to accommodate the diversity of mathematical abilities that exist in each individual (Ross, 2025). By using a gender perspective, this study seeks to understand more deeply the variations in mathematical anxiety experienced by students when facing activities that require numeracy literacy skills.

Despite its significance, existing literature has yet to qualitatively profile PISA numeracy literacy process indicators among students with severe mathematics anxiety through the lens of gender-role categorization. This study seeks to uncover in more depth the mechanisms by which severe mathematical anxiety influences students' numeracy literacy through masculine and feminine gender characteristics. This study not only compares the levels of anxiety or numeracy achievement between student groups but also explores how gender characteristics influence how students respond to anxiety when facing contextual numeracy literacy problems. Specifically, this study identifies differences in students' thinking patterns at each stage of numeracy literacy, starting from formulating contextual problems into mathematical models, using mathematical concepts, facts, and procedures, and interpreting, applying, and evaluating results. By examining these processes in depth, this study is expected to provide a more comprehensive picture of how mathematical anxiety and gender characteristics shape students' cognitive strategies in completing numeracy literacy tasks and enrich understanding of the dynamics of affective and social factors in mathematics learning.

The results of this study are expected to make a significant contribution to the world of education, particularly in helping teachers design mathematics learning strategies that are more adaptive to psychological and gender differences. This finding aligns with the research findings of Lopez-Pedersen et al. (2023), which stated that long-term interventions are needed to significantly improve student learning outcomes, particularly for students with low numeracy literacy skills. Interventions focused on cognitive support and emotional regulation be effective in borth reducing math anxiety and improving students' numeracy literacy (Cohen et al., 2021; García-santillán et al., 2022; Passolunghi et al., 2020; Sammallahti et al., 2023). Furthermore, the research findings of Mosia et al. (2025) suggest that gender gaps in numeracy literacy can be minimized in a more conducive learning environment.

Based on the background described above, the aims of this study are (1) to describe the numeracy literacy abilities of a student with severe mathematical anxiety and masculine gender, and (2) to describe the numeracy literacy abilities of a student with severe mathematical anxiety and feminine gender.

METHOD

Research Design

This is a qualitative descriptive case study. This approach was chosen because it aims to provide an in-depth description of students' numeracy literacy skills based on severe mathematical anxiety and masculine and feminine gender. The data were collected through a mathematical anxiety questionnaire, a gender questionnaire, a numeracy literacy test, and semi-structured interviews.

Research Instruments

The primary instrument in this study was the researcher herself. The researcher served as both a data collector and an analytical tool, interacting directly with the research subjects. This allowed the researcher greater flexibility in exploring the information in depth.

Supporting instruments used in this study included a mathematical anxiety questionnaire, a gender questionnaire, a numeracy literacy test, and a semi-structured interview guide. The mathematical anxiety questionnaire was used initially to determine student anxiety categories and serve as the basis for selecting subjects. The mathematics anxiety questionnaire used in this study was the Weighted Scoring-Based Mathematics Anxiety Rating Scale (WSB-MARS), developed by Tamal et al. It consisted of 15 questions, each of which was assigned a specific weight. The developed WSB-MARS had undergone expert validation and was therefore considered valid for measuring students' anxiety levels. The questionnaire was also declared reliable, with a Pearson coefficient of 0.968. It indicates that it can consistently measure students' anxiety levels across time. The scale model used in this questionnaire was the Likert Scale. The statements on the Likert Scale covered four frequency levels: never, rarely, sometimes, and very often. The questionnaire items are listed in Table 1.

Table 1. Mathematics Anxiety Questionnaire Items

No.	Items
1	Do you feel unusual nervousness when doing or thinking about maths?
2	Do you feel panic or cold, when calling on to answer maths related questions?
3	Do you have visible signs or nervousness (sweaty palms, shaky hands, and so on)?
4	Do you feel unusual nervousness when doing or thinking abaout maths?
5	Do you "fear of missing out" during math tests?
6	In spite of having good preparation, do you feel lack of confidence in math?
7	Do you suffer from fear or failure in maths subjects?
8	Do you think your parents/teachers expect a lot from you especially in maths subject?
9	Instead of understanding maths, do you prefer memorizing the process?
10	Do you practice math regularly?
11	Do you have trouble in sleeping at night especially before the day of maths test?
12	How often do you forget the lesson which you have just learnt?
13	Do you make mistakes on easy questions of maths that you knew very well?
14	How often do you have trouble finding words when you are talking to?
15	How often do you need to ask someone for repeating instructions or a story because you can was said in the first time around?

The weighting of each question and each answer refers to the Weighted Scoring Based Mathematics Anxiety Rating Scale (WSB-MARS) developed by Tamal et al. (2021) as listed in Table 2.

Table 2. Scoring of Items According to The Importance

Item	Importance of Items	Never	Rarely	Sometimes	Very Often
1	292,19	0	1	2	3
2	333,21	0	1	2	3
3	71,96	0	1	2	3
4	308,57	0	1	2	3
5	88,20	0	1	2	3

Item	Importance of Items	Never	Rarely	Sometimes	Very Often
6	313,22	0	1	2	3
7	377,84	0	1	2	3
8	443,81	0	1	2	3
9	112,49	0	1	2	3
10	187,16	0	1	2	3
11	359,94	0	1	2	3
12	110,44	0	1	2	3
13	145,89	0	1	2	3
14	155,51	0	1	2	3
15	193,17	0	1	2	3

Based on the weight of the questions and answers in the questionnaire, the maximum possible score that can be obtained was 10480.8, and the lowest possible score that can be obtained was 0. Based on the maximum and minimum scores, the level of student anxiety is categorized as shown in Table 3.

