

FACTORS INFLUENCING JUNIOR HIGH SCHOOL STUDENTS' NUMERACY SKILLS IN SOLVING ELECTRICITY COST PROBLEMS

Syaiful Hamzah Nasution¹, Al Jupri^{2*}, Abdul Halim Abdullah³, Bambang Avip Priatna Martadiputra⁴, Elvandri Yogi Pratama⁵

^{1,2*,4,5} Faculty of Mathematics and Natural Sciences Education, Universitas Pendidikan Indonesia, Bandung, Indonesia

³ Faculty of Educational Sciences and Technology, Universiti Teknologi Malaysia, Johor, Malaysia

* Corresponding author. Jl. Dr. Setiabudi 229, Sukasari, Bandung, Indonesia

E-mail: syaifulturen@gmail.com¹
aljupri@upi.edu^{2*}
p-halim@utm.my³
bambangavip@upi.edu⁴
elvandriyogipratama@upi.edu⁵

Received 06 June 2026; Received in revised form 19 June 2026; Accepted 26 June 2026

ABSTRACT

To support the SDGs, teachers can integrate numeracy problems based on real-life contexts, such as electricity costs. This study aims to describe junior high school students' numeracy skills in solving such problems and to identify the influencing factors. The participants were 152 eighth-grade students selected through purposive sampling, all of whom had mastered the prerequisite material. Data collection was conducted through students' written responses and interviews with selected students. The findings revealed that students' numeracy skills remain low, with a mean score of 32.57, falling into the requiring special intervention category. The contributing factors include unfamiliarity with numeracy problems, difficulties in comprehending contexts, tables, and stimuli, a lack of knowledge of appropriate mathematical tools, weak foundational numeracy skills, errors in data interpretation while reading, infrequent provision of numeracy problems by teachers, and students' anxiety when engaging with numeracy tasks. This study concludes that students' difficulties stem from limited contextual understanding and an inability to apply mathematical concepts appropriately. The implications underscore the need for teachers to provide more frequent exposure to contextual numeracy problems, incorporate explicit instruction on table reading and stimulus interpretation, and implement anxiety-reduction strategies within mathematics classrooms.

Keywords: electricity cost; influence factors of numeracy; numeracy; obstacle; SDGs

ABSTRAK

Untuk mendukung SDGs, guru dapat mengintegrasikan soal-soal numerasi berdasarkan konteks kehidupan nyata, seperti biaya listrik. Penelitian ini bertujuan mendeskripsikan kemampuan numerasi siswa sekolah menengah pertama dalam menyelesaikan soal-soal tersebut serta mengidentifikasi faktor-faktor yang memengaruhinya. Partisipan penelitian adalah 152 siswa kelas VIII yang dipilih melalui teknik purposive sampling, yang seluruhnya telah menguasai materi prasyarat. Pengumpulan data dilakukan melalui jawaban tertulis siswa dan wawancara dengan siswa terpilih. Temuan penelitian mengungkapkan bahwa kemampuan numerasi siswa masih rendah, dengan rerata skor 32,57 yang termasuk dalam kategori intervensi khusus. Faktor-faktor yang berkontribusi meliputi ketidakakrabans dengan soal numerasi, kesulitan dalam memahami konteks, tabel, dan stimulus, kurangnya pengetahuan tentang alat matematika yang tepat, lemahnya keterampilan numerasi dasar, kesalahan dalam menafsirkan data saat membaca, jarangya pemberian soal numerasi oleh guru, serta kecemasan siswa ketika mengerjakan tugas numerasi. Penelitian ini menyimpulkan bahwa kesulitan siswa bersumber dari pemahaman konteks yang terbatas dan ketidakmampuan dalam menerapkan konsep matematika secara tepat. Implikasi dari temuan ini menekankan perlunya guru memberikan paparan yang lebih sering terhadap soal-soal numerasi kontekstual, mengintegrasikan

pengajaran eksplisit tentang membaca tabel dan menafsirkan stimulus, serta menerapkan strategi pengurangan kecemasan di dalam kelas matematika.

Kata kunci: biaya listrik; faktor yang mempengaruhi numerasi; hambatan; numerasi; SDGs



This is an open access article under the [Creative Commons Attribution 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

Introduction

The unsustainable exploitation of resources and the pollution and waste generated by human activities threaten the survival of future generations on Earth (Domínguez-González & Delgado-Martín, 2022). This issue has become a serious concern for many countries, and they must jointly make efforts to provide meaningful understanding, awareness, and knowledge about sustainable development. To address this, the United Nations (2015) set seventeen Sustainable Development Goals (SDGs), which are urgent calls for all member countries of the United Nations to achieve these goals.

To support the SDGs, educational institutions can respond by providing education about sustainable development through education. Education for sustainable development has been supported and promoted in recent decades by international organizations such as the United Nations through the Global Programme of Action on Education for Sustainable Development (UNESCO, 2014). Education plays a fundamental role in social development, and in this regard, mathematics has an important role because mathematics is the language used to understand the world (Avigad, 2015; Hudson, 2020; Moschkovich, 2024). In addition, mathematics can serve as an instrument to measure and analyze complex realities (Domínguez-González & Delgado-Martín, 2022). Through mathematics, students learn to identify, understand, reason, and use the basics of mathematics needed to solve problems in everyday life (Anggraeni et al., 2019).

The two SDGs referred to in this research are Goals 4 and 12. Goal 4 is to Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (United Nations, 2015). This goal ensures open and equitable education and promotes lifelong learning opportunities for all. One of the focuses of Goal 4 is the acquisition of basic and higher skills at all levels of education and the values needed to contribute to social life. Furthermore, Goal 12, Responsible Production and Consumption (United Nations, 2015), commits countries to make fundamental changes in producing and consuming goods and services. Each individual is expected to contribute to changing unsustainable consumption and production patterns through this goal. This goal can only be achieved if consumers utilize limited resources adequately and equitably. The consumption and use of electrical energy must be managed carefully and responsibly to ensure its availability in the future. To support Goal 12 of the SDGs, people must be encouraged to adopt a more sustainable lifestyle by reducing and saving energy consumption.

The role of teachers in supporting the SDGs is to provide real-world problems that are learning-relevant to sustainable development. According to Blitstein et al. (2020), there is a growing interest in using real-world contexts in education to support numeracy skills. Integrating real-world contexts into learning enables

students to understand and address global challenges and apply mathematical concepts to solve problems arising from those contexts. More specifically, mathematics teachers can support the SDGs through numeracy problems by: (1) integrating SDG-related issues, such as responsible energy consumption, waste management, or food security, into numeracy problems; (2) designing problems that require students to interpret data and make decisions based on SDG-relevant information, for example, calculating energy savings, comparing costs, or analyzing consumption data; and (3) encouraging students to reflect on their role as individuals in contributing to the achievement of the SDGs. Through this approach, students not only enhance their numeracy skills but also gain an understanding of global issues and contribute to sustainable development.

Students need to master numeracy well to become numerate (OECD, 2024; Ogunsola & Adigun, 2025). In recent years, a numerate society has become a goal of government agencies both nationally and internationally (O' Sullivan, 2023; O'Sullivan et al., 2021; O'Sullivan & Goos, 2022; Sakurai et al., 2021; Sakurai & Goos, 2023). Genc & Erbas (2019) argue that mathematical understanding is at the core of individual readiness to face problems and challenges in daily life in personal, work, social, and scientific aspects. With numeracy, individuals can learn to solve everyday problems using mathematical reasoning to be prepared to face life's challenges (Goos et al., 2014; Stacey & Turner, 2015). Thus, numeracy is one of the crucial abilities that students must master to face future challenges.

However, various research findings indicate that Indonesian students' numeracy skills remain relatively low, particularly in solving contextual problems. The PISA 2022 results recorded Indonesia's mathematics literacy score at 366—down from 379 in PISA 2018 and only about 18% of students reached the minimum proficiency level, far below the OECD average of 69% (OECD, 2023). This finding is in line with the results of a Systematic Literature Review covering the period 2020–2024, which revealed that students consistently experience difficulties in interpreting data, connecting mathematical concepts to real-world contexts, and determining appropriate problem-solving strategies (Yani et al., 2026).

The cost of electricity can be used as a numeracy context to support the SDGs. In Indonesia, the cost of electricity consumption is determined by the basic electricity tariff and the amount of electricity used. The basic electricity tariff is determined based on the power class specified by the customer. In Indonesia, the public can select several power classes for household (non-commercial) purposes, namely 450 watts, 900 watts, 1,300 watts, and 2,200 watts. Each of these power classes has a different base price of electricity (Kementerian Energi dan Sumber Daya Mineral Republik Indonesia, 2023). Although electricity costs offer a potential context for teaching numeracy and fostering energy awareness, there remains a lack of research that specifically describes the numeracy skills and difficulties of junior high school students when solving numeracy problems in the context of electricity costs linked to the SDGs. In fact, this context is highly relevant to students' daily lives and is directly connected to the SDGs.

Based on the explanation above, this study aims to describe junior high school students' numeracy skills in solving such problems and to identify the influencing factors. The results of this study are expected to help teachers determine the proper treatment in teaching numeracy so that students have good numeracy skills.

Research Methods

This study employs a qualitative descriptive approach, supported by quantitative descriptive data, to describe students' numeracy profiles when solving numeracy problems in the context of electricity costs and to identify the obstacles they encounter. The students' numeracy profiles encompass their ability to understand information presented in tabular form, apply relevant mathematical concepts, interpret results, and reason. The qualitative approach in this study is used to describe the factors contributing to students' difficulties based on interview results and analysis of student responses. At the same time, quantitative descriptive data are utilized to describe the distribution of scores and the percentage of student answers.

The research procedure was as follows: first, we developed a numeracy problem instrument contextualized with electricity costs, which two experts then validated. The validation aspects included the context of the problems, problem construction, language, level of difficulty, and the time allocation provided. After being declared valid, the instrument was administered to the research subjects, namely 152 eighth-grade junior high school students, with a 45-minute allocation time. Students' responses were then analyzed through the stages of scoring, categorizing answers, identifying errors, analyzing per indicator, and interpreting findings. To gain further insight into the findings from the response analysis, interviews were conducted with selected students following the test administration. To ensure the validity of the research findings, data triangulation was conducted by comparing student responses and interview results. Finally, conclusions were drawn based on the overall findings.

The research subjects in this study were 152 eighth-grade students (12-13-years-olds) in one of the junior high schools in Malang, Indonesia, divided into five classes. All participants had studied the mathematical materials used to solve the given problems, namely social arithmetic, number operations, and table reading. The research subjects were selected using a purposive sampling technique, as they had studied the prerequisite material needed to solve the numeracy problems when they were in the sixth and seventh grades. The subjects worked on numeracy problems within the context of electricity costs. Ten students were selected as interview subjects, based on the errors identified in their answer sheets after working on numeracy problems.

The data sources of this research are students who are the research subjects. The data source produces data in the form of written answers to numeracy problems in the context of electricity costs and recordings of researcher interviews with ten students. A numeracy instrument with electricity cost context and a semi-structured interview guide were designed to collect data. The instrument was validated by two experts before being administered to the participants. Data collection was carried out over two days. On the first day, numeracy questions were given in three classes, with ninety-two students taking the test. On the second day, numeracy questions were given in two classes, with sixty students taking the test. All students work on the same instruments under uniform time and procedural conditions, and the test papers were collected immediately upon completion to maintain the instrument's confidentiality. Students are given forty-five minutes to

work on numeracy questions, and they can use calculation tools such as calculators. The teacher monitored students during the problem-solving process. After the students had completed the test, the answer sheets were collected. The responses were then checked and scored. Subsequently, an error analysis was conducted on the students' answers and the findings were recorded and recapitulated in an error table. We selected ten students to be interviewed to explore further information about the obstacles students face. These students were selected based on their answers when solving numeracy problems.