Table 3. Level of Math Anxiety

Level of Math Anxiety	Score
Normal	$0 \leq$ score $\leq$ 2620
Mild	$2620 <$ score ≤ 5240
Moderate	$5240 <$ score ≤ 7860
Severe	$7860 <$ score $\leq$ 10480,8

Next, a gender questionnaire was used in the initial stage to determine the students' gender categories as the basis for selecting subjects. The gender questionnaire used in this study was adapted from the Bem Sex Role Inventory (BSRI), consisting of 60 questions. Gender categorization in this study refers to the categorization according to Kamyab et al. (2025). Scores from the masculinity items were aggregated to obtain a total masculinity score, which was then averaged. Meanwhile, the scores from the femininity items were summed to obtain a total femininity score and calculated as the average. The median value for both categories, masculinity and femininity, was then determined. If the average score was above or equal to the median, it was considered a high level of masculinity or femininity; if it was below the median, it was considered a low level. The gender categorization is as shown in Table 4.

Table 4. Gender Categorization

Gender	Masculinity Item Score	Femininity Item Score
Masculine	$\bar{X}_M \geq Me_1$	$\bar{X}_F < Me_2$
Feminine	$\bar{X}_M < Me_1$	$\bar{X}_F \geq Me_2$
Androgyny	$\bar{X}_M \geq Me_1$	$\bar{X}_F \geq Me_2$
Undifferentiated	$\bar{X}_M < Me_1$	$\bar{X}_F < Me_2$

Information :
$\bar{X}_M$ = average score on the questionnaire for masculinity items
$\bar{X}_F$ = average score on the questionnaire for femininity items
Me_1 = median value for masculinity items
Me_2 = median value for femininity items

The next instrument used in this study was a numeracy literacy test. To measure the students' numeracy literacy skills, a numeracy literacy indicator was needed. The numeracy literacy indicators in this study refer to the numeracy literacy ability indicators in the Programme for International Student Assessment (PISA) conducted by the Organisation for Economic Co-operation and Development (OECD) (2023) as contained in Table 5.

Table 5. Indicators of Numeracy Literacy Ability

Aspects of Numeracy Literacy Ability	Indicators
1. Formulate contextual problems into mathematical models	1.1 Students can demonstrate mathematical ideas or concepts within contextual problems. 1.2 Students can identify important information from the context of the problem to formulate it mathematically. 1.3 Students can formulate contextual problems into appropriate mathematical models or representations.
2. Using mathematical concepts, facts and procedures	2.1 Students can use mathematical concepts, facts, or procedures correctly to solve problems. 2.2 Students can perform mathematical calculations and manipulations correctly. 2.3 Students can solve formulated problems. 2.4 Students can explain the reasons for using certain concepts, facts, or procedures to solve problems.
3. Interpret, apply, and evaluate the results	3.1 Students can convey final conclusions logically and contextually. 3.2 Students can relate mathematical results or solutions to the context of a given real-world problem. 3.3 Students can evaluate whether the results of calculations or mathematical reasoning are reasonable and relevant to the given problem.

The numeracy literacy test used in this study consisted of two questions, namely problem 1 (M1) and problem 2 (M2) as shown in Table 6.

Table 6. Numeracy Literacy Test

Question Codes	Questions
M1	*Mina padi* is an integrated farming system that combines the cultivation of rice and freshwater fish in the same paddy field. This system has been implemented by farmers in Negeri Lama Village, Bokat District, Buol Regency. It aims to simultaneously increase agricultural and fishery yields.  Mr. Rahman, a farmer in Negeri Lama Village, stocked 6,000 fish fry per hectare with a milkfish to tilapia ratio of 5:7. He used 2 hectares of land for cultivation. The price of milkfish fry was Rp 100 per fry, while tilapia fry was Rp 75 per fry. After 60 days, Mr. Rahman harvested a total of 9,000 kg of fish with the same weight ratio of milkfish to tilapia as the initial fry ratio, namely 5:7. The selling price of milkfish was Rp 45,000 per kg, while tilapia fry was Rp 37,000 per kg. Calculate Mr. Rahman's total cost of purchasing fry and the total income earned from fish sales.
M2	Persipal Palu is a football club from Central Sulawesi that competes in the Indonesian League 2. For a home match against a team from East Java, the committee printed 1,200 tickets, consisting of two types: East Stand tickets priced at Rp 50,000 and VIP tickets priced at Rp 100,000. All tickets were sold out, generating a total revenue of Rp 85,000,000.

Question Codes	Questions
	 After the match, the committee stated that VIP ticket revenue accounted for half of the total revenue, with the remainder coming from East Stand tickets. Is this statement correct? Explain and demonstrate the mathematical calculation.

Next, a semi-structured interview guide was used to explore students' perceptions, experiences, and attitudes toward numeracy literacy and mathematical anxiety. The interviews were conducted using a semi-structured approach, allowing the researcher to explore responses flexibly. The mathematical anxiety questionnaire and gender questionnaire used in this study were first validated by Munifah S.Psi., M.Psi., a lecturer in the Guidance and Counseling Study Program at Universitas Tadulako. The numeracy literacy test instrument and interview guide were validated by Dr. Sukayasa, M.Pd., a lecturer in the Mathematics Education Study Program at Universitas Tadulako.