The main instrument was a numeracy test, supported by a semi-structured interview guide. The questions refer to the *Asesmen Kompetensi Minimum* (Minimum Competency Assessment (MCA)) framework developed by the Indonesian Ministry of Education. The context presented in the problems is the cost of electricity within the algebraic domain, consisting of three questions at different cognitive levels. Therefore, the numeracy profile described in this study is limited to the context of electricity costs within the algebraic domain. The levels of the three questions are understanding, applying, and reasoning, respectively (Pusat Asesmen Pendidikan, 2023; Pusmenjar, 2020). Students are given information on the basic electricity tariff (in table form) that applies from October to December 2023. The electricity tariffs referred to in this study are those established by the Indonesian Government in 2023 (Kementerian Energi dan Sumber Daya Mineral Republik Indonesia, 2023). The text describes some standard terms used in determining electricity tariffs. The details of the stimulus can be seen in Figure 1.

| Calculating The Cost Of Electricity Consumption | | |
|--|---------------|----------------|
| In Indonesia, electricity tariffs are based on categories. For home use with low voltage (TR) is divided into three groups, namely Group R-1 low voltage (R-1/TR), Group R-2 low voltage (R-2/TR), and Group R-3 low voltage (R-3/TR). The electricity tariff scheme for October-December 2023 (Source: Ministry of Energy and Mineral Resources) is presented in the following table. | | |
| Electricity tariff table October-December 2023 | | |
| Goals | Power (in VA) | Tariff per kWh |
| R-1/TR | 900 | Rp. 1,352 |
| R-1/TR | 1,300 | Rp. 1,444.70 |
| R-1/TR | 2,200 | Rp. 1,444.70 |
| R-2/TR | 1,500 – 5,500 | Rp. 1,699.53 |
| R-3/TR | 6,600 and up | Rp. 1,699.53 |
| Notes: 1 VA = 1 Watt, kWh: kilo Watt hour. The rate per kWh is the amount paid for using one thousand Watts for one hour. | | |
| Answer questions 1, 2, and 3 using the information in the October-December 2023 Electricity Tariff table above. | | |

Figure 1. The stimulus is given in the numeracy question

Based on Figure 1. after the stimulus is given, students are asked to solve three problems using the information contained in the stimulus. Question number one is multiple choice with cognitive level knowing. Students are asked to perform simple calculations based on information obtained from the basic electricity tariff table in the stimulus. Question number one can be seen in Figure 2.

Translation

1. Mr. Hamzah subscribes to 2,200 Watts of electricity. In October 2023, Mr. Hamzah's electricity usage amounted to 110 kWh. What is the electricity fee that Mr. Hamzah must pay?

A. IDR. 148,720
B. IDR. 158,917
C. IDR. 169,000
D. IDR. 180,579

Figure 2. Question number one (knowing level) multiple choice form with one correct answer

Figure 2 presents the first question in a multiple-choice format designed to measure students' understanding at the knowing level. At this level, students are expected to recall basic concepts, recognize relevant information, and identify the correct answer from several available options. The question consists of one correct answer and several distractors, allowing the researcher to assess whether students have mastered the fundamental knowledge required before moving to higher levels of cognitive ability.

Question number two is a complex multiple-choice question that requires students to apply their cognitive level. In question number two, students are asked to apply algebraic operations and comparison concepts based on information obtained from the basic electricity tariff table in the stimulus. Question number two can be seen in Figure 3.

Translation

2. The electricity consumption for the rooms in the houses of Mr. Agung, Mr. Hamzah, and Mr. Pratama is presented in the following table.

| House | Electrical Power | Number of Rooms | Lights used in each room | Length of lamp usage per room |
|-------------|------------------|-----------------|--------------------------|-------------------------------|
| Pak Agung | 900 Watts | 3 | 23 Watts | 6 hours/day |
| Pak Hamzah | 2,200 Watts | 3 | 23 Watts | 5 hours/day |
| Pak Pratama | 3,500 Watts | 3 | 20 Watts | 6 hours/day |

Hammis will calculate the electricity usage cost for the lights installed by Mr. Agung, Mr. Hamzah, and Mr. Pratama in one week. Which of the following statements is true?

Mr. Hamzah's electricity usage costs are smaller than Mr. Agung's.
 Mr. Agung's electricity usage costs are smaller than Mr. Hamzah's.
 The electricity usage costs incurred by Mr. Pratama are the same as those of Mr. Hamzah.
 Mr. Agung's electricity usage costs are the smallest.
 Mr. Pratama's electricity usage costs are the highest.

Figure 3. Question number two (applying level) complex multiple choice form

Figure 3 presents the second question in a complex multiple-choice form designed to measure students' ability at the applying level. At this level, students are required not only to recognize or recall concepts, but also to use their understanding to solve a given problem or situation. The complex multiple-choice format allows students to select more than one relevant option based on the information provided, so it can reveal how well they apply concepts accurately in a specific context.

Question number three is a description question with a cognitive reasoning level. In it, students are asked to justify a statement by providing reasons that support the justification. Question number three can be seen in Figure 4.

Translation

3. To reduce the cost of electricity usage in the room, Mr. Agung, Mr. Hamzah, and Mr. Pratama made savings by replacing all room lights with 12 Watts energy saving lamps. Assuming that the length of usage is fixed, Hammis recalculated the electricity usage costs. Hammis concluded that Mr. Agung's electricity cost savings were greater than Mr. Hamzah. Do you think Hammis' conclusion is correct? Explain your opinion.

Figure 4. Question number three (reasoning level)

Figure 4 presents the third question designed to measure students' ability at the reasoning level. At this level, students are expected to analyze the information provided, connect relevant concepts, and draw logical conclusions before determining the answer. The question encourages students to use higher-order thinking skills because they must not only apply a concept, but also justify their choice based on evidence, patterns, or relationships found in the problem. The qualitative data analysis technique used in this research is interactive (Miles et al., 2014). Data analysis starts with collecting data, then analyzing student answers and sorting student answers. To analyze students' answers, the basic competencies of the cognitive level in the minimum competency assessment presented in Table 1 were used. Researchers used students' written answers to interpret and explain the barriers faced by students (Nowell et al., 2017). Data reduction was conducted by researchers to confirm the written answers through interviews with students to produce credible findings (Korstjens & Moser, 2018). Furthermore, the data were presented in detail by describing the problems faced by students in solving numeracy problems in the context of electricity costs and drawing conclusions. he detailed criteria for analyzing students' answers are presented in Table 1.

Table 1. Criteria for analyzing student answers

| No. | Cognitive Level | Description |
|-----|-----------------|--|
| 1. | Understanding | Assess students' knowledge of facts, processes, concepts, and procedures |
| 2. | Applying | Assess students' ability to apply knowledge and understanding of facts, relations, processes, concepts, procedures, and methods in real situations |
| 3. | Reasoning | Assess students' reasoning skills in analyzing data and information, making conclusions, expanding understanding, and being able to justify |

Table 1 presents the criteria used to analyze students' answers based on three cognitive levels: understanding, applying, and reasoning. The understanding level focuses on students' ability to recognize and explain basic knowledge, including facts, concepts, processes, and procedures. The applying level measures students' ability to use their knowledge in real or contextual situations by connecting facts,

relations, concepts, procedures, and methods. Meanwhile, the reasoning level emphasizes higher-order thinking skills, such as analyzing data and information, drawing conclusions, expanding understanding, and providing logical justification. These criteria were used as a guide to determine the cognitive quality of students' responses in solving the given questions.

Results and Discussion

Table 2 presents the descriptive statistics of students' scores on the numeracy test. Data were collected from 152 students. The maximum possible score was 100. The minimum score obtained by students was 0, while the maximum score achieved was 80. The mean score was 32.57 (requiring special intervention), with a standard deviation of 13.84. These results indicate that students' overall performance on the numeracy test was considerably low. The mean score of 32.57 suggests that, on average, students answered only about one-third of the questions correctly. The standard deviation of 13.84 reflects a moderate variation in students' performance, indicating that while some students performed relatively well, most scored within a similarly low range.

Table 2. Descriptive Statistics of Students' Scores

| N | Manimum Score Obtained by Students | Maximum Score Obtained by Students | Max Score | M | SD |
|-----|------------------------------------|------------------------------------|-----------|-------|-------|
| 152 | 0 | 80 | 100 | 32.57 | 13.84 |

Figure 5 presents students' mastery of Question 1, which was designed as an easy problem at the knowing level. This question required students to perform simple calculations without the need for in-depth reasoning.

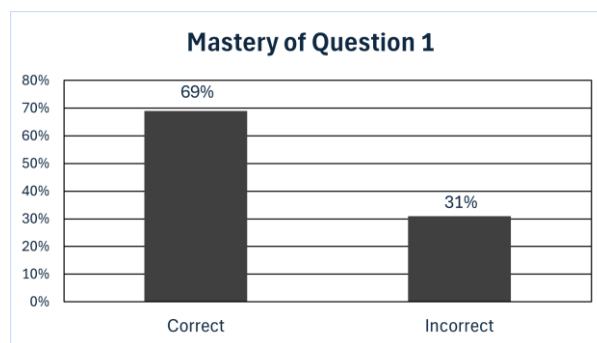


Figure 5. Student mastery in solving question number one

Based on Figure 5, the data show that 69% of students answered the question correctly, while 31% answered incorrectly. The relatively high percentage of correct answers indicates that most students were able to solve basic computation problems. However, the fact that nearly one-third of students still answered incorrectly suggests that even at the knowing level, some students experienced difficulties.

The student's answer in Figure 6, namely S1, shows that the student incorrectly used the tariff according to the power subscribed. The answer shows

that the basic electricity tariff used in the calculation is 1,352 rupiah, which applies to customers who subscribe to 900 watts (VA), even though the subscribed power is 2,200 watts. So, the student should have calculated by multiplying 1,444.70 by 110.

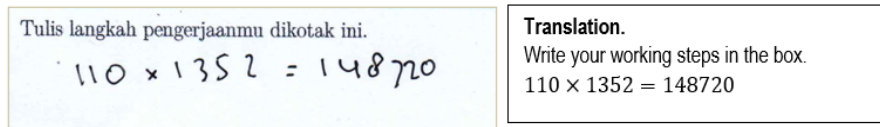


Figure 6. One of the test subject's answers (S1) in using the tariff

Based on Figure 6, the researcher interviewed S1 to learn more about why S1 answered. The following is an excerpt of the researcher's interview (R) with S1.

R : *Did you read the stimulus well?*

S1 : *Yes, sir.*

R : *Do you understand the content of the stimulus?*

S1 : *If I understand as a whole, no, sir. I am still confused about understanding the information contained in the stimulus.*

R : *Why does that happen?*

S1 : *The reading is too long, sir. I'm not used to working on problems with too long readings. I'm used to working on direct problems.*

R : *Why did you multiply 110 by 1352? (while showing the answer written by S1)*

S1 : *(Looking at the answer and rereading question number one). Well, I was wrong in determining the rate, sir. I was not careful enough in using the tariff.*

From the analysis of students' work and interviews with several students, it was found that the reasons why they could not solve question number one were (1) students had difficulty understanding the stimulus presented in the form of a story problem, (2) students were still confused about reading the table, (3) students did not know what to do (so they left the answer to problem number one blank), (4) there were errors in calculations, (5) errors in using tariff information, and (6) students were in a hurry to answer the questions without checking the answers given.

Based on the student answers presented in Figure 6 and the interview with the student, students can perform calculations but are less careful/careless. According to Legarde (2022); Tong and Nguyen Phu Loc (2017), carelessness is one of the mistakes students make when solving math problems. Students also have weak reading skills that make it difficult to understand the stimulus. As a result, students make mistakes when making calculations. It aligns with research by Cao et al (2022) which states that language skills affect students' numeracy skills.

Question number two is an application problem with a medium difficulty level (applying level). It measures students' ability to apply mathematical concepts and understand facts, relationships, processes, and procedures. This problem requires more detailed calculations and requires mastery of the concept of percentages. In general, the students' responses to question two were not accurate. The distribution of students' mastery in solving question number two is presented in Figure 7.