Research Subjects

The subjects in this study were 195 tenth-grade students in the 2025/2026 academic year at a senior high school (SMA) in Palu City. The subject selection was conducted using a purposive sampling technique in several stages. First, a mathematical anxiety questionnaire and a gender questionnaire were administered to the 195 tenth-grade students. Based on the questionnaire results, the students were then grouped into four anxiety categories and four gender categories, as shown in Table 7.

Table 7. Distribution of Students by Mathematical Anxiety Categories and Gender Roles

Category	Gender				Total
	Masculine	**Feminine**	**Androgynous**	**Undifferentiated**	
Severe Anxiety	5	3	7	7	22
Moderate Anxiety	31	16	19	33	99
Mild Anxiety	18	13	17	17	65
Normal	3	3	1	2	9
Total	57	35	44	59	195

Based on Table 7, two students were selected as study subjects. First, one student with severe mathematical anxiety, with the highest anxiety score in the masculine gender category, hereafter referred to as BM. Second, one student with severe mathematical anxiety, with the highest anxiety score in the feminine gender category, hereafter referred to as BF.

Data Trustworthiness

The data validity technique used in this study involves credibility and dependability tests. The data credibility was checked using member checks while the data dependability was tested using an audit trail. The purpose of member checking was to determine the extent to which the information obtained corresponded to the original sources. When no discrepancies were identified between the data collected by the researchers and the information provided by the participants, the data were considered credible. Dependability was subsequently ensured through a comprehensive audit of all stages of the research process, aimed at examining the researchers' activities. This process included the preparation of the research proposal, the implementation of revisions, data collection from participants, the presentation of findings, and the preparation of the research report, all of which were conducted in consultation with the supervisor.

Data analysis

The data analysis used in this study was based on the data analysis technique according to Miles, Huberman, and Saldana (2014). It consisted of three main stages. First, data condensation was carried out by selecting, simplifying, and sharpening the data collected from the numeracy literacy test answer sheets and interview transcripts. The researcher summarized the results of the interviews, documentation, and the numeracy literacy test answer sheets, and then focused on relevant core points. Specifically, the focus was directed at analyzing the numeracy literacy skills of students with high levels of anxiety and based on masculine and feminine gender. After the condensation stage was completed, the next step was to present the data systematically. Through this presentation, emerging patterns in the data were more easily identified and analyzed. The final stage in data analysis was drawing conclusions based on the patterns found in the presented data. These conclusions were then verified by comparing them with relevant theories. In this study, the conclusions obtained provided an overview of the students' numeracy literacy abilities with severe mathematical anxiety who were masculine (BM) and the students with severe mathematical anxiety who were feminine (BF).

RESULTS AND DISCUSSION

BM Subject Numeracy Literacy Ability

Figure 1 shows the results of the BM subject's numeracy literacy test in solving M1. Meanwhile Figure 2 shows the BM subject's numeracy literacy test results in solving M2.

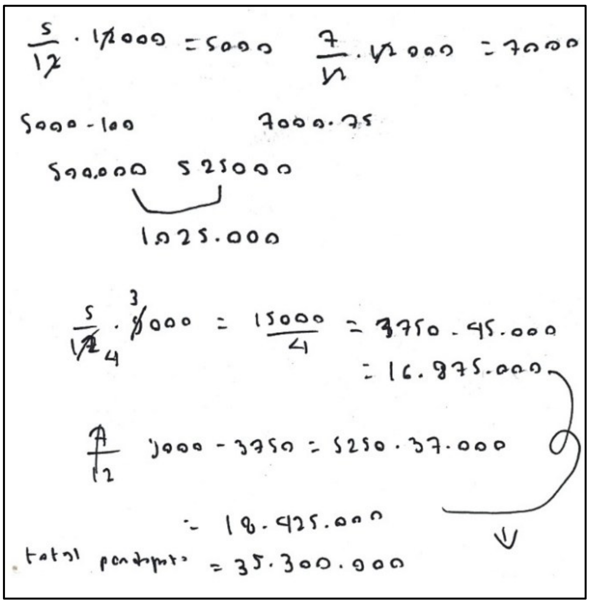

Figure 1. Results of BM's numeracy literacy test in solving M1

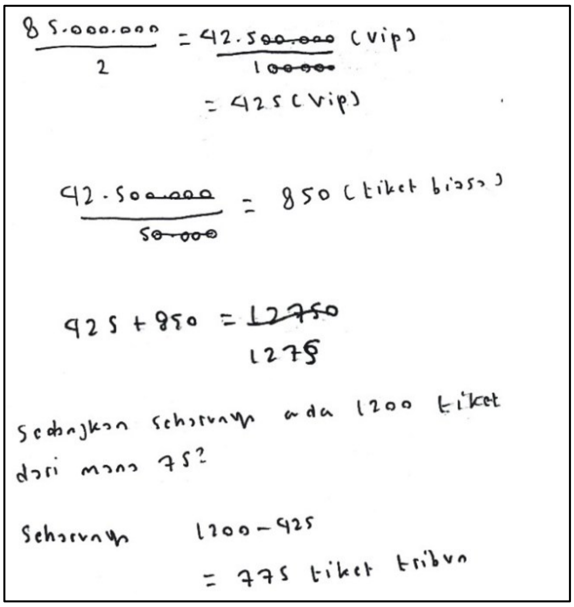

Figure 2. Results of BM's numeracy literacy test in solving M2

Next, the results of interviews with BM subjects in completing M1 and M2 are presented as shown in Table 8.

Table 8. Interview Results with BM Subjects

M1			**M2**		
P	:	What mathematical concept or idea is contained in the question?	P	:	What mathematical concept or idea is contained in the question?
BM	:	I think it's a ratio, sir.	BM	:	Arithmetic I think sir
P	:	What important information did you find from the question?	P	:	What important information did you find from the question?
BM	:	Farmers produce 6,000 fish fry per hectare. The ratio of milkfish to tilapia is 5:7, and the cultivation area is 2 hectares. The price of	BM	:	*First,* 1,200 tickets were printed. The tickets were available in two types: regular tickets and VIP tickets. Grandstand tickets cost Rp

M1			M2		
		milkfish fry is Rp. 100 per fish, while the tilapia fry is Rp. 75 per fish. Mr. Rahman harvested a total of 9,000 kg with a ratio of 5:7. The selling price of milkfish is Rp. 45,000 per kg, while tilapia fry is Rp. 37,000 per kg.			50,000 per ticket, while VIP tickets cost Rp 100,000 per ticket. The total revenue was Rp 85,000,000. The committee later stated that VIP ticket revenue accounted for half of the total revenue.
P	:	How would you turn this problem into mathematical form?	P	:	So there is nothing made in mathematical form, right?
BM	:	First I use the comparative property, for example there is P:Q, then the formula is $\frac{P}{P+Q}$	BM	:	There isn't any.
P	:	So what concept or formula did you use to solve the problem?	P	:	What mathematical formula concept did you use to solve this problem?
BM	:	Ratio	BM	:	Ordinary multiplication and division.
P	:	Why did you choose this method or step over other methods?	P	:	Why did you choose this step or method over other methods for finding the number of tickets?
BM	:	Because it's easy.	BM	:	This is the only way I know
P	:	Does the answer you got match the context or story in the question?	P	:	Does the answer you got match the context or story in the question?
BM	:	I think it's wrong.	BM	:	Yes, It does.
BM	:	Because there are some parts that are miscalculated.	BM	:	Because if it is multiplied again, the result is the same.

Furthermore, the researcher analyzed the data from the numeracy literacy tests and interviews of subject BM based on the PISA numeracy literacy framework, as presented in Table 5.

Formulating Contextual Problems into Mathematical Models

Based on the results of interviews with subject BM in solving Problem 1, it was found that BM stated that M1 was related to the concept of comparison. Meanwhile, in M2, BM incorrectly identified the idea or concept contained in the problem. The idea or concept contained in M2 was related to algebra, specifically systems of linear equations in two variables, but BM stated that M2 was related to arithmetic. These data indicate that BM was not consistently able to demonstrate mathematical ideas or concepts within contextual problems.

Furthermore, the interview results showed that subject BM was able to cite important information from M1, including the number of fish fry released, the ratio of tilapia to milkfish, the area of land used, the price of fry per fish, the fish harvest, and the selling price of milkfish and tilapia. BM was also able to cite important information obtained from M2, namely the number of tickets printed, the price of each VIP ticket, and the east stand, and the total revenue from ticket sales. These data show that BM can identify important information from the problem context and formulate it mathematically.

The interview results showed that BM used the proportional property of $\frac{\mathrm{P}}{\mathrm{P+Q}}$ to solve M1. However, in solving M2, BM did not use mathematical modeling. These data indicate that BM was unable to consistently formulate contextual problems into mathematical models or representations accurately.

Based on the data analysis above, it can be seen that in formulating contextual problems mathematically, BM only met Indicator 1.2, namely, determining important information from the problem context for mathematical formulation. In the BM case, the ability to determine important information from the problem context can still emerge because the process primarily involves early cognitive activities such as reading, identifying facts, and selecting explicit information in the problem (Suningsih & Budayasa, 2024). Masculine gender characteristics, which tend to think more directly, focus on goals, and be oriented toward problem solving, enable students to still be able to extract data or information even when under conditions of severe anxiety (Kamyab et al., 2025). However, severe mathematical anxiety tends to interfere with advanced cognitive processes such as organizing ideas, activating conceptual knowledge schemes, and processing information in working memory (Pelegrina et al., 2020). As a result, students experience difficulties when they have to move to a more abstract stage, namely, identifying the mathematical ideas or concepts underlying the problem and transforming the contextual situation into an appropriate mathematical model or representation. This is in line with the results of research by Ismaimuza et al. (2024), which stated that although students with severe mathematical anxiety can read problems well, they are unable to identify the mathematical concepts in the problem. Furthermore, mathematical anxiety limits the cognitive processing capacity needed for mathematical modeling and conceptual connections, so students are only able to stop at the information identification stage without successfully constructing a mathematical representation that fits the problem structure (Li et al., 2023).