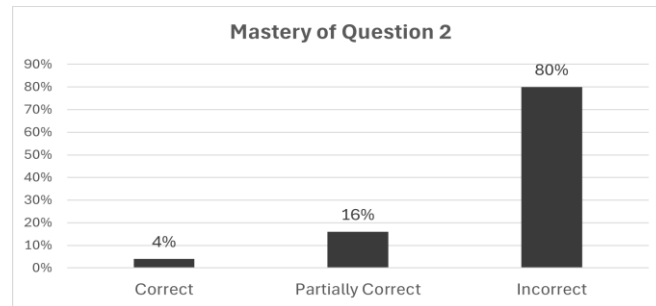


Figure 7. Student mastery in solving question number two

Figure 7 presents students' mastery of Question 2, designed at the applying level to measure students' ability to understand and read information presented in tabular form. The data reveal that only 4% of students provided a completely correct answer. A further 16% of students produced a partially correct response, indicating a developing but incomplete understanding of the underlying procedures. The majority of students (80%) answered the question incorrectly. This pattern suggests that students experienced significant difficulty in applying the required mathematical concepts and procedures. The overwhelming proportion of incorrect answers implies that students' foundational numeracy skills in this specific context remain very low.

In comparing the cost of electricity usage in question number two, some students determined it only by looking at the amount of power electricity subscribed (Figures 8.a and 8.b). Based on interviews with students, they assume that customers with more power will pay more. In addition, some students compare the cost of electricity usage with the total amount of electricity used in a week without multiplying it by the electricity tariff according to the class (Figure 8.c). It shows that students do not understand how to determine the cost of electricity usage, which is the multiplication of the total power used by the electricity tariff price per kWh according to the class of electricity subscribed. In addition, some students only evaluate the cost of expenses for two customers, Mr. Agung and Mr. Hamzah, without calculating the cost of other customers (Figure 8.d). In Figure 8.d, it can be seen that students simply compare the cost of electricity used in one week by looking at the cost of electricity used in one day. Examples of students' errors in solving question number two are presented in Figure 8.

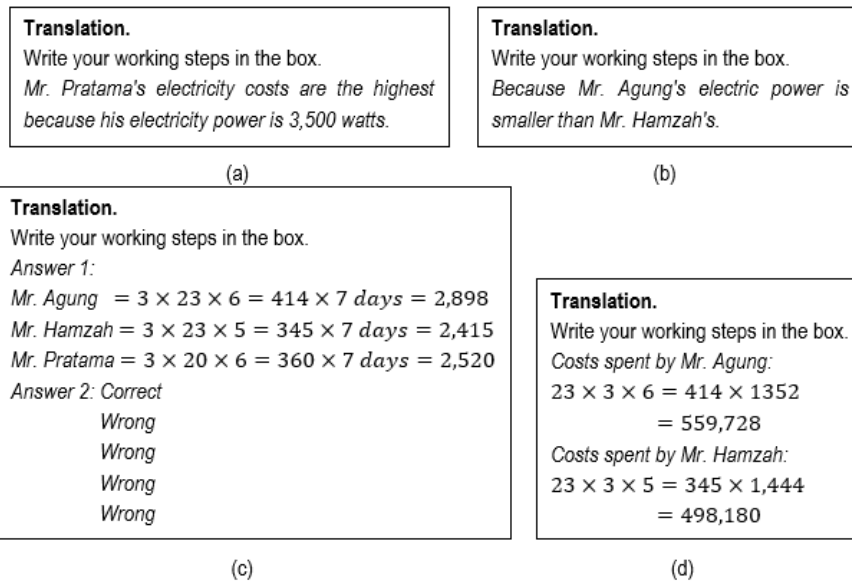


Figure 8. Some students' errors in solving problem number two

The following is an excerpt of the researcher's (R) interview with the student (S2), who gave the answers as shown in Figures 8.a and 8.b.

R : Why did you answer question number two like this? (showing student answers Figures 9.a and 9.b)

S2 : (looking at the answer) I see from the stimulus that the greater the electric power used, the higher the price, sir. Because Mr Pratama subscribes to electricity with the highest power (3500 watts), the cost is also high, sir. Also, for Mr Agung, because the electric power subscribed by Mr Agung is lower than that of Mr Hamzah, the price paid by Mr Agung is lower than that of Mr Hamzah, and the lights used are the same.

R : Okay, if someone, say A, uses an electrical appliance longer than someone else, say B, should A pay more than B?

S2 : Yes, sir, A pays more.

R : Okay, so is the length of light use included in calculating electricity usage costs?

S2 : It should be included in the calculation, sir. Wow, I was careless, sir.

The results of analyzing student work and interviews with several students revealed that the obstacles faced by students in solving problem number two were that they did not know what to do, did not understand what formula to use, and were not used to solving problems like problem number two. In addition, students are also not careful because they only do some of the calculations. During the interview, the researcher provided scaffolding to students through questions and analogies. After being explained, the student realized his answer was wrong and knew what to do. This result is in line with the research of Herman et al. (2022) and Legarde (2022), which showed that the biggest obstacles students face in solving contextual problems are language and formulating problems in mathematical form.

Question 3 was designed as a reasoning-level problem aimed at assessing students' ability to evaluate the truthfulness of a statement and to provide logical

and appropriate reasoning to support their answer. Students' mastery in solving Question 3 is presented in Figure 9.

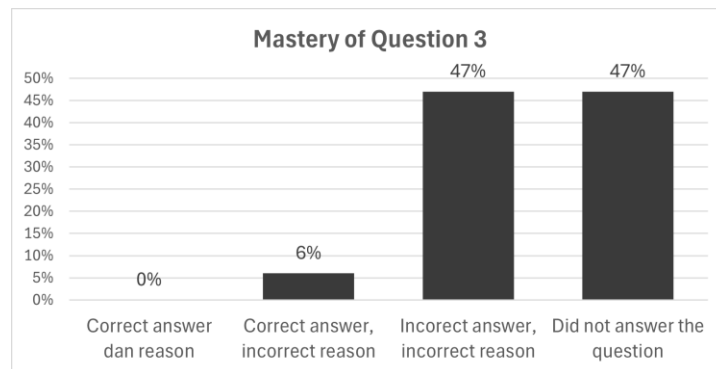


Figure 9. Student mastery in solving question number three

Based on Figure 9, the analysis revealed that none of the students (0%) provided both a correct answer and a correct reason. This finding indicates that students' mathematical reasoning abilities regarding electricity costs remain very weak and have not developed optimally. Furthermore, only 6% of students answered correctly, yet their reasoning was inaccurate. It suggests that their correct answers were likely coincidental or based on guesswork rather than sound reasoning, as they were unable to provide logical justifications for their choices. A total of 47% of students provided incorrect answers accompanied by incorrect reasoning. This group demonstrates that they not only failed to understand the concepts being tested but could not also construct arguments or reasoning to support their answers. In addition, another 47% of students did not answer the question at all. The high proportion of students who either did not respond or provided incorrect answers with incorrect reasoning indicates that students still encounter difficulties in solving reasoning-level problems.