Using Mathematical Concepts, Facts, and Procedures

Based on Figure 1, BM completed M1 by calculating the number of milkfish seeds using the comparison concept, namely $\frac{5}{12} \times 12000 = 5000$. Next, BM calculated the number of tilapia fish seeds, namely $\frac{7}{12} \times 12000 = 7000$. Then, BM calculated the cost of purchasing seeds by multiplying the number of seeds by the price of fish seeds per tail. BM calculated the total expenditure for purchasing fish seeds per tail by adding the cost of purchasing milkfish and tilapia fish seeds, so that the total expenditure was Rp. 1,025,000. After that, BM took the right step by calculating the income from the sale of milkfish and tilapia fish using the comparison concept, so that the total income was Rp. 35,300,000. Meanwhile, in Figure 2, it can be seen that BM completed M2 by calculating the number of VIP tickets and east tribune tickets by dividing the total income from ticket sales, namely Rp. 85,000,000 divided by 2. This shows that BM is using the wrong concepts and procedures because he did not use a two-variable linear equation system to determine the number of tickets sold. The data shows that BM cannot use mathematical concepts, facts, or procedures correctly in solving the problem.

In M1, BM made an error in calculating the result 3570 × 45000 and also in calculating the result 5250 × 37000. Meanwhile, in M2, BM correctly performed integer operations at each step of the solution. These data indicate that BM was not consistently able to perform mathematical calculations and manipulations correctly.

Based on Figure 1, BM was able to obtain the total expenditure from purchasing seeds and the total revenue from selling fish despite the calculation errors. Meanwhile, in M2, BM was unable to find a solution to the given problem. This is shown in Figure 2, where BM was confused by the calculation results, as indicated by the sentence "where does 75 come from?". These data indicate that BM was not consistently able to solve the formulated problem.

Based on the interview results, BM used the concept of comparison in solving M1 because it was the easiest method to use to answer the problem in M1. Meanwhile, in M2, BM stated that this was the only method he knew to solve the given problem. The data shows that BM cannot specifically explain the reasons for using certain concepts, facts, or procedures in solving problems.

Based on the data analysis above, it appears that BM cannot meet all numeracy literacy indicators in the aspect of using mathematical concepts, facts, and procedures. The inability to use mathematical concepts, facts, or procedures correctly and the difficulty in performing mathematical calculations and manipulations are related to the interaction between affective stress due to anxiety and the characteristics of cognitive tendencies that often appear in masculine gender orientation. High mathematical anxiety can increase the cognitive load on working memory so that mental resources that should be used to access concepts, choose appropriate procedures, and perform mathematical manipulations are disrupted (Güner & Gökçe, 2021; Núñez-peña & Campos-rodríguez, 2024; Putri & Miatun, 2023). Under conditions of severe anxiety, students tend to rush to take steps to solve problems without conducting adequate conceptual reflection (Colomé & Núñez-peña, 2021; Ismaimuza et al., 2024). Meanwhile, according to Colome (2021), someone with severe mathematical anxiety tends to be unable to find alternative solutions to solve problems due to low cognitive flexibility. Furthermore, students who experience severe mathematical anxiety often do not implement problem-solving plans appropriately due to confusion and calculation inaccuracies (Umbara et al., 2024). For students with severe mathematical anxiety to be able to solve problems, they must be supported by good metacognitive skills (Fajri & Amir, 2022). Meanwhile, masculine tendencies in the context of learning are often associated with a results-oriented and high self-confidence in initial answers, so students do not double-check the procedures used (Kamyab et al., 2025). The combination of these two factors causes students not only to make mistakes in mathematical calculations and manipulations, but also to have difficulty solving problems that have been formulated systematically and to be unable to explain the reasons for using certain concepts, facts, or procedures, because their thinking processes are more dominated by quick responses under the pressure of anxiety compared to reflective and structured mathematical reasoning (Commodari et al., 2021; Pantoja et al., 2020).

Interpreting, Applying, and Evaluating Results

Based on Figure 1, BM can conclude the total expenditure for fish seed sales and the total revenue from fish sales. Meanwhile, in Figure 2, BM fails to conclude the validity of the committee's statement that VIP ticket revenue contributed half of the total revenue from ticket sales due to doubts about the calculation results obtained. These data indicate that BM is unable to consistently convey final conclusions logically and contextually.

Based on the interview results, BM can explain the calculation results obtained in M1. Meanwhile, in M2, BM cannot connect the calculation results obtained to the given problem. This is because BM is confused because the number of tickets BM obtained from the calculation results differs from the number of tickets given in the problem. These data indicate that BM is unable to relate the mathematical results or solutions to the context of the given real-world problem.

The interview results with BM indicate that the solution obtained in M1 does not align with the context of the given problem due to calculation errors in several steps. Meanwhile, in M2, BM checks the obtained answers by multiplying each ticket quantity by the ticket price. The data shows that BM can evaluate the results of mathematical calculations or reasoning that are reasonable and relevant to the given problem.

Based on the data analysis above, BM only met Indicator 3.3 in the aspect of interpreting, applying, and evaluating results. In the BM case, the ability to evaluate whether the results of calculations or mathematical reasoning are reasonable can still emerge because the internal evaluation process of mathematical steps is more procedural and rule-based (Scheibe et al., 2022; Suningsih & Budayasa, 2024). Masculine gender characteristics that tend to be analytical and focus on logical structures allow students to continue checking the correctness of calculations or the appropriateness of the procedures used even when under conditions of high anxiety (Kamyab et al., 2025). However, severe mathematical anxiety significantly burdens working memory and interferes with the integration of mathematical representations with contextual meaning (Pelegrina et al., 2020). As a result, students experience difficulty in reconnecting the calculation results obtained to the given problem (Núñez-peña & Campos-rodríguez, 2024). Emotional pressure from anxiety makes students' attention more focused on procedural solutions than on interpreting the results, so that students are unable to link mathematical solutions to the context of the problem or formulate final conclusions logically and relevantly to the given situation (Kusmaharti et al., 2025).

BF Subject Numeracy Literacy Ability

Figure 3 shows the results of the BF subject's numeracy literacy test in solving M1. Meanwhile Figure 4 shows the BF subject's numeracy literacy test results in solving M2.

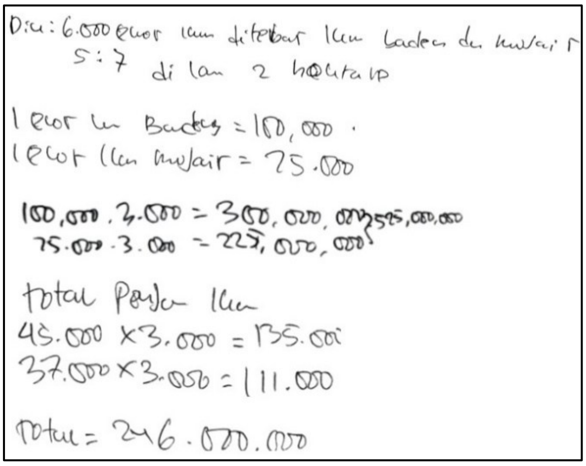

Figure 3. Results of BF's numeracy literacy test in solving M1

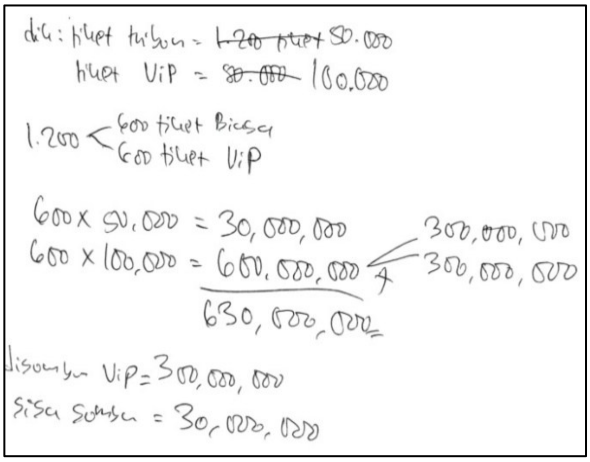

Figure 4. Results of BF's numeracy literacy test in solving M2

Next, the results of interviews with BF subjects in completing M1 and M2 are presented as shown in Table 9.

Table 9. Interview Results with BF Subjects

M1			**M2**		
P	:	What mathematical concept or idea is contained in the question?	P	:	What mathematical concept or idea is contained in the question?
BF	:	Ratio	BF	:	Linear equations of two variables.
P	:	What important information did you find from the question?	P	:	What important information did you find from the question?
BF	:	Farmers stocked 6,000 fish fry per hectare with a milkfish to tilapia ratio of 5:7. Two hectares of land were used for cultivation. The price of milkfish was Rp. 100 per fish, while tilapia was Rp. 75. Mr. Rahman harvested 9,000 kg of fish. The selling price of milkfish was Rp. 45,000 per kilogram, while tilapia was Rp. 37,000 per kilogram.	BF	:	The committee printed 1,200 tickets, consisting of two types: East stand tickets priced at Rp50,000 and VIP tickets priced at Rp100,000. The total revenue generated reached Rp85,000,000. The committee stated that VIP ticket revenue accounted for half of the total revenue, with the remainder coming from East stand tickets. The question is, is this true?
P	:	Why did you choose that method or step over another?	P	:	Why did you choose that method or step over another?
BF	:	Because I don't really understand the formula for linear equations of two variables.	BF	:	If I use the formula for linear equations with two variables, I don't really understand it for story problems like this.
P	:	What do you feel?	P	:	What concept is used?
BF	:	Lack of focus and nervousness. Fear of oneself.	BF	:	I multiply 600 east tribune tickets by the price of 50,000 so the result is 30,000,000
P	:	Can you explain the final result?	P	:	How much do you earn from VIP tickets?
BF	:	For the seed sales, it was 525,000,000.	BF	:	The total price for the VIP ticket is 600×100,000 = 600,000,000

M1			M2		
P	:	Does the answer you got match the context or story in the question?	P	:	Does the answer you got match the context or story in the question?
BF	:	As for the answer, it's actually not appropriate.	BF	:	Based on my answer, the statement is still not quite right.
BF	:	Because in the answer that I calculated, I made a calculation error and a reasoning error.	BF	:	Because here for all tickets sold, the income earned reaches 85,000,000, while what I get here is 630,000,000

Furthermore, the researcher analyzed the data from the numeracy literacy tests and interviews of subject BF based on the PISA numeracy literacy framework, as presented in Table 5.

Formulating Contextual Problems into Mathematical Models

Based on the interview results, BF stated that M1 related to the concept of ratio. Meanwhile M2 related to a system of linear equations in two variables. These data indicate that BF can show mathematical ideas or concepts within contextual problems.

In M1, BF mentioned important information, including the number of fish fry released, the ratio of tilapia to milkfish, the area of land used, the price of fry per fish, the fish harvest, and the selling price of milkfish and tilapia. Meanwhile, in M2, BF was able to cite known and questionable information, including the number of tickets printed, the price of each VIP ticket and the east stand, and the total revenue from ticket sales. These data indicate that BF can identify important information from the problem context to formulate it mathematically.