Students' answers in Figure 10 show that they cannot provide the right reasons to support their answers; they only look at the amount of power subscribed. An example of a student's answer that is correct but accompanied by an incorrect reason is presented in Figure 10.

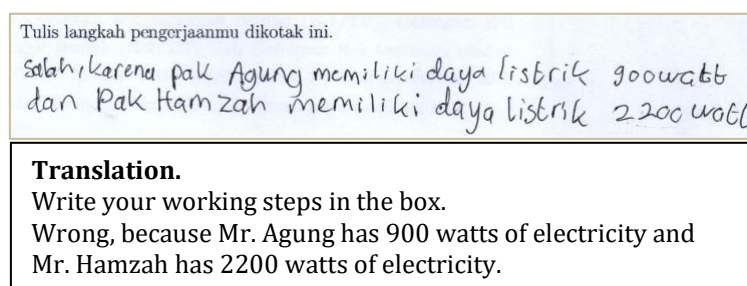


Figure 10. The student's answer is correct, but the reason given is wrong

Figure 10 shows an example of a student's response in which the selected answer is correct, but the reason given is incorrect. This condition indicates that the student may have guessed the answer correctly or recognized the correct option without having a complete conceptual understanding. The inappropriate reasoning

suggests that the student still has difficulty explaining the relationship between the concept and the problem context. Therefore, although the final answer is correct, the student's reasoning process still needs further attention and improvement.

To find out why students are wrong in providing arguments that support the answers, the researcher (R) interviewed student (S3). The following is an excerpt from the interview.

R : Have you read and understood the stimulus and question number three?

S3 : I have, but I still don't understand the word's meaning, so the length of usage is fixed.

R : Okay, can you explain why you gave this answer (while showing the student's answer)?

S3 : I answered wrong.

R : Why did you answer this way?

S3 : Honestly, sir, I am still confused about calculating the electricity costs incurred. I only looked at the electricity subscribed to by Mr. Agung and Mr. Hamzah. Because Mr. Agung subscribes to less electricity than Mr. Hamzah, I assume that the electricity costs incurred are lower, so the money saved by Mr. Agung is greater than Mr. Hamzah's.

Based on interviews with students, it was found that students could not answer question number three because they did not understand the meaning of "electricity cost savings". Students did not understand the meaning of the question, and students were still confused about calculating electricity costs. Students did not understand the meaning of the questions in the problem due to their weak language skills. Based on this, understanding the context well is important to solving the problem. Understanding the context well requires good language skills. Furthermore, understanding the context is important in making mathematical models and determining the right strategy to solve problems. Thus, language skills, the ability to understand the context, the ability to create mathematical models, and the ability to perform calculations are important so that students can justify a statement, especially in solving problems. This result is in line with Cao et al (2022); Genc and Erbas (2019); Herman et al (2022); Scristia et al (2022) research.

To find out the cause of students' weak numeracy skills, the researcher interviewed the math teacher whose students were the subjects in the study.

R : What do you think about students' numeracy skills?

T : Generally, if we refer to the minimum competency assessment (MCA), our students have basic numeracy skills.

R : What obstacles do you think students face in solving numeracy?

S : Our students face quite a lot of obstacles. First, our students have difficulty solving story problems, and most of them find it difficult to understand the context presented in story problems. This is due to literacy or language factors. In addition, students are not used to solving story problems; they prefer direct and procedural problems. In addition, we also realize that we are not optimal in giving numeracy problems. This results in students rarely practising numeracy problems.

R : What challenges will you face in teaching numeracy in the future?

T : There are quite a lot of challenges that will be faced. First, in terms of curriculum, there is no specific subject for numeracy. Numeracy is included in some subjects, especially math and science subjects. However, learning numeracy across subjects is still not optimal. Our school has a literacy movement, but its role is still not optimal. Students' motivation and resilience in solving numeracy problems or problem-solving are also not optimal. Some students still think math is difficult, and some experience fear or anxiety when learning math.

From the interview, information was obtained that the problems faced by students in solving numeracy problems were caused by: (1) students are not used to working on numeracy problems, (2) students have difficulty in understanding problems, (3) students' numeracy skills are weak, (4) teachers rarely give numeracy problems, (5) students' language skills are still weak, and (6) students rarely practice, and (7) students experience anxiety during math learning. Most students work on problems only when at school. It is in line with research conducted by Cao Thi et al. (2023); Indah et al. (2016); Perdana and Suswandari, (2021); Widiastuti and Kurniasih (2021).

Students' ability to solve numeracy problems in the context of electricity costs remains low. Based on the analysis of student responses and interviews, the factors contributing to this low numeracy proficiency include: carelessness in performing calculations, weak contextual comprehension due to inadequate language skills, difficulties in formulating problems into mathematical models, inability to provide proper arguments or justification for their answers, lack of familiarity with numeracy problems due to insufficient practice, and the experience of mathematics anxiety.

Based on the student answers presented in Figure 7 and the interview with the student, students can perform calculations but are less careful/careless. According to Legarde (2022); Tong and Nguyen Phu Loc (2017), carelessness is one of the mistakes students make when solving math problems. Students also have weak reading skills that make it difficult to understand the stimulus. As a result, students make mistakes when making calculations. It aligns with research by Cao et al (2022), which states that language skills affect students' numeracy skills.

The primary obstacle students face in solving numeracy problems lies in their limited ability to comprehend the given context. This difficulty stems from underdeveloped language proficiency. Furthermore, this limitation leads to inaccuracies in formulating appropriate mathematical models for the presented problems. Thus, language skills, the ability to understand the context, the ability to create mathematical models, and the ability to perform calculations are important so that students can justify a statement, especially in solving problems. This result is in line with the research of Cao et al (2022); Genc and Erbas (2019); Herman et al (2022); Legarde (2022); Scristia et al (2022), which showed that the most significant obstacles students face in solving contextual problems are language and formulating problems in mathematical form.

Interview findings reveal that students remain unaccustomed to solving numeracy problems, primarily due to insufficient practice. Most students only engage with numeracy exercises during school-based learning activities. These

observations align with research by Cao Thi et al (2023); Indah et al (2016); Perdana and Suswandari (2021); Widiastuti and Kurniasih (2021). This practice deficit proves particularly consequential given mathematics education research demonstrating that deliberate practice is essential for developing mathematical skills and expertise. As Lehtinen et al (2017) establish, such practice enables the automation of basic skills, thereby freeing cognitive capacity for more complex mathematical tasks.

Conclusion and Suggestion

The findings of this study reveal that students' numeracy skills in solving electricity cost problems remain low. Although students performed relatively well on knowledge-level questions (69% correct on Question 1), their performance declined sharply on applying-level questions (only 4% fully correct on Question 2) and reasoning-level questions (0% fully correct on Question 3). The main difficulties identified include limited contextual understanding, inability to apply mathematical concepts, difficulty in reading information presented in tabular form, and lack of familiarity with solving numeracy problems. These findings imply that teachers need to provide more contextual numeracy problems and facilitate students' understanding of context and reasoning skills to support SDG-related learning.

Future research should consider incorporating additional variables such as mathematics anxiety and mastery of prerequisite material, as well as simplifying the stimulus narratives in numeracy questions to facilitate student comprehension.

Reference

- Anggraeni, Y., Abdulhak, I., & Rusman, R. (2019). The Development of Mathematics Curriculum to Increase The Higherorder Thinking Skills in The Sustainable Development Goals (SDGs) Era. *Proceedings of the Proceedings of The 1st Workshop Multimedia Education, Learning, Assessment and Its Implementation in Game and Gamification, Medan Indonesia, 26th January 2019, WOMELA-GG*. Proceedings of The 1st Workshop Multimedia Education, Learning, Assessment and its Implementation in Game and Gamification, Medan Indonesia, 26th January 2019, WOMELA-GG. <https://doi.org/10.4108/eai.26-1-2019.2282915>
- Avigad, J. (2015). Mathematics and language. In E. Davis & P. J. Davis (Eds), *Mathematics, Substance and Surmise* (pp. 235–255). Springer International Publishing. https://doi.org/10.1007/978-3-319-21473-3_12
- Blitstein, J. L., Guthrie, J. F., & Rains, C. (2020). Low-Income Parents' Use of Front-of-Package Nutrition Labels in a Virtual Supermarket. *Journal of Nutrition Education and Behavior*, 52(9), 850–858. <https://doi.org/10.1016/j.jneb.2020.04.003>
- Cao, T. H., Nguyen, H. C., Dang, X.-C., Chu, C. T., Le, T. A., & Le, T. T. H. (2022). Exploring Numeracy Skills of Lower Secondary School Students in Mountainous Areas of Northern Vietnam. *International Journal of Learning, Teaching and Educational Research*, 21(10), 309–324. <https://ijlter.org/index.php/ijlter/article/view/6113>
- Cao Thi, H., Le, T. A., Tran Ngoc, B., & Phan Thi Phuong, T. (2023). Factors affecting the numeracy skills of students from mountainous ethnic minority regions in

- Vietnam: Learners' perspectives. *Cogent Education*, 10(1), 1–17. <https://doi.org/10.1080/2331186X.2023.2202121>
- Domínguez-González, R., & Delgado-Martín, L. (2022). Arousing Early Strategic Thinking about SDGs with Real Mathematics Problems. *Mathematics*, 10(9), 1–22, 1446. <https://doi.org/10.3390/math10091446>
- Genc, M., & Erbas, A. K. (2019). Secondary Mathematics Teachers' Conceptions of Mathematical Literacy. *International Journal of Education in Mathematics, Science and Technology*, 7(3), 222–237. <https://ijemst.net/index.php/ijemst/article/view/611>
- Goos, M., Geiger, V., & Dole, S. (2014). *Transforming professional practice in numeracy teaching*, in Y. Li, E. Silver Sc S. Li (eds), *Transforming Mathematics Instruction: Multiple approaches and practices*, (pp 81-102). Springer. https://doi.org/10.1007/978-3-319-04993-9_6
- Herman, T., Rahmi, K., & Utami, N. S. (2022). Student learning obstacles in solving contextual mathematical problems. *The 8th Annual International Seminar on Trends in Science and Science Education (Aistsse) 2021*, 040001. <https://doi.org/10.1063/5.0113653>
- Hudson, R. (2020). Mathematics in Language. *Cognitive Semantics*, 6(2), 243–278. <https://doi.org/10.1163/23526416-bja10005>
- Indah, N., Mania, S., & Nursalam, N. (2016). Peningkatan Kemampuan Literasi Matematika Siswa Melalui Penerapan Model Pembelajaran Problem Based Learning di Kelas VII SMP Negeri 5 Pallangga Kabupaten Gowa. *MaPan: Jurnal Matematika dan Pembelajaran*, 4(2), 200-210. <https://doi.org/10.24252/mapan.2016v4n2a4>
- Kementerian Energi dan Sumber Daya Mineral Republik Indonesia. (2023). *Peraturan Nomor 8 Tahun 2023 Tentang Perubahan Kelima Atas Peraturan Menteri Energi dan Sumber Daya Mineral Nomor 28 Tahun 2016 Tentang Tarif Tanaga Listrik yang Disediakan oleh PT Perusahaan Listrik Negara (Persero)*. Retrieved from <https://jdih.esdm.go.id/dokumen/view?id=2395>
- Korstjens, I., & Moser, A. (2018). Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice*, 24(1), 120–124. <https://doi.org/10.1080/13814788.2017.1375092>
- Legarde, M. A. (2022). Working with Mathematical Problems: An Analysis of Students Misconceptions and Its Impact on Mathematics Learning. *International Journal of Advanced Research*, 10(03), 25–33. <https://doi.org/10.21474/IJAR01/14358>
- Lehtinen, E., Hannula-Sormunen, M., McMullen, J., & Gruber, H. (2017). Cultivating mathematical skills: From drill-and-practice to deliberate practice. *ZDM*, 49(4), 625–636. <https://doi.org/10.1007/s11858-017-0856-6>
- Miles, M. B., Huberman, A. M., & Saldana, J. (2014). *Qualitative Data Analysis A Methods Sourcebook* (Third). Sage Publications.
- Moschkovich, J. N. (2024). Language and Learning Mathematics: A Sociocultural Approach to Academic Literacy in Mathematics. *Proceedings of the 14th International Congress on Mathematical Education*, 459–472. https://doi.org/10.1142/9789811287183_0031
- Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of*