Test results and interviews indicated that BF did not perform mathematical modeling of the problems presented in M1 and M2. These data indicated that BF was unable to formulate contextual problems into appropriate mathematical models or representations.

Based on the data analysis above, BF can fulfill Indicators 1.1 and 1.2 in the aspects of formulating contextual problems into mathematical models. However, BF cannot fulfill Indicator 1.3. BF can demonstrate mathematical ideas or concepts in contextual problems and identify important information because, in the initial stages of problem solving, they are still able to understand the context through the process of reading, interpreting situations, and connecting them with existing conceptual knowledge (Putri & Miatun, 2023; Susanti et al., 2024). The characteristics of feminine tendencies that are often associated with accuracy, sensitivity to context, and thoroughness in understanding information make students relatively able to recognize relevant concepts and select important information from problems (Kamyab et al., 2025). However, high mathematical anxiety tends to interfere with advanced cognitive processes, especially at the stage of transforming problems from contextual language to formal mathematical forms (Husni & Herman, 2024). Emotional distress due to anxiety can limit working memory capacity and reduce confidence when performing symbolic representations or more abstract mathematical modeling (Doz et al., 2024; Pelegrina et al., 2020). As a result, even though students can understand the context and recognize the concepts involved, they have difficulty transforming this understanding into appropriate mathematical models or representations, such as equations, diagrams, or other symbolic forms (Susanti et al., 2024).

Using Mathematical Concepts, Facts, and Procedures

Figure 1 shows that in solving M1, BF made an error in determining the quantity of each fish fry because he did not use the concept of proportion. BF also made an error in determining the total expenditure for purchasing fish fry. Meanwhile, Figure 2 shows that in solving M2, BF directly divided 1,200 tickets by 2, resulting in 600 tickets for the east stand and 600 tickets for the VIP section. Furthermore, BF did not use the concept of a two-variable linear equation in solving M2. These data indicate that BF failed to correctly use mathematical concepts, facts, or procedures to solve the problem. In M1, BF incorrectly calculated the total revenue from fish sales because he did not first calculate the quantity of each type of fish. He directly multiplied the selling price of each fish by 3,000. In M2, BF made an error in calculating the total revenue for VIP tickets. These data indicate that BF failed to perform mathematical calculations and manipulations correctly.

The interviews with the subjects revealed that BF was confused about how to use the comparison values given in M1. Meanwhile, in M2, BF was unable to correctly calculate the revenue from VIP ticket sales. These data indicate that BF was unable to solve the formulated problem. Furthermore, BF cannot provide a rationale for selecting the solution steps used in solving M1. Meanwhile, in M2, BF lacked a clear understanding of how to use a two-variable linear equation system in a word problem, had difficulty reasoning, and was confused about determining the steps in solving the problem. These data indicate that BF was unable to explain in detail the reasons for using the concepts, facts, or procedures used in solving the problem.

Based on the data analysis above, it can be seen that BF did not meet all the indicators of numeracy literacy in the aspect of using mathematical concepts, facts, and procedures. The main causes were BF's lack of conceptual understanding, experiencing confusion and fear in solving problems, and making errors in integer operations. In the BF case, difficulties in using mathematical concepts, facts, and procedures correctly are generally associated with high emotional stress that interferes with cognitive processes when solving problems (Živković et al., 2022). Intense anxiety can reduce working memory capacity, making it difficult for students to access previously learned mathematical knowledge, perform calculations accurately, and systematically perform symbolic manipulation (Commodari et al., 2021; Pantoja et al., 2020; Pelegrina et al., 2020). Furthermore, anxiety can also reduce self-confidence and increase doubts about the steps taken, so students tend to hesitate in applying appropriate procedures or problem-solving strategies (Rahe & Quaiser-Pohl, 2021). In line with the research results of Ismaimuza et al. (2024), students who experience severe mathematical anxiety often provide answers without adequate explanations and tend to rush in solving the problems given. Students with severe mathematical anxiety are often unable to solve the problems given because they are confused about using the information provided in the problem and are lazy in finding the right solution strategy (Umbara et al., 2024). Feminine gender characteristics that tend to be more sensitive to evaluative pressure and worry about mistakes can strengthen the effects of this anxiety which ultimately causes students to be unable to solve problems that have been formulated mathematically or explain in detail the reasons for choosing concepts, facts, or procedures used in the problem-solving process (Kamyab et al., 2025; Romadhon et al., 2024).

Interpreting, Applying, and Evaluating Results

Based on the interview results, BF can conclude the total expenditure for seed purchases and total revenue from fish sales, based on calculations. Meanwhile, in M2, BF can conclude the validity of the committee's statement regarding total revenue from VIP ticket sales. These data demonstrate that BF was able to draw conclusions logically and contextually.

In M1, BF stated that the calculation result, Rp. 525,000,000, was the total expenditure for purchasing seeds. Meanwhile, in M2, Rp. 30,000,000 was the result of east stand ticket sales and Rp. 600,000,000 was the result of VIP ticket sales. This data demonstrates that BF can relate mathematical results or solutions to the context of the given real-world problem.

In solving M1, BF realized that his solution was incomplete due to calculation errors and logical errors. Meanwhile, in M2, BF only calculated the total revenue of 63,000,000 and failed to evaluate the validity of the committee's statement regarding the total revenue from VIP tickets. These data indicate that BF was unable to evaluate whether the calculation results or mathematical reasoning were reasonable and relevant to the given problem.