- Qualitative Methods*, 16(1), 1-13.
<https://doi.org/10.1177/1609406917733847>
- O' Sullivan, K. (2023). *Investigating Pre-service Teachers' Knowledge of Numeracy and their Ability to Teach Numeracy for Disciplinary Learning*.
<https://doi.org/10.34961/researchrepository-ul.21591333.v1>
- OECD. (2023). *PISA 2022 Results (Volume I)*. <https://doi.org/10.1787/53f23881-en>
- OECD. (2024). *Do Adults Have the Skills They Need to Thrive in a Changing World?: Survey of Adult Skills 2023*. OECD. <https://doi.org/10.1787/b263dc5d-en>
- Ogunsola, J. A., & Adigun, O. T. (2025). Effect of critical thinking skills on numerate behaviours among management and business-related higher education students: A Nigerian case. *Cogent Education*, 12(1), 1-14, 2492713.
<https://doi.org/10.1080/2331186X.2025.2492713>
- O'Sullivan, K., & Goos, M. (2022). Numeracy Across the Curriculum in Initial Teacher Education. In N. Fitzallen, C. Murphy, V. Hatisaru, & N. Maher (Eds), *Mathematical confluences and journeys (Proceedings of the 44th Annual Conference of the Mathematics Education Research Group of Australasia)* (pp. 434–441). Launceston: MERGA. <https://merga.net.au/wp-content/uploads/2025/02/Osullivan-RP-MERGA44-2022.pdf>
- O'Sullivan, K., O'Meara, N., Goos, M., & Conway, P. (2021). How Covid-19 has reinforced the importance of a numerate society. *Irish Educational Studies*, 40(2), 341–347. <https://doi.org/10.1080/03323315.2021.1915844>
- Perdana, R., & Suswandari, M. (2021). Literasi Numerasi dalam Pembelajaran Tematik Siswa Kelas Atas Sekolah Dasar. *Absis: Mathematics Education Journal*, 3(1), 9-15. <https://doi.org/10.32585/absis.v3i1.1385>
- Pusat Asesmen Pendidikan. (2023). *Framework Asesmen Kompetensi Minimum (AKM)* (2023rd edn). Pusat Asesmen dan Pembelajaran Badan Standar, Kurikulum, dan Asesmen Pendidikan Kemendikbudristek. Retrieved from <https://repositori.kemendikdasmen.go.id/33375/>
- Pusmenjar. (2020). *AKM dan Implikasinya pada Pembelajaran*. Pusat Asesmen dan Pembelajaran. <https://repositori.kemendikdasmen.go.id/19690/>
- Sakurai, J., & Goos, M. (2023). Revisiting tools in numeracy learning: The role of authentic digital tools. *Frontiers in Education*, 8:1291407, 1-11)
<https://doi.org/10.3389/feduc.2023.1291407>
- Sakurai, J., Sawatzki, C., & Tout, D. (2021). *Real life numeracy contexts—the spark to ignite mathematics learning*. https://www.teachermagazine.com/au_en/
- Scristia, S., Aisyah, S., Meryansumayeka, M., Safitri, E. R., & Kurniawan, H. (2022). Students' Errors in Solving Reasoning-Based Congruence Proof Problems. *AKSIOMA: Jurnal Program Studi Pendidikan Matematika*, 11(4), 3160-3167.
<https://doi.org/10.24127/ajpm.v11i4.5825>
- Stacey, K., & Turner, R. (2015). The evolution and key concepts of the PISA mathematics frameworks. In *Assessing Mathematical Literacy: The PISA Experience* (pp. 5–33). https://doi.org/10.1007/978-3-319-10121-7_1
- Tong, D. H. & Nguyen Phu Loc. (2017). Students' Errors in Solving Mathematical Word Problems and Their Ability in Identifying Errors in Wrong Solutions. *European Journal of Education Studies*, 3(6), 226-241.
<https://doi.org/10.5281/ZENODO.581482>

- UNESCO. (2014). *UNESCO Roadmap for Implementing the Global Action Programme on Education for Sustainable Development* (pp. 1-38). Unesco. Retrieved from <https://unesdoc.unesco.org/ark:/48223/pf0000230514>
- United Nations. (2015). *THE 17 GOALS - Sustainable Development Goals*. <https://sdgs.un.org/goals>
- Widiastuti, E. R., & Kurniasih, M. D. (2021). Pengaruh Model Problem Based Learning Berbantuan Software Cabri 3D V2 terhadap Kemampuan Literasi Numerasi Siswa. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, 5(2), 1687–1699. <https://doi.org/10.31004/cendekia.v5i2.690>
- Yani, F., Rahayu, C., & Caswita. (2026). Systematic Literature Review: Tren Penelitian dan Faktor Penentu Kemampuan Numerasi Siswa Indonesia Tahun 2020–2024. *JIPM (Jurnal Ilmiah Pendidikan Matematika)*, 14(2), 190–207. <https://doi.org/10.25273/jipm.v14i2.23473>