Based on the data analysis above, it can be seen that BF meets Indicators 3.1 and 3.2, but fails to meet Indicator 3.3. In the BF case, the ability to convey final conclusions logically and connect them to the context of real problems can still emerge because students tend to focus on the meaning of the situation and understanding the context of the problem given (Kusmaharti et al., 2025; Scheibe et al., 2022). Feminine gender characteristics tend to pay attention to the relationship between information in the problem and the real situation so that they are able to re-narrate the results of the solution into a conclusion that is appropriate to the context (Romadhon et al., 2024). However, severe levels of mathematical anxiety can interfere with higher-order thinking processes related to monitoring and evaluating solution strategies (Kusmaharti et al., 2025). This anxiety condition reduces students' working memory capacity and concentration when having to re-check calculation steps or assess the reasonableness of the results obtained (Pelegrina et al., 2020). As a result, although students can relate answers to the problem context and draw logical conclusions based on the solution flow they follow, they struggle to critically evaluate whether the results of the calculations or mathematical reasoning used are truly reasonable and relevant to the given problem conditions (Rolison et al., 2020). Students with severe mathematical anxiety tend not to enjoy the process of solving math problems and therefore rush through solving problems without checking the correctness of their written answers (Maloney & Retanal, 2020).

Comparison of Numeracy Literacy Skills between BM and BF

Based on the results and discussion presented above, the researcher presented the indicators fulfilled by the research subjects in Table 10. If the indicator was fulfilled, it was marked with a check mark (√). Meanwhile, if the indicator was not fulfilled, it was marked with a cross (×).

Table 10. Summary of Numeracy Literacy Indicator Achievement by BM and BF

Subject	Indicator									
	1.1	1.2	1.3	2.1	2.2	2.3	2.4	3.1	3.2	3.3
BM	×	√	×	×	×	×	×	×	×	√
BF	√	√	×	×	×	×	×	√	√	×

Based on Table 10, BM anda BF can fulfill Indicator 1.2, namely determining important information from the problem context to be formulated mathematically because this stage is more related to the process of understanding the context and identifying facts stated in the problem rather than performing complex mathematical manipulations. Although severe mathematical anxiety often interferes with cognitive performance at more complex processing stages, the ability to read problem situations and extract basic information is still relatively possible (Suningsih & Budayasa, 2024). The difference appears at the advanced reasoning stage, which is influenced by gender characteristics. Students with severe mathematical anxiety who are masculine tend to show an analytical and critical orientation so they are better able to evaluate whether the results of calculations or mathematical reasoning obtained are reasonable and relevant to the given problem (Kamyab et al., 2025; Scheibe et al., 2022; Suningsih & Budayasa, 2024). In contrast, BM dan BF show a greater tendency towards understanding the meaning and communication of ideas, so that they are better able to identify mathematical ideas or concepts contained in contextual problems, convey final conclusions logically and contextually, and reconnect mathematical solutions with the real situation that underlies the problem (Kusmaharti et al., 2025; Romadhon et al., 2024).

These findings have important implications for education, namely the need for learning strategies that accommodate different student characteristics (Cranley et al., 2022; Doz et al., 2024; Lievore et al., 2024). Teachers not only need to reduce mathematical anxiety through supportive and contextual learning approaches but also facilitate the development of different abilities in each student (Buckley & Sullivan, 2023; Commodari et al., 2021). Adaptive and inclusive learning approaches like this have the potential to improve students' numeracy literacy skills more comprehensively (Gabriel et al., 2020).

CONCLUSION

Based on the results and discussion, it can be concluded that BM and BF can identify important information from the problem context to formulate it mathematically. There were differences in the abilities of BM and BF. BM can evaluate whether the results of calculations or mathematical reasoning are reasonable and relevant to the given problem. Meanwhile, BF can show mathematical ideas or concepts within contextual problems, convey final conclusions logically and contextually, and relate mathematical results or solutions to the context of the given real-world problem. BF and BM cannot meet all indicators of numeracy literacy skills in the aspect of using mathematical concepts, facts, and procedures. This needs to be taken into consideration by teachers when designing learning that can strengthen conceptual understanding in students with severe mathematical anxiety.

A limitation of this study was that the students' numeracy literacy skills with androgynous and undifferentiated genders were not described. The effects of mathematical anxiety may also occur in both genders, so further research is needed. Furthermore, it is also necessary to provide a picture of the numeracy literacy skills of students with moderate and low mathematical anxiety so that teachers can design more inclusive learning. In addition, this study bases its findings on two case profiles to provide analytical insights rather than statistical generalization.

RECOMMENDATION

Based on the research results, the researcher recommends several recommendations: teachers should design learning that focuses not only on cognitive achievement but also on affective aspects, particularly student anxiety. Furthermore, further research is recommended to expand the research subject area to include gender androgynous and gender undifferentiated categories.

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AUTHOR CONTRIBUTIONS STATEMENT

Name of Author	C	M	So	Va	Fo	I	R	D	O	E	Vi	Su	P	Fu
Aswan	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓	✓
Pathuddin	✓	✓		✓	✓		✓	✓		✓		✓	✓	
Dasa Ismaimuza	✓	✓		✓	✓		✓	✓		✓		✓	✓	

CONFLICT OF INTEREST STATEMENT

Authors state no conflict of interest.

DATA AVAILABILITY

Data supporting the findings of this study can be obtained by contacting the corresponding author.

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